

Underground Transmission Lines

Caution: Rough Road Ahead

Complex and intricate, they promise to deliver obstacles and challenges every step of the way. Are you ready?



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Electric transmission lines have been around for more than a century, and in North America, they are predominately built overhead. There is currently an estimated 200,000 miles of transmission lines in the United States and only 5,000 miles of those lines are underground. So while overhead lines will probably continue to be the predominant approach, the landscape is changing and underground construction is becoming more frequent.

In recent years, a growing number of projects have included underground lines. Some of these include:

- In California, San Diego Gas & Electric's Otay-Metro Powerloop, a 230 kV line totals 52 miles with 10 miles underground.
- Entergy's 4,000 foot transmission line was built 100 feet under the Mississippi River in New Orleans, LA.
- Pacific Gas & Electric's Jefferson-Martin 230 kV line in San Francisco, CA was built with 24 miles underground.
- Australia's Murraylink line was built entirely underground and is reportedly 110 miles long.

DEMAND FOR UNDERGROUND LINES

The increasing number of underground line projects originates from two primary sources: customer/governmental requests and siting issues. For example, the state of North Carolina has spent considerable time, energy and funds to become an international destination for biomedical research and manufacturing. The general approach to building these research parks and facilities is to provide pedestrian friendly, campus-type parks where visible utilities are restricted or forbidden outright by deed restriction.

It is also increasingly common in urban areas that utilities encounter some difficult siting situations. Pre-existing constraints and obstacles can limit a project's options to the point where consideration of an underground line is unavoidable. And surprisingly, motivated customers are in some cases finding ways to build—and pay for—underground projects. So while a utility's project engineers may zealously explain the significant drawbacks to an underground transmission line, they are being built more frequently.

THE DOWNSIDE OF GOING UNDER

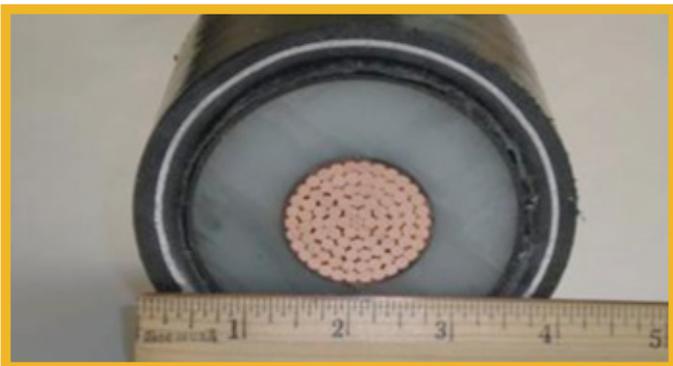
Once involved in an underground project, it becomes evident very quickly that the process is far more complex than simply taking an overhead line and placing it under the ground. It is an intricate process with the potential for many obstacles and challenges along the way. While some of these project issues are common to all transmission lines, some are unique to underground projects.

The drawbacks of underground lines can generally be divided into two broad categories—budgetary and engineering. As might be expected, cost is very often the determining factor. The additional expense of building an underground line varies dramatically, depending on the specifics of the project and the site. The reality of the cost, which can be many multiples of the cost of an overhead line, quickly ends many discussions of requested underground lines.

Another potential roadblock involves the rights appropriate to building, operating and maintaining a high voltage underground transmission line. An informal, and admittedly unscientific, polling of a number of utilities—both large, multi-state corporations and smaller utilities—suggests that it may be time for a thorough discussion of what underground rights may need to be acquired.

Initially, approaching a topic of this type and potential importance will require a meaningful discussion of the differences in needs for underground versus overhead lines. The results from such meetings would likely be more actionable if they included representatives from not only the real estate/right of way staff, but also from engineering, surveying, legal and others who may be involved in a company's underground project.

Many factors related to acquiring rights for underground lines are common to acquiring rights for overhead lines and are typically being addressed in some fashion by existing documents and practices. It is likely that, unless adequate attention is given to the different rights needed (and any associated document changes), some critical rights may not be acquired, while other rights are acquired that aren't of any benefit at all. One example of this



Protecting the line, extruded dielectric cable is used for underground 100kV transmission line.



