



Gas-Insulated Transmission Line (GIL)

The superior solution for special requirements

Power Transmission and Distribution

SIEMENS

GIL – Power transmission technology for the 245 to 550 kV range



420 kV GIL system at Elstree, London, Great Britain, commissioned in 2004



300 kV GIL for Palexpo in Geneva (Switzerland), commissioned in 2001, the world's first GIL with gas mixture insulation

Flexibility à la GIL: above or below ground

Our customers are choosing gas-insulated lines of the second generation for high-power applications where environmental or structural considerations rule out the use of overhead transmission lines. The outstanding features of a GIL system are its high transmission capacity, much better electromagnetic compatibility (EMC) than any other transmission system and flexible installation options – our GIL can be laid above ground, installed in tunnels or buried straight into the soil, depending on individual requirements.

420 kV GIL system in Germany's Wehr power plant, commissioned in 1975



GIL installation in Wehr power plant



Basic GIL configuration



Connecting the GIL to the overhead transmission network



Superior technology and excellent know-how assure quality and reliability

Our GIL systems are based on the successful SF₆ tubular conductor technology (which has been around for several decades) but are filled with an insulating gas mixture of nitrogen and SF₆. An automated orbital welding procedure accompanied by special ultrasonic inspection techniques during installation ensure the gas-tightness of the aluminium tubes. The encapsulated design automatically affords our GIL systems protection against the external environment. In addition, GIL systems provide a long service life thanks to the simple and maintenance-free design, as well as to the use of high-quality materials. We have also solved the issue of recycling: the GIL tubular system with all its components and the insulating gas mixture are 100% recyclable. These factors help to minimize life-cycle costs.

Impressive practical record: a GIL system in Germany's Wehr power plant

We installed a GIL section in a tunnel in the Wehr pumped-storage power station in the Black Forest as long ago as 1975. With a phase length of almost 4 kilometers this system is still one of the largest anywhere in the world. An inspection after 30 years of service showed that all components are still nonetheless in top condition, and assured the customer that this GIL will provide many more years of reliable operation.

Flexible grid connections – optimum grid integration

GIL systems consist of just a few basic modular elements and are suited to any kind of route, for instance through built-up areas or river crossings. The actual installation of GILs makes use of sophisticated laying techniques (borrowed from the pipeline

construction industry), so completion duration can be kept to a minimum. Technically too, our GIL systems are remarkably flexible because of their outstanding design features. Thanks to their high transmission capacity GILs can be linked directly into the overhead power line system – without the need for compensation measures of any kind. Our GILs can also be directly linked to substations or transformers and integrated into existing protection systems.

Outstanding safety in operation

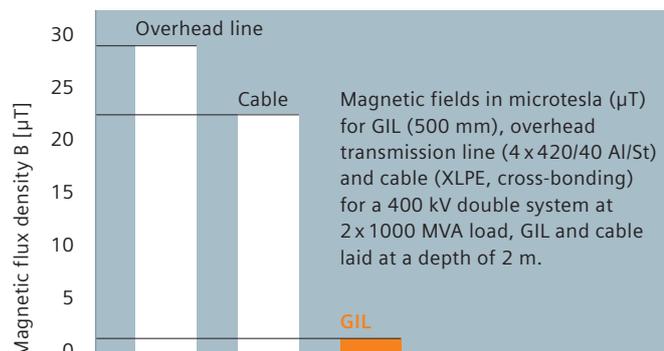
GIL systems from Siemens live up to their reputation not just with their technical specifications but also by showing excellent operational safety. GIL systems are immune to the sort of hazards that can affect other systems. Their very design renders them absolutely safe to touch in operation as well as fireproof and explosion-proof. These systems are totally gas-tight and so retain their superior operating properties throughout their service life. Moreover, GILs are constructed as separate sealed gas-tight compartments up to 1200 m in length.

Excellent electromagnetic compatibility enables flexible route planning

The construction of our GILs results in much smaller electromagnetic fields than with conventional power transmission systems. This makes them suitable for completely new routing options and provides maximum flexibility for the planning of transmission networks in EMC-sensitive environments (such as all applications where magnetic fields have to be avoided). When used close to telecommunications equipment, hospitals, residential areas or flight monitoring systems and similar, Siemens GIL systems satisfy the most stringent magnetic flux density requirements, for example the Swiss limit of 1 μ T.



A comparison of the magnetic fields for different high-voltage transmission systems



GIL – Versatile applicability

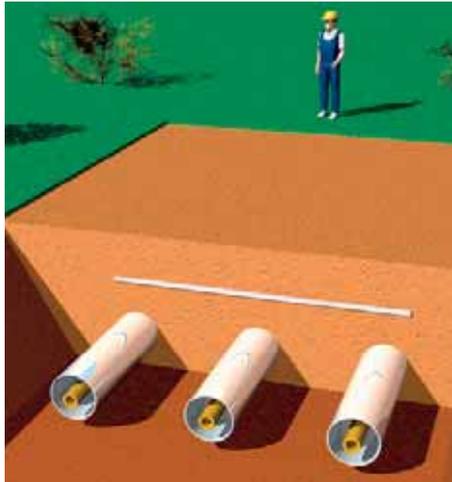


300 kV GIL system (operating voltage 220 kV) for Palexpo in Geneva (Switzerland), commissioned in 2001

GIL arrangement in a tunnel



GIL arrangement for buried installation



Buried GIL installation

Equipped with passive and active corrosion protection, GIL systems can also be laid straight into the soil as an environmentally sustainable solution causing only negligible disruption to the local landscape. With this option, magnetic fields measured at the surface are minimal. Once installation is complete, the land can be returned to agricultural use with minor restrictions.

