

OVERHEAD VS. UNDERGROUND

Information About Undergrounding High-Voltage Transmission Lines



Photo courtesy of Georgia Transmission Corporation

Working on underground lines in typical 8x8x24 foot manhole

Tri-State Generation and Transmission Association (Tri-State) owns (wholly or jointly) or has maintenance responsibilities for more than 5,200 miles of transmission line across Colorado, Nebraska, New Mexico and Wyoming. Line crews and substation technicians work to ensure power delivery is safe and reliable.

As a not-for-profit electric utility, Tri-State continues to invest in transmission infrastructure to ensure dependable power delivery to its 44 member cooperatives throughout its four-state service territory. The West's vast power supply network is currently strained – improvements and expansion to the system are essential to enhancing regional power reliability.

High-voltage overhead transmission lines are a reliable, low-cost, easily maintained and established method to transport bulk electricity across long distances. In 2006, there were approximately 160,000 miles of 230 kilovolt or greater high-voltage transmission lines in the United States. The percentage of underground transmission is estimated at between 0.5 to 0.6 percent of this total. Tri-State's line crews have a topnotch performance and safety record for repairing and maintaining its extensive overhead infrastructure.

Construction of high-voltage transmission lines underground are appropriate in densely urban and suburban settings, or in some instances where sufficient right-of-way is not available for an overhead line.

When an electric utility considers whether or not to construct high-voltage underground transmission facilities, it must evaluate the following considerations:

Power Outages

While underground transmission lines are somewhat immune to weather-related failures, any damage is difficult to pinpoint and repair and the required repairs may take a couple of weeks to several months. Damage to overhead lines is easily located and typically takes several hours or days to repair.

Network vs. Radial Installations

Underground transmission lines in a radial system require more cables to meet the same reliability as an overhead line. The additional components translate to a higher cost and can reduce overall system reliability.

Line-Length Challenges

Underground lines will require additional equipment to compensate for voltage rise along the distance of the transmission line. The additional equipment translates to a higher overall cost, limits the length of the underground installation and increases the likelihood of failure due to additional components.

Cable Selection

There are currently two cable types that could be used in a high-voltage underground option. One is a cross-linked polyethylene (XLPE) system and the other is a high-pressure fluid filled (HPFF) system. Both systems require



Photo courtesy of Georgia Transmission Corporation

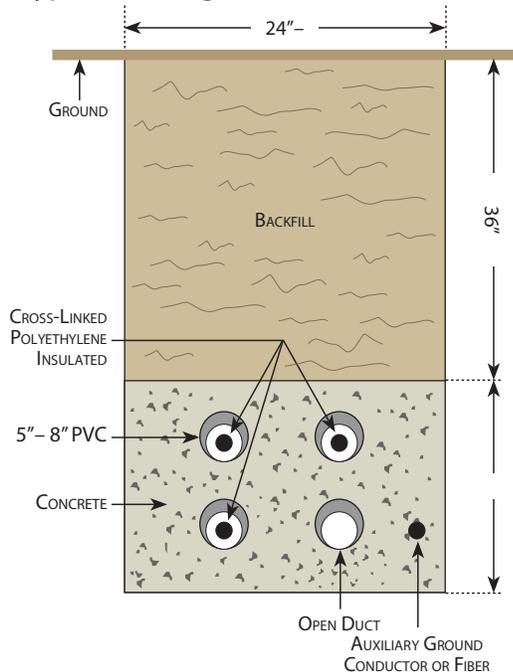
Thick underground cable next to smaller overhead conductor

the installation of underground vaults at regular intervals depending on reel length for installation of cable splices, but HPFF will also need pumping facilities for cycling fluid for cable cooling that will require access to a distribution power source. Either system may require the installation of addition cables to meet the equivalent capacity requirements of the overhead line. Life-cycle analysis will be applied to determine the best cable choice.

Construction Impacts

The environmental impacts of construction are greater for an underground transmission line than for a comparable overhead line. Depending upon the types of overhead structures used, an overhead line typically requires one or more augured foundations that may be several feet in diameter. Such foundations will be required at every structure location, and each foundation can vary from 600 to more than 1,000 feet apart. As a minimum, an underground transmission line would require a continuous trench at least 5 feet in width at the bottom and 5 feet deep. Multiple parallel trenches separated by as much as 8 feet may be required to meet the capacity requirement. Considerable clearing and grading is expected in suburban and rural settings, and dust and noise from construction will last three to six times the duration of an overhead line. Concrete manholes or large splice vaults are needed at recurring intervals. During repairs, a whole segment between these vaults may need to be excavated again.

Typical Underground Cable Installation



Easement Requirement

An overhead line typically has a wider easement footprint than an underground line.

Life Expectancy

Depending on the choice of cable system, the life expectancy of an underground line is about half that of an overhead line.

Costs

An underground line is expected to be four to 14 times the cost (depending on voltage) of an overhead line due to time, materials, process and the use of specialized labor. An underground line must also be routed to avoid other underground installations such as water, gas and sewer lines. Unstable slopes, hazardous material sites, wetlands and bedrock must be avoided. Going under a road, highway or under a river requires expensive construction techniques such as directional boring. All these aspects of underground transmission construction lead to a much higher cost than overhead line construction.

Electric and Magnetic Fields

Underground transmission lines do not mitigate Electric Magnetic Fields (EMF) since the earth does not provide shielding. EMF intensity levels may be higher above an underground installation than an overhead line.

Tri-State's Undergrounding High-Voltage Transmission Facilities Policy

If a landowner or jurisdictional body wishes to bury a line, the requesting party must follow the following review procedure:

- The requesting party first must provide a written request to Tri-State's general manager for the line to be placed underground.
- The request must be approved by the democratically elected, 44-member board of directors.
- An outside consultant will provide cost estimates for both underground and overhead line construction to determine the cost difference.
- The requesting party must agree to pay for the difference in cost between construction of an overhead line and an underground line. If approved by both parties, the requesting party will have six months to provide the financing.



Contact Information

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