Should Power Lines be Underground?

After storms cause extensive damage to overhead electrical lines, it's natural to wonder if it would be better to bury lines underground to protect them from wind, vegetation, debris or ice. Entergy is not opposed to all undergrounding projects—in fact, power lines in some downtown business districts and many neighborhoods in our service area are already underground. However, customers should be aware of the pros and cons.

Underground has several noteworthy advantages

- There's the obvious aesthetic consideration. Except for an above-ground terminal here and there, they're out of sight entirely.
- They are less vulnerable to airborne elements like wind and ice.
- In some areas, like downtown districts, they are often more practical than overhead lines.

Underground costs more to install and maintain, resulting in increased electric rates

- Several studies have shown that installing lines underground is expensive for customers and taxpayers, costing 10 times more than overhead distribution or transmission lines.
- Underground lines are much more difficult and expensive to work on when problems arise. They require earth-moving equipment and specialized technicians.
- Installing underground is best done as an area is being developed. This is less expensive than converting later from overhead to underground.
- Overhead systems are easier, thus less expensive, to upgrade, such as when a community grows and needs additional electricity capacity.
- Several state regulatory agencies have found that the cost of burying power lines is much more than the benefit provided.

Underground lines are not necessarily more reliable than overhead lines

- Typically, underground lines experience fewer outages. But when outages involving underground lines do happen, they typically last longer because underground lines are more difficult than overhead lines to troubleshoot and repair.

Besides having accumulated a great deal of experience of our own, this topic has been widely studied. *See page 2.*

- While overhead lines are exposed to damage from airborne debris, trees and public interference, outages typically take less time to restore than underground outages.
- Underground lines are less susceptible to damage caused by wind, trees and ice, but face outages from trees collapsing on above-ground transformers and switch boxes or from tree-root systems uprooting buried cable when trees fall.
- As underground cables approach the end of their life, failure rates increase significantly, and these failures are extremely difficult to locate and repair.
- While a neighborhood may be locally served by underground lines, all electric service eventually comes back above ground and connects to overhead service, either in the neighborhood next door or further down the street where overhead main lines and transmission lines move electricity from power plants and substations into our neighborhoods. Thus, exposure of above-ground and overhead service to problems such as weather or trees cannot fully be eliminated. In fact, after Hurricane Wilma struck South Florida in 2004, the media reported that 97 or 98 percent of Florida Power & Light customers in Broward County lost power, even though 54 percent of them were served by underground lines.
- Storm-related flooding – particularly salt-water flooding – can cause and prolong outages in underground systems, and can shorten the life and increase the ongoing maintenance of the underground system.

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Real-world Experience and Third-party Research on the Feasibility of Underground Power

- A 2006 study by the Edison Electric Institute found that burying overhead power lines costs approximately $1 million per mile, 10 times what it costs to install overhead lines.
- A 2007 study by Entergy Texas, made at the request of the Public Utility Commission of Texas, reached a similar conclusion: construction of underground transmission lines is roughly 10 times more expensive than overhead construction. On a per mile basis, it costs $5 million to build an underground transmission line versus $500,000 for overhead construction.
- Studies of statewide undergrounding proposals in North Carolina in 2002 and Florida in 2003 suggest that undergrounding distribution lines would require rate increases ranging from 80 percent to 125 percent.
- A 2004 study by the Virginia Corporation Commission calculated the annual cost of a statewide undergrounding initiative at approximately $3,500 per customer. Based on the projected costs and benefits for undergrounding much of its state's electric system, the Virginia commission calculated that the benefits would offset only about 38 percent of total costs and concluded that a comprehensive statewide effort to bury the state's electric distribution system appears "unreasonable."
- In 1998 Australian officials completed what may be the most comprehensive research to date to quantify the benefits and costs related to undergrounding. The Australian study reached a conclusion similar to the Virginia study and estimated that the benefits of undergrounding would offset only about 11 percent of the costs.
- A five-year survey (1998-2002) of underground and overhead reliability comparisons for North Carolina's investor-owned electric utilities – Duke Energy, Progress Energy Carolinas and Dominion North Carolina Power – indicated that the frequency of outages on underground systems was 50 percent less than for overhead systems, but that the average duration of an underground outage was 58 percent longer than for an overhead outage.
- A 2000 study by the Maryland Public Service Commission looked at the reliability of "comparable" overhead and underground feeders and concluded that the impact of undergrounding the lines was, at best, "unclear." As underground cables approach their end of life, the Maryland report showed, failures increase significantly and are extremely difficult to locate and repair. Maryland utilities say their underground cables become unreliable after 15 to 20 years and reach their end of life after 25 to 35 years.

The North Carolina Experience

In early December 2002, a major ice storm blanketed much of North Carolina with up to one inch of ice, causing an unprecedented power outage to approximately two million electric utility customers. In the immediate aftermath of the storm, the public expressed considerable interest in burying all overhead power lines in the state. A special Natural Disaster Preparedness Task Force investigated the issue for the North Carolina Utilities Commission and unequivocally recommended against the step.

The task force study "determined that replacing the existing overhead distribution lines of the (state's investor-owned) utilities with underground lines would be prohibitively expensive. Such an undertaking would cost approximately $41 billion, nearly six times the net book value of the utilities' current distribution assets, and would require approximately 25 years to complete. The ultimate impact of the capital costs alone on an average residential customer's monthly electric bill would be an increase of more than 125 percent."

Rates would also be impacted by the higher operating and maintenance costs associated with direct-buried underground systems, particularly in urban areas, where underground conductors are four times more costly to maintain than overhead facilities, the task force found. "In addition to the impact on the cost of providing utility service, conversion to underground would impose costs on individual customers, municipalities, and other utilities," it added. "While these costs have not been quantified, they could be significant."

The report also determined that "underground facilities are not without their disadvantages. Although underground systems are more reliable than overhead systems under normal weather conditions, they are not impervious to damage, and the repair time for underground systems is almost 60 percent longer than for overhead systems when damage does occur. Consequently, the [Task Force] does not recommend that the utilities undertake the wholesale conversion of their overhead distribution systems to underground."