

Overhead vs. Underground

Information about undergrounding high-voltage transmission lines



Colorado's renewable energy future

High-voltage 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 (kV) or greater high-voltage transmission lines in the United States. The percentage of existing underground transmission is estimated at between 0.5 and 0.6 percent of this total. Lines crews have a top-notch performance and safety record at repairing and maintaining this extensive overhead infrastructure.

Construction of high-voltage transmission lines underground is appropriate in densely populated 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 transmission facilities, it must evaluate the following considerations:



Working on an underground line in a typical 8' x 8' x 24' vault

POWER OUTAGES

While underground transmission lines are somewhat immune to weather-related failures, any damage is difficult to pinpoint and repair; required repairs may take a couple weeks to several months to complete. Damage to overhead lines is easy to locate 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 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 line installation, and increases the likelihood of failure because of additional components.

MULTIPLE CABLES AND FORCED COOLING OPTIONS

Depending on the type of cable system used, cooling equipment may be required at underground transmission line substations. The cooling equipment increases noise above ground. Overhead lines are air cooled and widely spaced for safety.

CONSTRUCTION IMPACTS

The environmental impacts of construction are greater for an underground transmission line than for a comparable overhead line. Depending on the types of overhead structures used, an overhead line typically requires one or more augured foundations that may be several feet in diameter. Such a

foundation is required at every structure location, and each foundation can vary from 600 to more than 1,000 feet apart. At a minimum, an underground transmission line requires a continuous trench at least five feet wide at the bottom and five feet deep. Considerable clearing and grading is expected in suburban and rural settings, and dust and noise from construction lasts 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.

EASEMENT REQUIREMENT

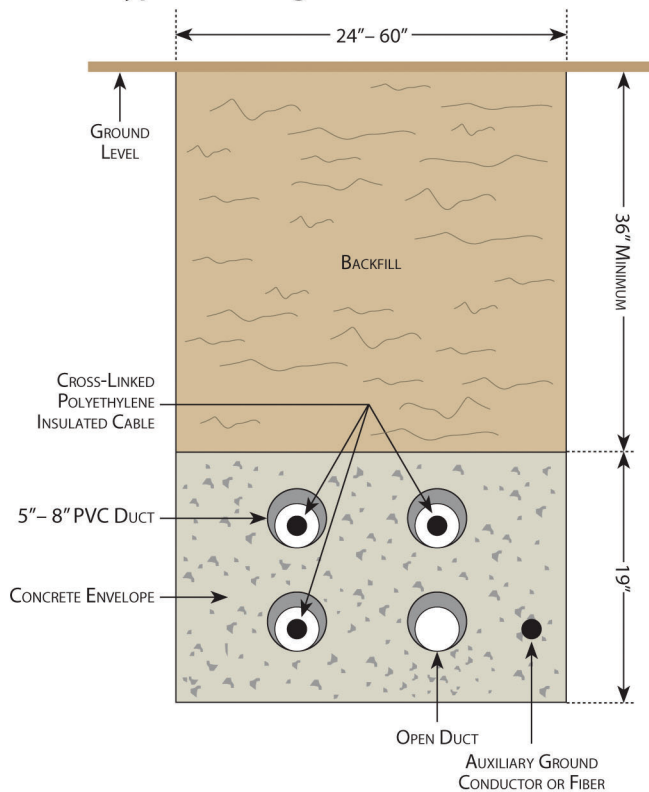
An overhead line typically has a wider easement footprint than an underground line.



Photo courtesy of Georgia Transmission Corporation

Underground cable and smaller overhead conductor.

Typical Underground Cable Installation



LIFE EXPECTANCY

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 15 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 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) because the earth does not provide shielding. EMF intensity levels may be higher above an underground line as compared to overhead lines.