

Going Underground

Though Inhibitors Remain, Market Continues Trend To Build Underground

Winter in 2007 got off to a devastating start in many parts of the country as snow, ice and subfreezing temperatures disrupted normal activities and left hundreds of thousands of residences and businesses without electrical power.

Any time disaster strikes, restoring electrical service is a first priority, and the question often asked is: why not put power cables underground where they will be protected from future damage?

Of course, providers of power services and others in the industry are aware of the benefits of having cable underground, but immediately after a disaster is not the time to try to convert from overhead to underground; installing underground cable requires careful planning, permitting and other time-consuming but necessary steps.

And while virtually all electrical transmission and distribution lines were once hung on poles, distribution cable has been placed underground for many years, and there clearly is a trend to bury more power lines.

Significantly higher costs of underground construction have been a primary reason for not putting electrical cable underground, but improvements in cable products and installation methods has narrowed the gap between overhead and underground construction costs, and that is influencing de-



Overhead or Underground? The Pros and Cons

Overhead power transmission and distribution systems are less expensive to install and maintain, but they are vulnerable to storms and other disasters. Underground cable is protected from winds and ice, but subject to damage by careless excavation and routine faults can be difficult and are more expensive to repair.

Dion Emami, director, business development for utility contractor Henkels & McCoy, San Dimas, CA, provides the pros and cons of aerial and underground power lines:

Pros for overhead facilities

- More cost-effective design;
- Routine inspection is easier and faster;
- Damages and fault conditions are easier to locate and can generally be repaired quickly; and
- Expanding an existing network is easier and less costly.

Cons for overhead facilities

- Frequent outages during wind, rain and winter storms due to trees and debris blowing into lines and ice loading damage;
- Facilities adjacent to public thoroughfares are subject to damage and outages from vehicular traffic accidents;
- Negative public perception due to visual, safety and environmental issues;
- Equipment failure more likely to cause collateral damages to

private property or require environmental clean up; and

- Increased maintenance and shorter equipment life spans due to exposure to elements, including dust, pollution, salt, industrial contamination, etc.

Pros for underground facilities

- Public perceptions improved – increased aesthetic appeal;
- Not susceptible to storm damage or damage from vehicles;
- Service interruptions may be less frequent;
- Cable can be located along public roadways without regard to pedestrian or vehicle impacts;
- Equipment failures contained to vaults and ducts, decreasing environmental concerns; and
- Decreased maintenance from problems caused by environmental factors such as dust and contamination.

Cons for underground facilities

- More costly to construct and expand;
- Planning for future expansion essential during original design;
- Can be susceptible to water intrusion and local flood damage;
- Outages typically last longer due to fault location and more complex repair requirements; and
- Repair is more time consuming and costly.

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decisions whether to place cable overhead or underground.

A report prepared for the Edison Electric Institute (EEI) released last summer found that electric utilities are placing a significant number of power lines underground. In the past 13 years, the report said, about half the capital expenditures of investor-owned utilities in the U.S. for transmission and distribution lines have been to place cable underground. Some state regulatory agencies encourage converting overhead utility cables to underground.

Any discussion of underground electrical cable usually centers on distribution – transmission lines historically have always been overhead. But that, too, is changing.

Narrowing the cost gap

An article published in 2006 stated that improvements in cable insulation and increasing difficulties in obtaining permits to construct overhead transmission projects, make underground transmission more feasible, and a narrowing of the gap between costs of underground versus aerial construction all contribute to make underground transmission a possible and affordable alternative. Several 230-kV underground projects have been completed in the U.S. in the past five years.

However, power distribution lines to serve new housing developments have been placed underground for more than 30 years, and few commercial developments today are served by overhead electrical lines. Many providers of power services today have ongoing programs to replace deteriorating or failing underground lines with new cable, a task for which directional drilling is ideally suited.

"It has been three or four years since we did an overhead subdivision," said Chip Nelson, chief operating officer of Cobb EMC, Marietta, GA, the state's largest electrical cooperative, serving more than 170,000 customers in the fast-growing Atlanta metropolitan area. "The quality of the subdivisions in our area appeal to home buyers who do not want overhead utility lines."

Old buried lines are being replaced underground, primarily by directional drilling. Cobb EMC purchased the first compact horizontal directional drilling (HDD) units in the state of Georgia, specifically for that purpose.

"We have three full-time drilling crews – one a company crew, two subcontractors – busy replacing old cable mostly in developed areas where easements are landscaped," Nelson said. "The choice is to destroy and replace the landscaping and make everyone unhappy, or use directional drilling to limit damage."

Two other HDD crews work on new con-

California Underground Initiatives

California power companies have been going from aerial to underground for more than 20 years, observes Dion Emami, director, business development for utility contractor Henkels & McCoy, San Dimas, CA.

Emami said there are tariff rules of the state regulatory commission to govern these conversions and identify how they would be funded – either through utility rates, or by private developers, existing property owners, or local governments.

"A limited amount of rate payer funds are allocated to local governments each year roughly based on the number of customers that are served from overhead facilities," said Emami. "Cities and counties served by public utilities can apply for specific local conversion projects to be approved, upon demonstration of sufficient public benefit, using these available funds."

