

Overhead vs. Underground

Information about burying high-voltage transmission lines

High-voltage transmission lines are a reliable, low cost, easily maintained and established to transport bulk electricity from generation sources to customers, often over long distances. In 2010, there were approximately 337,000 miles of 115 kilovolt (kV) or greater high-voltage transmission lines in the United States. The percentage of existing underground transmission is estimated at 0.5 percent of this total. Line crews have a top-notch performance and safety record at repairing and maintaining this extensive overhead infrastructure.

Burying high-voltage transmission lines may be appropriate in densely populated urban and suburban settings, near airports, or when sufficient right-of-way is not available for an overhead line. Electric utilities consider the following factors when deciding whether to construct high-voltage transmission facilities above ground or bury them:

Power restoration

Damage to underground transmission lines is difficult to pinpoint, and repairs may take a few weeks to several months to complete. Damage to overhead lines is easy to locate and typically takes several hours or days to repair.



Crews work on an underground duct bank extending from a typical 8'x 8'x24' vault

Capacity requirements

For underground transmission, a large number of cables are often required to match the capacity of the overhead circuit. Additional components increase the underground cost as a duct bank, vaults, splices and terminations are required which can also reduce overall system reliability.

Line-length challenges

High-voltage underground lines may require additional equipment to ensure proper electrical performance 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. A system study would be required to determine if this additional equipment would be required.

Multiple cables and cooling options

Overhead lines are air cooled and widely spaced for safety. Underground cables are installed in concrete encased PVC duct banks. Heat generated by the cables is dissipated into the earth.

Construction impacts

Burying transmission lines has more environmental impacts than placing them overhead. A 230 kV overhead line typically requires erecting structures and placing foundations about every 900 feet. Typical monopole structures are 80 to 130 feet tall with either reinforced concrete drilled pier foundations or direct embed foundations. At a minimum, an underground transmission line requires a continuous trench at least three feet wide at the bottom and five feet deep. Considerable clearing and grading would be necessary, and dust and noise from construction would last three to six times longer than it would for overhead construction. Large concrete splice vaults or access structures (see photo) are needed at 2,000 to 2,500-foot intervals. Permanent access to the vaults is required to make repairs when needed.

Easement requirement

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

Life expectancy

Underground high-voltage transmission lines generally need to be replaced after approximately 40+ years, while overhead lines have a life expectancy of more than 80 years.

Costs

An underground 230 kV line costs 10 to 15 times the cost of an overhead line due to time, materials, process, the need to include transition substations and the use of specialized labor. The proposed overhead 230 kV double-circuit line would cost approximately \$850,000 per mile. Part of the added costs to bury lines may include routing and boring to avoid other underground installations, such as water, natural gas and sewer lines. An overhead line often can be routed around or over these difficult areas.

Electric and magnetic fields

Electric magnetic fields (EMF) are generally higher directly over an underground installation (the earth does not provide shielding) and directly under an overhead installation. Magnetic fields tend to decrease more rapidly with distance from underground installations compared to overhead lines.

Noise and lighting

Overhead high voltage lines can emit hiss or hum noises. Underground lines are silent except in the immediate area near the transition substations. The substations are lighted throughout the night for security purposes.



Photo courtesy of Georgia Transmission Corporation

Underground cable and smaller overhead conductor.

Transition substations

High-voltage underground transmission lines require small substations – called transition substations – wherever the underground cable connects to overhead transmission. Transition substations require grading, access roads, storm water management facilities, fencing and night time lighting.

Site restoration

Site restoration for underground construction is a much larger endeavor than it is for overhead construction because soil is disturbed along the entire route. Top soils have to be restored and returned to vegetated areas, and all hard surface areas must be reestablished to meet local codes. Vegetated areas may require up to two years to return to preconstruction conditions.