THE POWER TO CHANGE THE FACE OF AMERICA...

Converting Overhead Utilities to Underground

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Executive Summary

More than 3 million miles of electrical cables are strung overhead across the country. Add to that at least 180 million telephone and cable TV lines, and it's no wonder hurricanes, tornadoes, fires and ice storms are wreaking havoc on America's electrical systems each year, causing utility outages that last days, weeks and longer.

Power outages over extended periods present major health and safety concerns and economic losses. In the aftermath of these storms, there is invariably an outcry from the public, the government and the media to place overhead utilities underground.

Concerns about the reliability of overhead lines, increases in their maintenance and operating costs, and issues of public safety and quality-of-life are leading more and more utilities and municipalities to the realization that converting overhead distribution lines to underground is the best way to provide high-quality service to their customers.

According to a report by the Edison Electric Institute, "almost 70 percent of the nation's distribution system has been built with overhead power lines." Over the past 15 years or so, however, "approximately half the capital expenditures by U.S. investor-owned utilities for new transmission and distribution wires have been for underground wires."

Making such a conversion is rarely justified solely on the basis of costs. For utility companies, undergrounding provides potential benefits through reduced operations and maintenance (O&M) costs, reduced tree trimming costs, less storm damage, reduced loss of day-to-day electricity sales, and reduced losses of electricity sales when customers lose power after storms. Creative funding options are often available to make the goal of undergrounding a reality.

For some conversions, the evolution of horizontal directional drilling and the ability to physically locate underground utilities using vacuum have been key to the success of many of these projects.

The Situation

The headlines are everywhere. In September 2008, heavy winds in Ohio caused an outage which deprived approximately 2.6 million customers of power. In December 2008, ice storms in the northeast cut power to millions of customers. Overhead power lines have caused devastating fires in San Diego County.

In addition to the utility's restoration costs, social costs of outages include lost revenue and other business disruptions, public safety and security, and convenience.

As so-called 100-year storms and events happen with frightening regularity, forecasters anticipate that increased hurricane activity will continue to occur in some regions and extended drought conditions will continue in others, causing significant impact to utilities, primarily in the Gulf, Atlantic and Pacific coastal areas.

According to Michael Beehler, associate vice president of Burns and McDonnell and moderator of the utility industry's 2009 DistribuTech conference held in San Diego, "the total restoration costs for Hurricanes Katrina, Rita, Gustav, and Ike totaled approximately $2 billion. Some power lines were downed during both Hurricane Rita in 2005 and Hurricane Ike in 2008. We rebuilt the system and then we rebuilt it again."

In September 2003, Hurricane Juan, one of the most damaging hurricanes to impact Canada, made landfall in Nova Scotia, resulting in more than $24 million in damage to Halifax Regional Municipality infrastructure and property. In addition, Nova Scotia Power Inc. (NSPI) incurred costs of $12.6 million as a result of the storm or approximately 11% of earnings that year. In just the next 14 months, Nova Scotia was struck by two more storms resulting in above-average power outages and substantial power infrastructure repair costs. The majority of the outages resulted from downed power transmission and distribution lines due to high winds, fallen trees and branches, ice and snow.

Sample of Electric Outages Caused by Severe Storms: 1996-2005 (Not inclusive of all storms)

Storm Event	Utility	Date	Customers Impacted	Outage Duration (Days)
Hurricanes Katrina & Rita	Entergy	2005	832,000	Power never restored for some in New Orleans
Hurricane Wilma	Florida Power & Light	2005	3,200,000	18
Hurricane Francis	Florida Power & Light	2004	2,800,000	12
Hurricane Isabel	Dominion, VA Power BGE	2003 2003	1,800,000 790,000	14 8
Ice Storm	Kentucky Utilities	2003	146,000	8
Ice Storm	Duke Carolina Power	2002 2002	1,375,000 561,000	9 8
Ice Storm	KCPL	2002	305,000	10
Snowstorm	Carolina Power	2000	173,000	5
Hurricane Floyd	Virginia Power Carolina Power BGE	1999 1999 1999	800,000 537,000 500,000	5 6 8
Ice Storm	Pepco BGE	1999 1999	213,000 360,000	5 5
Ice Storm	Central Maine Power	1998	250,000	21
Ice Storm	Virginia Power	1998	401,000	10
Hurricane Fran	Virginia Power	1996 1996	415,000 450,000	6 9
Ice Storm	Duke Carolina Power	1996 1996	650,000 790,000	8 10

Source: Press Accounts of Storms

Table used in *A Study on the Costs and Benefits of Undergrounding Power Lines*. Prepared for the Edison Electric Institute (EEI).