Tunnel installation

Tunnels made up of prefabricated structural elements are another quick and easy method of GIL installation. The tunnel elements are assembled in a trench, which is then backfilled to prevent any long-term disfiguring of the local landscape. The GIL is installed once the tunnel has been completed.

With this method of installation the land above the tunnel can be fully restored to agricultural use. Only a negligible amount of heat is dissipated to the soil from the GIL.

Above ground installation

GIL installation above ground is another trouble-free option, even for extreme environmental conditions. GILs are unaffected by high ambient temperatures, intensive solar radiation or severe atmospheric pollution (such as dust, sand or moisture). Corrosion protection is not always strictly necessary.

Example of buried GIL installation



245 kV GIL system at Cairo North, Egypt, commissioned in 2004



420 kV GIL system at Elstree, London, Great Britain, commissioned in 2004

550 kV GIL system at Sai Noi, Bangkok, Thailand, commissioned in 2002



The **answers** to power transmission challenges – past, present and future

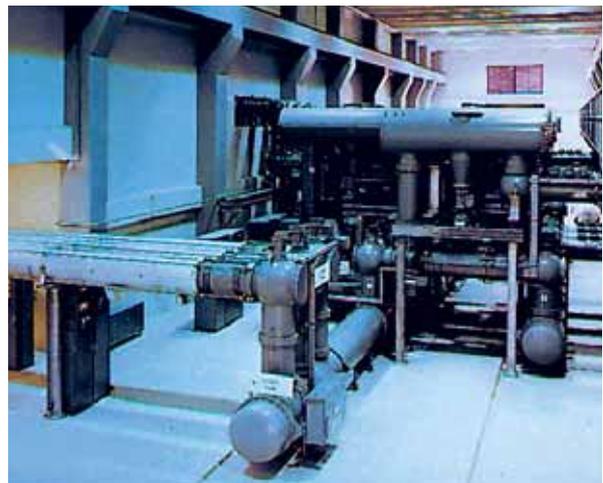


FACTS substation, Germany, 2005

Turnkey substation supplied by Siemens to stabilize power transmission in southern China, 2004



GIL connection to a gas-insulated substation, Germany, 1975



Siemens – a strong international partner

Our customers tend to think in terms of two generations for return on investment in power transmission projects. So it's perfectly logical for them to choose a partner who will still be there tomorrow. We not only have decades of success behind us in this sector; we also have the human and financial resources to handle projects of any magnitude, both now and in future. Moreover, our research and development activities are capable of providing crucial incentives for enhanced reliability and cost effectiveness in power transmission.

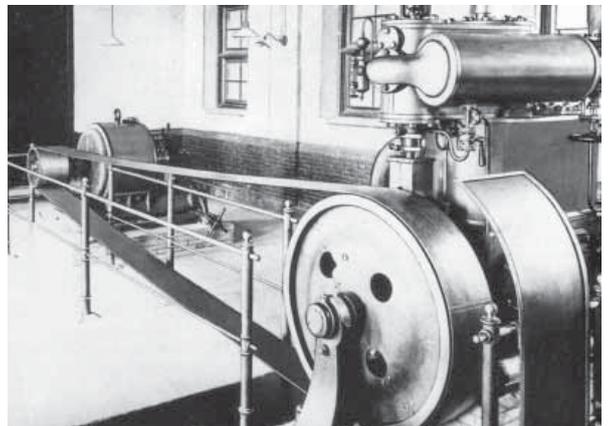
Confidence is based on understanding and experience

Siemens Power Transmission and Distribution has been one of the world's leading all-round suppliers of infrastructure equipment in its market sector since the second half of the 19th century. A comprehensive product portfolio – ranging from generator transformers, substations, FACTS and HVDC-systems to gas-insulated transmission lines – is proof of our expertise. Coupled with decades of experience it allows us to offer our customers optimum solutions for all their requirements, including first-rate technical services and reliability in operation. Our particular advantage: Siemens supplies everything from a single source without interface problems, on schedule and – above all – on budget.

Innovative gas-insulated outdoor substation, Spain, 2005



Company founder Werner von Siemens, 1887



Power generation equipment 1899-style in Beijing, built by Siemens&Halske

Making advanced technology the standard

A power transmission system is more than just a combination of separate parts. All systems have their own special requirements; they all call for specially engineered components. For Siemens, a leading turn-key supplier, this is an immutable part of the job: designing power transmission and distribution systems that extend all the way from the power plant to the consumer, modifying components for local conditions, coordinating projects. All our actions are directed toward a standard target: creating special solutions to solve special requirements.

GIL – Technical data	
Rated voltage	245 to 550 kV
Rated current	up to 4000 A
Rated short-time current	63 kA/3s
Insulating gas	N ₂ and SF ₆ gas mixture
System length	from 100 m to 100 km



Cross-section through a GIL of the 2nd generation showing conductor tube, enclosure, paired post insulators and integrated particle trap

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