

## High Power Underground Transmission Lines

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### ABSTRACT

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 paper. An economical comparison of power cable systems and gas-insulated underground transmission lines is presented and referred to the ongoing Cigré JWG B3/B1.27.

The technology 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.

### KEYWORDS

GIL, Gas-insulated lines, high power transmission,

### 1 INTRODUCTION

Gas-insulated transmission lines (GIL) is an established high-voltage technology used when environmental or structural considerations restrict the use of overhead transmission lines [1]. Up to now, more than 750 km of GIL tubes (single phase) are in service all over the world. GIL offers several advantages for high capacity power transmission as low transmission losses, low capacitive load, negligible electromagnetic fields, no thermal or electrical ageing, a high reliability and a high level of personal safety. High power ratings enables to go directly in series with overhead transmission lines and an operation like an overhead transmission line with the so-

called auto-reclosure function is practicable [1]. GIL consists of two concentric aluminum tubes. The inner conductor is resting on cast resin insulators, which center it within the outer enclosure (**figure 1**). This enclosure is formed by a sturdy aluminum tube, which provides a solid mechanical and electrotechnical containment for the system.

To meet up-to-date environmental and technical aspects GIL are filled with an insulating gas mixture of mainly nitrogen and a smaller percentage of SF<sub>6</sub> (sulphur hexafluoride).



**Fig. 1: Basic design of GIL, consisting of two concentric aluminum tubes and cast resin insulators.**

The installation of GIL can be realized in all common laying arrangements (horizontal, vertical or inclined laying, tunnel installation as well as directly-buried installation [2]). The installation options are visualized in **figure 2**.



**Fig. 2: Installation of GIL: (a) Directly-buried; (b) inclined tunnel; (c) tunnel with bending radius**