OVERHEAD VS. UNDERGROUND

INFORMATION ABOUT BURYING HIGH-VOLTAGE TRANSMISSION LINES

High-voltage transmission lines are a reliable, low cost, easily maintained and established way to transport bulk electricity from generation sources to customers, often over long distances. In April 2021 there were approximately 385,000 miles of high-voltage transmission lines (100 kilovolts or greater) in the United States. Just 0.5% or an estimated 2,045 miles of this infrastructure is underground. 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 (345 kV or higher) 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. Line crews have a top-notch performance and safety record at repairing and maintaining this extensive overhead infrastructure.

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.

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 through the earth to the surface.

Crews work on an underground duct bank extending from a typical 8'x8'x24' vault

Construction impacts

Buried transmission lines have more environmental impacts than those overhead. The proposed single-pole 345 kV overhead line requires erecting 130 to 190-foot structures and placing the structures every 950 feet. At a minimum, an underground transmission line for this project requires a continuous trench at least ten feet wide at the bottom and eight feet deep. Considerable clearing and grading would be necessary, and dust and noise from construction would last three to six times longer than they 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. Underground line easements must be kept clear of buildings, soil addition, trees and woody vegetation so that cooling of the underground cables is not affected. Buildings, additional soil, trees and woody vegetation add insulating value above the cables which reduce the current carrying capacity of the cable. The easement should also be kept clear in case the duct bank needs to be excavated to make future repairs.

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Life expectancy

Underground high-voltage transmission lines generally need to be replaced after approximately 50 years, while overhead lines have a life expectancy of more than 80 years.

Costs

An underground 345 kV line costs at least 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 overhead double circuit 345 kV line will cost approximately $2.0 to $2.5 million 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.

Electric and magnetic fields

Electric & Magnetic Fields (EMF) are generally higher directly over an underground installation (the earth does not provide shielding) than 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.

Transition substations

High-voltage underground transmission lines may 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 for overhead construction because soil is disturbed along the entire route. Top-soils must be restored and returned to vegetated areas, and all hard surface areas must be re-established to meet local codes. Vegetated areas may require up to two years to return to preconstruction conditions.

Underground single circuit cable installation
(2 to 3 cables per phase)

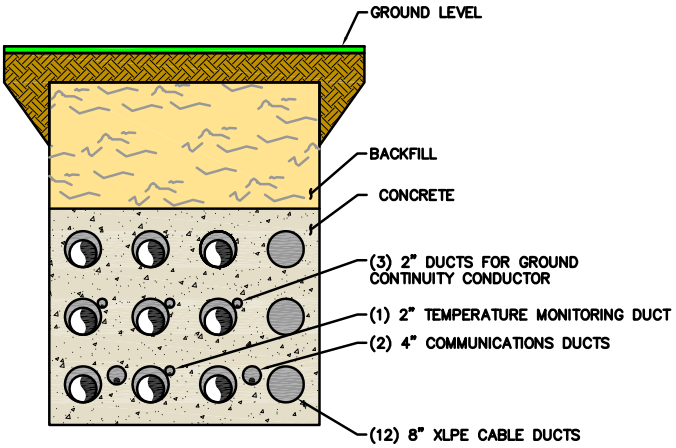

Photo courtesy of Georgia Transmission Corporation

Underground cable and smaller overhead conductor.