Add to that the aging conditions of overhead lines and poles, the encroachment of overgrown trees, aesthetic considerations and public safety concerns – such as vehicle/utility pole accidents which result in approximately 1,000 fatalities every year, and live-wire contact injuries – and it's no wonder utilities are converting overhead distribution lines, and eventually transmission lines to underground.

Success - Edmond Electric

Taking an incremental, section-by-section approach to conversion has proven to be a win-win for many utilities and municipalities, including municipally-owned Edmond Electric, (Oklahoma).

A case study, published by Dean Sherrick, distribution superintendent, describes Edmond as a 'bedroom community' of Oklahoma City where residents appreciate their trees and quality of life. Citizens wanted to be rid of their lines and poles, in part because of aesthetics, and in part because Edmond is located in "tornado alley". The community is also prone to ice storms.

According to Sherrick, who oversaw the community's overhead to underground conversion, "Given the aging condition of some of our 96-year-old company's poles and facilities, our utility first identified areas already in need of repair and upgrade. By starting with an area that needed attention, some of the conversion expense could be absorbed in annual maintenance and upgrade costs already budgeted." First project completed was Henderson Hills, converting nearly 500 residents to buried electric cable in conduit. The next project targets a similarly sized neighborhood where outages have been high and older equipment needs replacement and repairs."

Sherrick credits horizontal directional drilling (HDD) with reducing installation and restoration costs, and minimizing disruptions to the community, traffic problems and recurring sinking caused associated with open trenches, setting a precedent for future projects. Their city council approved a revised budget line item for overhead to underground conversion covering five years.

Project Power On (Undergrounding) – AmerenUE

AmerenUE, which serves customers in Missouri, is undergoing a $300 million core reliability program, designed to better protect its delivery system against the forces of nature. This effort includes substantial underground cabling in areas where undergrounding is feasible to improve reliability. The project planning, design, and construction represent a major collaborative effort between UE, county and municipal governments, the region's contracting industry and UE customers. UE also has identified some "must-do" undergrounding projects that supersede the local government

engagement process. In all cases, the upgrades will be designed to improve reliability, not just the cosmetic appearance of the system.
The undergrounding projects could include high- or low-voltage overhead lines and may include service conductors physically attached to customer residences and/or businesses. In some cases, small portions of overhead circuitry may be reconstructed or relocated before they are placed underground.

The project is part of a $1 billion initiative to improve reliability and protect the environment.

Potential Benefits of Underground Electric Facilities

Advantages of underground lines include aesthetics, higher public acceptance, perceived benefits of protection against electromagnetic field radiation (which is still present in underground lines), fewer interruptions, and lower maintenance costs. Failure rates of overhead lines and underground cables vary widely, but typically underground cable outage rates are about half of their equivalent overhead line types.

Potentially far fewer momentary interruptions occur from lightning, animals and tree branches falling on wires which de-energize a circuit and then re-energize it a moment later.

Primary benefits most often cited can be divided into four areas:

Potentially-Reduced Maintenance And Operating Costs
- Lower storm restoration cost
- Lower tree-trimming cost

Improved Reliability
- Increased reliability during severe weather (wind-related storm damage will be greatly reduced for an underground system, and areas not subjected to flooding and storm surges experience minimal damage and interruption of electric service.
- Less damage during severe weather
- Far fewer momentary interruptions
- Improved utility relations regarding tree trimming

Improved Public Safety
- Fewer motor vehicle accidents
- Reduced live-wire contact injuries
- Fewer Fires

Improved Property Values
- Improved aesthetics (removal of unsightly poles and wires, enhanced tree canopies)
- Fewer structures impacting sidewalks

Tangible Savings

The following chart, which summarizes the total benefits that the Virginia State Corporation Commission calculated Virginia utilities might realize if the state's entire electric distribution system were placed underground, shows tangible metrics for projecting savings to utilities. It shows an annual projected savings of approximately $104 million.

