

# Southern Colorado Transmission Improvements

## San Luis Valley – Calumet – Comanche Transmission Project

### Overhead vs. Underground

#### Information about Undergrounding High-Voltage Transmission Lines



*Photo courtesy of Georgia Transmission Corporation*

**Working on underground lines in a typical 8' x 8' x 24' vault**

Tri-State Generation and Transmission Association (Tri-State) and Public Service Company of Colorado (PSCo), an Xcel Energy company, are jointly proposing to construct the San Luis Valley–Calumet–Comanche Transmission Project, which would be owned and operated by the two companies.

The proposed project would be constructed by the utilities and include the following components:

- Approximately 95 miles of new double-circuit 230-kilovolt (kV) transmission line from the existing San Luis Valley Substation, north of Alamosa, to a new Calumet Substation near Walsenburg
- A new 230/345-kV Calumet Substation at a location six miles north of Walsenburg on property owned by Tri-State and expansion of three existing substations
- Approximately 45 miles of new double-circuit 345-kV transmission line between the proposed Calumet Substation and the existing Comanche Substation near Pueblo
- Approximately six miles of new 230-kV transmission line between the proposed Calumet Substation and the existing Walsenburg Substation
- Proposed communication facilities to support operation and maintenance of the 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 United States. 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 high-voltage 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. Tri-State and PSCo have separate policies on undergrounding transmission lines.

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. 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 would 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 because of the 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 noises above ground. Overhead lines are air cooled and widely spaced for safety.



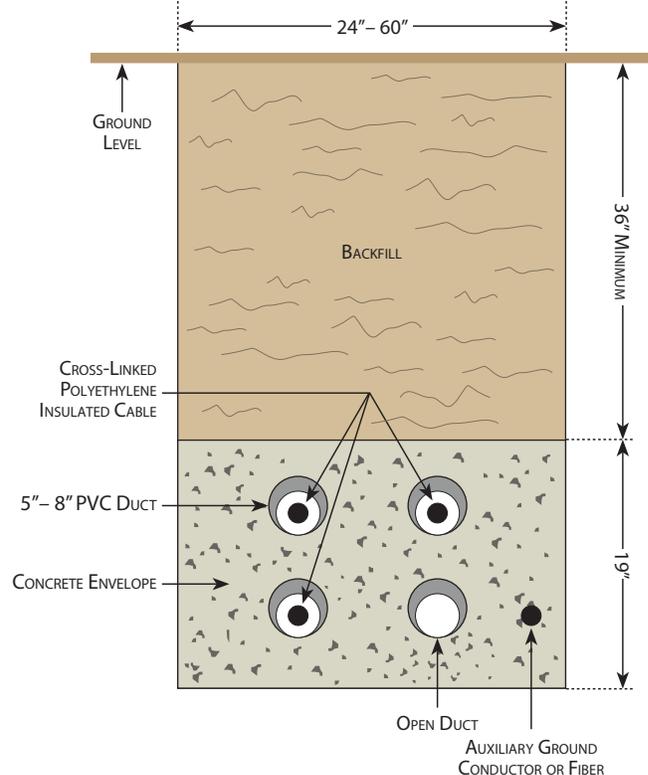
Photo courtesy of Georgia Transmission Corporation

**Underground cable and smaller overhead conductor**

## 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 would be 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 would require a continuous trench at least 5 feet in width at the bottom and 5 feet deep. Considerable clearing and grading would be expected in suburban and rural settings, and dust and noise from construction would last 3 to 6 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

The life expectancy of an underground line is about half that of an overhead line.

## Costs

An underground line is expected to be 4 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 installation as compared to overhead lines.