Underground projects prove far more complex throughout each phase.

includes vegetation. The presence of trees within the right of way that are below the specified height restriction may be perfectly acceptable with overhead lines, however with an underground line, those same trees may have root systems that could be potentially damaging to the underground equipment.

ENVIRONMENTAL IMPACTS

A significant area of concern with underground lines relates to environmental issues. Not only are the issues complex, but the solutions are not typically simple or easily addressed. There is an increased risk of exposure to pre-existing contamination, as a multitude of potential contaminants are being found in underlying ground water, like dry cleaning solvents or petroleum products. The soil itself can also harbor some of these same chemicals, as well as other contaminants like lead, arsenic, pesticides and/or buried building materials such as asbestos. Prospective owners of right of way would find it in their best interest to consider adjusting their standard protocols to include Phase I environmental inspections for all underground lines.

Not all environmentally contaminated sites will be readily apparent or even suspicious initially. Open fields and woodland may not appear to hold any risk for a transmission line, at least not until a livestock pit used for pesticide dipping in an earlier era is discovered. Neither is it uncommon in some areas for preliminary site inspections to discover unregistered private landfills with rusted, unmarked barrels and discarded car batteries. These types of discoveries are always of interest with any transmission line project, and they take



A Phase I environmental inspection can determine whether contamination poses any potential health risks.

on increased importance due to the excavation involved with an underground project. In addition to the costs and project delays, there are potential health risks, as this type of contamination presents the potential for considerable exposure to dangerous chemicals for right of way agents, surveyors and others who must inspect and build the project.

In urban situations where a number of underground projects are being sited, there is an increased risk of brownfields being established that may include existing transmission right of way. It is entirely possible that the owner of the right of way may not be included in any discussions about the prospective brownfield or the associated land use restrictions. The result of not being involved in those discussions could easily end up with the utility being prohibited by statute from any excavation work related to normal maintenance or even emergency repairs. This scenario could be avoided by something as simple as requiring (within the right of way document) prior notification to the utility of plans for establishing a brownfield. In addition, the right of way document might also address the related safety issue of whether, in the future, a third party contractor should be allowed to excavate for remediation around a 230,000 volt transmission line.

With transmission assets buried in the ground, there is an increased likelihood of meaningful environmental events. Attention must be given to a number of aspects that would not necessarily be an issue with overhead lines. For example, a property owner may store their junk vehicles in a right of way, leaving behind all the associated oil leaks and antifreeze. Or, an unknown party may illegally dispose of toxic chemicals in an existing right of way. When preparing the right of way documents, it would seem reasonable to include a requirement for immediate notification to the right of way owner in the event of any type spill or discharge of fluids or materials considered reportable under local

or federal guidelines. While these issues are not likely to result in a significant impact on overhead lines, they would definitely be of concern with an underground line.

Water issues are yet another important factor to be considered. Surface water erosion, ponding of water over the transmission line and leaks (from storm drains or water supply lines) are all situations that could cause serious problems for an energized underground line. There can also be significant impact from outside the right of way when grading work is done, new highways are built or otherwise simple changes are made affecting the surface water drainage patterns. And even with existing energized lines, the utility may only learn of the effect on their right of way a year or more after the damaging impact occurs. Fly-over inspections, if done at all, may not identify these type problems until the damage has become extensive.

LEGAL IMPLICATIONS

Another potentially significant area of concern with underground lines is the wide range of potential legal issues. Many agents classify these as the project's most difficult, complex and potentially damaging problems for the utility to resolve. It is unlikely that a list of all the factors under the umbrella of 'legal issues' would ever be complete. This topic is already of overriding concern on essentially all overhead line projects built, and where transmission lines are placed underground, the list grows even longer. Obviously, legal expenses could increase dramatically if any environmental issue were to arise.

One specific area of legal concern involves the subject of indemnity (related to property damages and/or the costs of power outages). It is an issue that has not typically been needed or included in standard right of way documents. With underground lines and the possibility of grading and heavy equipment digging within the right of way, damage to a duct bank containing a transmission line or damage to a line itself becomes a real possibility. A related outage could affect many tens of thousands of customers, including businesses and manufacturing plants that may suffer millions of dollars in damages and expenses. These costs, plus repairs, would need to be absorbed by someone, whether customers, the utility or the instigators of the damage.

