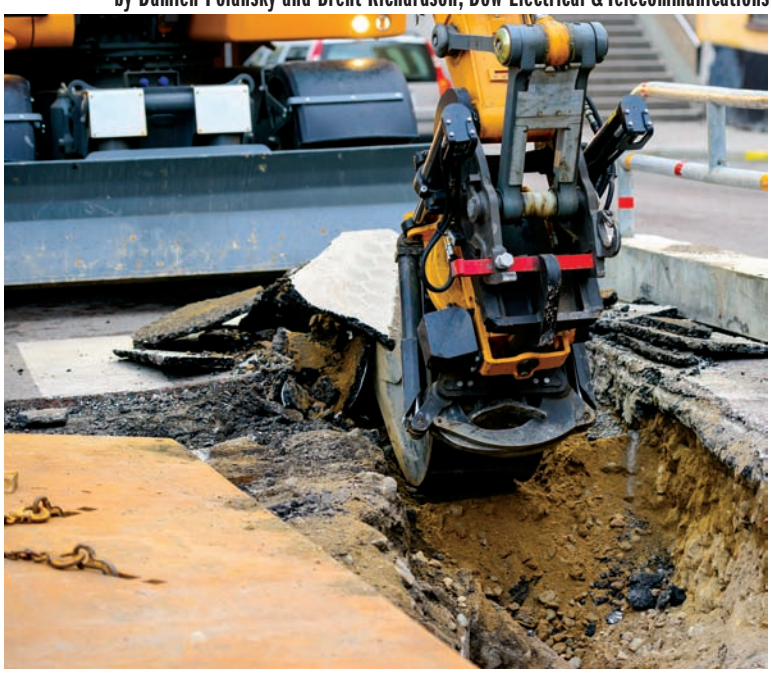
Intelligent Undergrounding—Burying Highly Reliable Cable When, Where it Makes Sense

by Damien Polansky and Brent Richardson, Dow Electrical & Telecommunications



Whether talking about aesthetic appeal in new residential and commercial zones, obtaining legal rights of way or economic loss from storm-related power outages, putting transmission and distribution infrastructure underground is a hot topic.

Although underground distribution is common, one of the largest pain points is the perceived cost of installation for underground transmission.

High-voltage underground transmission installations typically have higher up-front price tags than overhead lines; however, as new trenching methods such as horizontal directional drilling become more readily available and technologies create more reliable long-life cables, costs are moving to a more equitable position with overhead lines. This is true especially when seen in the light of ongoing costs for repair and maintenance of overhead lines over the life of the system.

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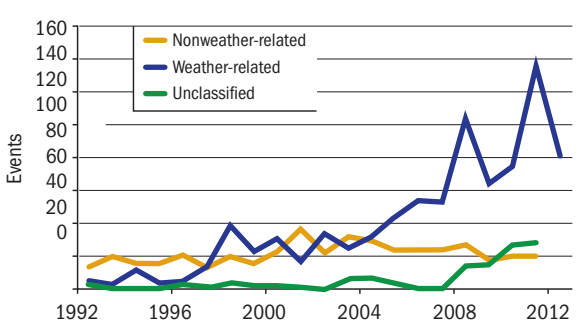
An article in the February 2013 issue of *Electric Light & Power* by Frank Alonso and Carolyn Greenwell, both transmission line engineers with SAIC, aptly states, "The time is quickly approaching when utility customers and government officials will demand an answer that provides a more in-depth, independent look at how much more expensive underground power delivery is compared with overhead power delivery. Changes will be precipitated by power outages associated with natural disasters, citizens who don't want their homes devalued by nearby overhead lines, and competitive economic forces that drive utilities to consider placing power lines underground."

An August 2013 report from the White House, "Economic benefits of increasing electric grid resilience to weather outage," further supported a position for underground installations.

"Between 2003 and 2012 roughly 679 power outages, each affecting at least 50,000 customers, occurred due to weather events," according to the report. "Monetary costs of these outages account for up to between $18 billion and $33 billion annually."

Observed Outages 1992-2012



Sources: Energy Information Administration

The Case for Intelligent Undergrounding

Businesses within the entire power industry value chain—from compound suppliers, accessory component producers to cable makers, installers and utilities—all have a vested interest in improving electrical system reliability. This is why Dow Electrical & Telecommunications (Dow E&T) is advocating intelligent undergrounding, which is to bury highly reliable, polyethylene-based cable when and where it makes sense: cross-linked polyethylene (XLPE) for high-voltage transmission and tree-retardant XLPE (TR-XLPE) for medium-voltage distribution.

Three recent examples include projects initiated by

Wisconsin Public Service (WPS), which services 440,000 customers in rural Wisconsin, and Dominion Virginia Power, the largest electric utility in Virginia with 2.3 million customers.

