When Cables Won’t Do

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More and more, grid designers encounter situations where neither overhead lines nor buried cables are suitable for high-voltage transmission. Therefore, they are turning to an emerging option: gas-insulated lines.

Overhead transmission lines are a safety hazard near airports. A dual GIL system buried in a narrow trench is a possible solution.

Text: Eric Johnson, Illustration: Leandro Castelao
Pylons – these high-voltage highways grid landscapes around the globe. Marching across mountains, cutting across prairies, their stiff, robot-like figures guide massive loads of power from one place to another. So ubiquitous as to be iconic, pylons are the face to the public of the electricity industry. Nonetheless, there are many places pylons cannot go. And sometimes, even their most common stand-in – underground cables – are also problematic. Take, for example, the main artery of a hydropower plant, the high-voltage line between the generating cavern and the external switchgear. Or the intra- and interconnections of gas-insulated switchgear (GIS). Or, for that matter, anywhere high-voltage power must share confined space with people and valuable equipment. Siemens has a homegrown solution: the gas-insulated transmission line (GIL). Since its 1974 debut at a southwest German hydropower plant, the high-voltage line between the generating cavern and the external switchgear. The massive metal content in GILs absorbs much more heat than an XLPE line, allowing it to maintain lower operating temperatures, even linked polyethylene, a plastic compound. The massive metal content in GILs absorbs much more heat than an XLPE line, allowing it to maintain lower operating temperatures, even in overload mode. Thanks again to its massive, robust construction, a GIL is also much less prone to internal-arc faults and short circuits, and like overhead lines, it is amenable to automatic reclosure. Nonflammability was among the key considerations in several recent hydropower installations. In Kaprun, Austria, for instance, a 150-meter GIL system is in action, and a 650-meter line consisting of 13 kilometers of GIL tubes is being built in China’s Sichuan Province. In both cases, power is piped from the generators deep down in the mountain up to the top, where the pylons pass it on to end users. Using a nonflammable GIL rather than a conventional cable that could catch fire has two major design benefits: The tunnel no longer requires fire barriers, which block convection and therefore make cooking more...
GAS-Insulated Lines

More information about GIL can be found in this book by Siemens engineer Hermann Koch, commissioned by the Institute of Electrical and Electronics Engineers (IEEE):


GIL Specifications

- Max transmission capacity per system: 3,700 MVA
- Max voltage: up to 550 kV
- Max transmission distance without compensation of reactive power: up to 70 km
- Performance remains constant over time; no aging
- Fireproof
- High overload capacity
- High short-circuit withstand capacity
- Autoreclosure functionality
- Lowest electromagnetic field

A comparison of the magnetic fields for different high-voltage transmission systems for a 400-kV double system at 2 x 1,000 MVA load.

Cable
Overhead line
GIL

0 5 10 15 20 25 30
Magnetic Lux Density B [μT]

So Which Is It?

It is impossible to say precisely which feature is most important. The weighting of reasons, Poehler says, varies from one customer to the next. “And GIL won’t be for everybody,” he adds. “But it’s a transmission technology that is going to grow and grow.” Not into a replacement for the pylon, but enough so that decision makers really need to know about it.


Further Information

www.siemens.com/energy/hv-gil

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