One approach would require that the legal department provide a document with conceptual language that essentially outlines that nothing can be done in the right of way without the utility's express written permission. Another approach may utilize a document that attempts to list every conceivable issue possible. A utility may even find it acceptable to use their own document as a starting point and then make frequent concessions to each landowner, consciously accepting any future risks inherent with using multiple, modified right of way agreements.

At the end of the day, after all the planning, the meetings and the construction, the utility is left with a single document to acquire and protect their rights. Every utility must work within the constraints of the applicable laws, regulations and corporate policies it has adopted.

ACCURATE PROPERTY DESCRIPTIONS

Part of the legal aspect of acquiring a right of way relies on accurately describing the right of way itself, and this becomes even more difficult with an underground line. This is a critically important part of every transmission line project, as it involves determining where the right of way will be positioned. Experienced utility surveyors should always be consulted as early in the process as possible with all transmission line projects, but particularly with an underground line.

Above ground line surveys are, in concept, fairly straightforward. The standard survey shows the right of way width to be “x” feet wide and “y” feet long. In a typical right of way map or document, there is generally no need to reference height issues. However, in addition to defining the length and width of an underground right of way, the utility may want to consider adding language in their document to address the need for protection of the subsurface area around an underground line from encroachment. The added language could include describing a specified, uniform depth of the right of way or a protective zone on all sides of the line or duct bank. The as-built surveys, ground penetrating radar (either pre-construction and/or post-construction), or profile mapping could become an invaluable resources for many years to come.

Accurate descriptions are also important for protecting the lines and the concrete vaults (typically 8'x8'x28') that are required at intervals along the transmission line. The importance of this issue recently surfaced where a concrete duct bank was damaged. After a large area was excavated from beneath the duct bank, the concrete failed from lack of support. This incident highlights the advantages of considering in advance how to address future utility crossings of the right of way (either above or below the line). The potential for co-location of other utilities within the right of way could also be addressed at the same time. Both situations would present different impacts on underground lines compared to overhead lines. It is also possible that future grading related to other utility projects may result in bringing the line into noncompliance with the National Electric Safety Code (USA) concerning proper depth for a line and safe buffer distances immediately around a transmission line or a duct bank.



Markers signal potential danger of high-voltage line.

Closely related is another aspect of surveying that is important to the issue of risk management. It is the use of effective markers along the underground line route. With the virtual guarantee of future digging in or adjacent to the underground line, the utility should certainly consider their role in warning the public of the dangers surrounding these high voltage underground transmission lines.

ACQUIRING ACCESS TO THE LINE

Access issues for an underground line are yet another area that may differ from a standard overhead line project. Obviously, every overhead line requires access to its towers and poles. Some utilities acquire access at all points along the line, while others don't.

With an underground line, full and open access is mandatory along the full length of the line. There are a number of things like landscaping berms, plantings and storm water detention ponds that are often acceptable within overhead line right of way, but may be totally unacceptable with underground lines. Also, access for temporary construction easements may be required for initial construction work on an underground line, as is commonly done with pipeline projects.

What may be overlooked with underground electric transmission lines are the potential future needs related to repair or replacement projects. There is the possibility that, particularly in urban areas, new development will be built next to the line which may not accommodate an area for future repair staging or equipment placement. This lack of space for future construction work may be made even more problematic if a narrower right of way width has been acquired. For example, if the acquired right of way is 25', and a 6' duct bank is constructed along the centerline of the right of way, then upon excavation, there will be a maximum of only 9.5' on either side of the line for equipment and working space.

IN SUMMARY

The decision to construct a line underground is not likely to be made after considering any one particular issue. There are a multitude of topics to be considered, including engineering, budgets, regulatory issues, public perception and input, environmental... and the list goes on. An informed and experienced right of way agent can provide enormous value to the project—value that goes far beyond just getting a signed document.

The reality is that the demand for underground projects will continue to rise, regardless of the challenges and obstacles. However, with input and perspective from an informed right of way agent, many of the potential problems and issues can be mitigated or avoided outright. As we gain more expertise and share our project challenges and successes, we can begin to establish best practices and create a win-win for the utilities, agents and landowners alike. ⚡