1. As reported in the July 23, 2013, issue of the Milwaukee Journal Sentinel, "The five-year project (for WPS) will involve burying distribution lines underground along hundreds of miles of power lines in rural areas." Vern Peterson, vice president of energy delivery for WPS, was quoted as saying, "In the affected areas, electric reliability is significantly lower than state and national averages. The areas we will target are those in which customers are repeatedly faced with the loss of power due to storms—sometimes for several days." The article went on to state, "The project is expected to add between $4 and $5 a month for a typical utility customer."
2. In another good example of intelligent undergrounding, Dominion Virginia Power won a Southeastern Electric Exchange (SEE) Industry Excellence Award in the Transmission Line Category for its Pleasant View-Hamilton 230-kV project in 2011. The project addressed electricity demand and desired property aesthetics. As stated in the presentation abstract, "To meet the increased demand for electricity in western Loudoun County, Dominion Virginia Power built a new 230 kV transmission line to serve the areas west of Leesburg. The total length of new line is 12 miles, with 2 miles installed underground with solid dielectric XLPE cable. The underground portion of the project is sited in an upscale neighborhood along a popular nature trail."
3. Similarly, in the July 19, 2013, Richmond Times-Dispatch, Dominion Virginia Power released information from a study that indicated, "Undergrounding 20 percent of the company's worst-performing residential lines could reduce by 63 percent the number of repairs required to restore power to all customers as a result of damage from major storms." Rodney Blevins, vice president of distribution operations, said, "Ninety-nine percent of the utility's storm-related outages happen on its overhead power lines. While underground lines are significantly more expensive to install and maintain than lines strung on poles, restoring power after a storm also is expensive, typically costing the company $4 million to $14 million per day of outage." Dominion Virginia Power has a goal to put 350 miles of line underground per year—at an estimated cost of $175 million annually— until 4,000 miles have been moved. Senate Democratic Leader Richard L. Saslaw, who sponsored the legislation for this underground project, said, "The rate increase could range from 70 cents a month at the start of the project to $4 per month by its completion."

These examples of intelligent undergrounding underscore the where and when it's needed: weather-related outages, relieving congestion and reduction in the physical space needed for rights of way and preserving aesthetics in natural areas. They also provide a clearer understanding regarding cost. Data that objectively compares the upfront cost of underground vs. overhead lines is limited. Every project is unique with widely varying costs; however, when all factors are considered in the total life cycle of the assets, undergrounding can be cost-effective, particularly when spread over time and among many customers and when weighed against the cost of repairs and reputation when it comes to system reliability.

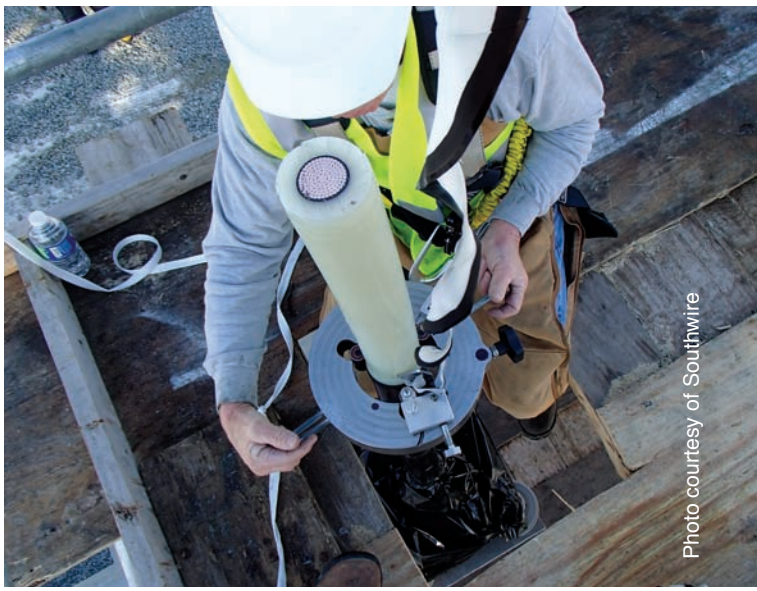


Photo courtesy of Southwire

Quality Materials Matter

Cable compound suppliers are a critical part of the value chain in the power industry and can have a huge impact on power system reliability. Cable manufacturers and utilities have many choices when it comes to specifying materials to manufacture cables. Years of experience and data from independent testing institutes indicate that XLPE and TR-XLPE continue to provide the best performance for robust manufacturing, ease of installation and high electrical breakdown strength that ensures failure-free operation and lower electrical losses over the lifetime of the cable.

Quality materials made to meet or exceed stringent industry standards are key to long-life, reliable cables that extend that reliability to the underground systems in which they are placed.

Thinking Ahead

Ongoing scrutiny of aging power grids and decisions for the best systems to support new infrastructure will keep the debate of overhead vs. underground lines going for a long while. This is where intelligent undergrounding best fits. The industry must come together to weigh all factors objectively into the analysis between underground and overhead line systems. The industry, however, shouldn't look at underground and overhead lines as mutually exclusive, but potentially working in tandem to quantify the first and long-term costs to determine when and where each makes sense. All participants in the power value chain can share their collective experience to benefit the entire industry to ensure reliable, long-life service of electrical infrastructure that delivers peace of mind to utilities and their customers for decades. ELP