Overhead vs. Underground
Information about Undergrounding High-Voltage Transmission Lines

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-kV or greater high-voltage transmission lines in the US. The percentage of existing underground transmission is estimated at between 0.5 and 0.6 percent of this total. Line crews have a top-notch performance and safety record at repairing and maintaining this extensive overhead infrastructure. Construction of transmission lines underground is 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 required repairs may take a couple of weeks to several months to complete. Conversely, 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 installation, and increases the likelihood of failure.

- **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 noises 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 5 feet in width at the bottom and 5 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.

Transmission lines are installed in concrete-encased duct banks.

- **Easement Requirement**: An overhead line typically has a wider easement footprint.
- **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 fifteen 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.

At the ends of an underground line section, large, one-acre transition structures need to be constructed.

- **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 installation as compared to overhead lines.