

## High power underground transmission lines

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The latest state of knowledge and research about high power gas-insulated underground transmission lines as well as the latest technical improvements are presented in this contribution. An economical comparison of power cable systems and gas-insulated underground transmission lines is presented and referred to the ongoing CIGRE JWG B3/B1.27 "Factors for investment decision GIL vs. Cables for AC Transmission".

At first, the technology of high power underground transmission lines is presented and the technical performance compared to power cable systems is shown. The main benefits are a very high power transmission capability, a low capacitance, lower resistive losses compared to power cables and overhead lines, low electromagnetic fields, no ageing phenomena of the insulating system and a maintenance free design. High power underground transmission lines are fire resistant and do not contribute to fire load.

The different installation options of power transmission lines are presented with regard to realized projects: The longest directly buried installation of two systems with max. 3100 A transmission current with a length of 5400 m (single phase) and 420 kV AC was realized in Kelsterbach in 2010 (Fig.1 (a)). An outdoor aboveground installation on steel structures is possible at sites without public accessibility, i.e. substations (Elstree, Great Britain, 2004, Fig. 1 (b)). In Munich, a 420 kV tunnel installation with a tunnel length of 540 m length was built with a low bending radius of the power transmission line of 400 m only for the first time in 2013 (Fig.1 (c)).

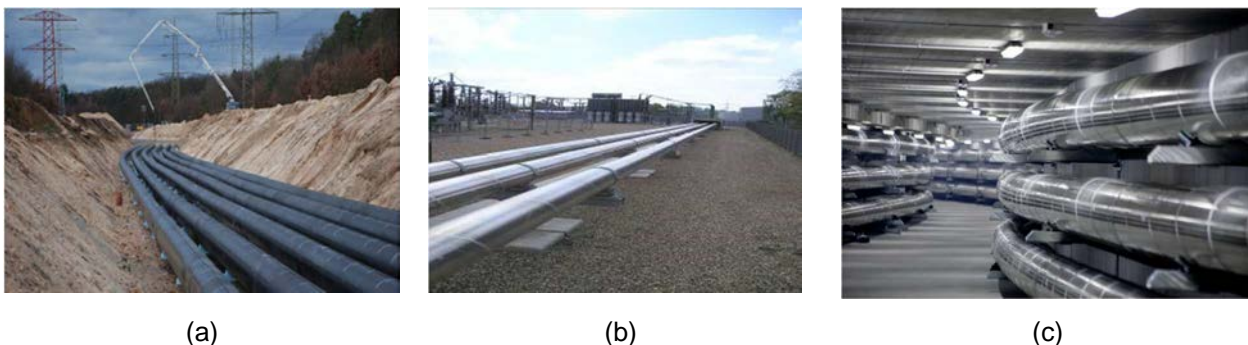


Fig. 1: Installation options of gas-insulated power transmission lines:  
 (a) Directly buried (Kelsterbach, Germany, 2010),  
 (b) Outdoor aboveground installation (Elstree, Great Britain, 2004),  
 (c) Tunnel Installation (Munich, Germany, 2013)

The ongoing research and development activities on advanced high power underground transmission technology are presented. These ongoing activities concentrate on the development of new insulators, improvements on the construction (i.e. welding technology) and new concepts for a fast and cost optimized directly buried power transmission lines over long distances with respect to standardization of this technology, time and cost optimized installation concepts for the new solution for direct and alternating current transmission via high power underground transmission lines.

The expected benefit of the improved technology is worked out. Finally, an economical evaluation of compact transmission lines in function of transmission power, transmission length, route planning and different installation options is presented.

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