Emami said the number of circuit miles of overhead lines that are converted annually in this manner is currently running about 70 to 75 miles total for the three investor-owned utilities providing electrical power. A lesser number of miles of overhead lines are converted using private funding, depending on the level of development activity in a given area.

"Municipally-owned electric utilities," Emami said, "generally do not utilize taxpayer moneys for routine programs of converting overhead facilities to underground, relying instead on private developers and property owners to initiate, if desired, such conversion work within city boundaries."

struction projects.

Nelson said trends in the area are to tear down older homes, replacing them with a greater concentration of new residences on the cleared land and to demolish houses in commercially-zoned areas to build new retail businesses. Power to both types of development is delivered by underground lines. Most main feeders remain aerial, although some now are going underground.

Replacement

Some service providers have initiated programs to replace aging overhead systems with new underground distribution cable.

Last year, Edmond Electric, the city-owned agency that provides electrical service for the city of Edmond, OK, (population 75,000) completed replacing deteriorated overhead cable poles and wire with new underground cable in the second of two of its older neighborhoods.

The program of going from aerial to underground began in 2003, the year after a major ice storm caused extensive damage to the city's aerial distribution system. The first project, serving 465 homes, was completed in two phases, said Dean Sherrick, Edmond Electric distribution superintendent. The second project involved 93 homes. High-voltage cable was placed in street right-of-way in front of homes; low-voltage lines were buried in backyard easements. Contractor crews used directional drills to install HDPE conduit in the ease-

ments; new cable then was placed inside the conduit. Sherrick said approximately 71,000 feet of HDPE conduit was installed on the two projects.

"Everything went very smoothly on both projects," said Sherrick. "Directional drilling limited surface damage and minimized interference with traffic and neighborhood activities. Our customers accepted the conversion very well, and we've had comments from homeowners that their service is no longer affected by storms."

While cost is a major factor deterring converting from aerial to underground, Sherrick said the department's strategic planning team recognized this type of project would improve system reliability and address concerns about deteriorating electric facilities. Projections are the city ultimately will recover the investment from reduced repair and maintenance costs, while customers enjoy improved service.

Other factors

Edmond Electric's goal is to continue to replace aerial distribution lines with underground cable. However, factors other than construction costs must be considered.

"Electric cable and equipment price increases over the past year are limiting Edmond Electric's ability to do further conversions at this time," Sherrick said. "The budget crunch is also worsened by increasing delivery times causing the need to encumber more funds to assure adequate

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supplies for Edmond Electric's continuing growth of almost 5 percent a year."

While the amount of underground electrical construction projects are increasing, including conversions from aerial to underground, the EEI report notes that about 70 percent of the nation's electrical distribution lines were constructed with aerial cable. Many of those overhead cables remain in place with no immediate plans to convert them to underground.

The study for EEI emphasized the issue of cost: "Undergrounding is expensive, costing up to \$1 million per mile on average to underground existing overhead lines, or almost 10 times the cost of a new overhead power line, and would likely require large rate increases for electric customers. This means that most undergrounding projects cannot be economically justified and must cite intangible, unquantifiable benefits, such as improved community or neighborhood aesthetics, for their justification. Determining who pays and who benefits from undergrounding projects can be difficult and often requires the establishment of separate government-sponsored programs for funding."

Some may question the \$1 million-per-mile cost the study cites for placing cable underground, pointing out that actual costs vary widely and are affected by many variables, including site conditions and the method of construction. Using an arbitrary dollar-per-mile figure to make estimates fails to take into account savings in labor and site restoration costs when an installation is made by directional drilling rather than open-cut construction.

The study also points out that burying existing overhead power lines does not completely protect consumers from power outages. While underground power lines do result in fewer overall power outages, the duration of power outages on underground systems tends to be longer than for overhead lines because they are more difficult to repair.

Higher costs still key

Based on the EEI study and information available from other industry sources, the status of aerial versus underground in the electrical market in 2007 can be summarized this way: higher costs to place cable underground has been and continues to be a factor limiting the amount of electrical undergrounding; the difficulty and higher costs of maintaining and repairing underground cable also is a deterrent.

For these and other reasons – except in new residential and commercial developments – underground placement of transmission and distribution lines often has been considered a last resort when overhead

options are not feasible because of physical or regulatory limitations.

However in recent years, the number of underground projects has increased in part due to the desire for more open space by state and local agencies, along with NIM-BY (not in my backyard) issues in many urban areas which influence many utilities to consider underground transmission installation.

Other factors include advances in new technologies in cable and insulation. Installation and tools for maintenance have also been lowering the cost and in some cases making it increasingly competitive with overhead projects. While considering the advantages and disadvantages, ultimately local conditions and individual community needs and preferences account for the different decisions on whether or not to place wires underground.

Finally, HDD is playing an important role in converting aerial cable to underground and replacing existing old underground cable and can be expected to continue to do so in the future. Indeed, the most recent *Underground Construction HDD Study* (June 2007) found the electrical market accounted for 15.3 percent of HDD projects among respondents, close to gas distribution, and more than sewer and water construction. Only telecommunications and oil and gas pipelines account for more HDD activity. ■