Cost Saving Item:	**$/Year**
Operations & Maintenance	no savings
Tree Trimming	$ 50,000,000
"Hundred-Year" Post Storm Rebuild	$ 40,000,000
Reduction in Day-to-Day Lost Electricity Sales	$ 12,000,000
Elimination of Lost Electricity Sales From "Hundred-Year" Storms	$ 2,000,000
	Total $ 104,000,000

Source: Virginia State Corporation Commission, January 2005, "Placement of Utility Distribution Lines Underground"

Societal Benefits

The following summarizes some of the societal benefits, including enhanced electric reliability to the economy, reduced economic losses to customers due to fewer power outages after major storms, and reduced injuries and deaths from automobiles striking utility poles.

Cost Saving Item:	**$/Year**
Avoided Impact of Day-to-Day Outages	$ 3,440,000,000
Avoided Impact of "100-Year" Storm Outages	$ 230,000,000
Avoided Impact of Motor Vehicle Accidents	$ 150,000,000
	Total $ 3,820,000,000

Reports indicate nine out of 10 new subdivisions bury power lines. Some of the cities which have already developed comprehensive plans to bury or relocate utility lines to improve aesthetics, include:

- Colorado Springs, Colorado
- New Castle, Delaware
- Frederick, Maryland
- Saratoga Springs, New York
- San Antonio, Texas
- Williamsburg, Virginia
- Tacoma, Washington

Utilities vary in how they charge for providing underground service to new residential construction. Some samples of residential undergrounding requirements are illustrated in the following:

Utility	State	Requirement
SDG&E, PGE & SCE	CA	Customer/Developer pays for trenching & backfilling. Utility pays remaining costs.
Atlantic City Electric	NJ	Customer/Developer pays $802.74 + $4.35 per front foot for each home. Utility pays remaining costs.
Cobb Electric Membership Corp.	GA	Customer/developer pays $260 per customer. Utility pays remaining costs.
Green Mountain Power	VT	Customer/Developer pays for trenching & backfilling. Utility pays remaining costs.
Nantucket Electric Co.	MA	The utility pays up to $837.85. The customer pays the remaining costs.
Consolidated Edison	NY	The utility charges the customer the differential in charges for equivalent overhead construction
Mississippi Power	MS	Developer pays the cost differential above what it would cost to install overhead lines

Source: "Utility Undergrounding Programs", Scientech, May, 2001

In addition, creative funding options are being implemented using special assessment areas, undergrounding districts, and state and local government initiatives.

For example, according to a Florida Power & Light press release, in January 2006, the company announced that subject to Public Service Commission approval, it intended to "pay for 25 percent of the cost of converting overhead lines to underground for local government-sponsored conversions. Florida Power & Light is hoping its actions will encourage local governments to take the necessary steps to invest in undergrounding."

South Carolina Electric & Gas has established a special undergrounding program, approved by the South Carolina Public Service Commission. Under the program, if the local municipality agrees to contribute a matching amount, SCE&G contributes 0.5 percent of the gross receipts it is obligated to pay to the municipality. This money goes into a special undergrounding fund.

Progress Energy has included a provision in its line extension policy where, upon request, it will convert overhead facilities to underground without charge in a downtown commercial area, provided the area has sufficient density. The municipality must agree to receive underground street lighting service and satisfy certain other requirements

The City of Boulder, Colorado assists individuals or groups of property owners with undergrounding existing utilities adjacent to their property through the Xcel Energy Undergrounding Credit. Xcel is required to make one percent of the preceding year's electric revenues available each year for undergrounding electric distribution lines in public places. Program participants pay 50 percent of undergrounding costs up to $100,000, and 100 percent of program costs in excess of $100,000.

Conclusion

After decades of discussion, municipalities and electric utilities are discovering that the many real and societal advantages to undergrounding power lines go far beyond just avoiding infrastructure damage from storm events such as hurricanes and ice storms.

In fact, cost benefits accrue from reducing day-to-day maintenance and operating costs, improving reliability, enhancing public safety and improving aesthetics and property values.

In many areas of the country, public policies are being developed which consider some form of cost-sharing for undergrounding, as governmental agencies learn more about the benefits which accrue to themselves and to utilities, developers, homeowners, businesses, communities and other rate payers, as a result of undergrounding.

Converting overhead facilities fits with many utilities' goals of providing high-quality electric service to its customers.

Evolving technology, such as horizontal directional drilling, and the ability to more safely physically locate underground utilities which are already underground, are resulting in higher-than-expected production, setting a precedent for projects to come.

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