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Optimized gas-insulated transmission line

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Résumé

La technologie des lignes à isolation gazeuses (LIG) est basée sur celle des postes blindés à isolation gazeuse. Cette technologie est aujourd'hui largement éprouvée. Grâce à leurs caractéristiques physiques intrinsèques, les LIG pourraient devenir une alternative aux lignes aériennes sur des longueurs pouvant atteindre la centaine de kilomètres. Les récents progrès en matière d'optimisation de la conception et le développement de méthodes de pose adaptées rendent ce produit de plus en plus attractif dans les cas où les lignes aériennes ne sont pas acceptées. Toutefois, malgré les progrès réalisés, le rapport des coûts entre une LIG et la ligne aérienne équivalente reste encore élevé.

Abstract

Gas-insulated line (GIL) technology is based on gas-insulated switchgear technology. That technology has today demonstrated its merits. The intrinsic physical characteristics of the GIL could make them an alternative to overhead lines over distances up to a hundred kilometres. Recent advances in design optimisation and the development of specific installation methods have made this product more and more attractive when overhead lines are not acceptable. However, despite the progress made, the costs for a GIL still remain higher than for an equivalent overhead line.

1. How electricity is transmitted

Over long distances, EHV overhead lines are the cheapest means of electricity transmission. But such lines are increasingly contested on environmental grounds due to their unacceptable appearance or noise, or to insufficient space in urban areas. With synthetic insulation cables, transmission and distribution links may be buried in the ground. Unfortunately, their low unitary transmission capacity as well as their short critical length limit their application to links of a few kilometres at very high voltages [1]. Gas-insulated lines (GIL) seem to be an alternative for the transmission of electricity. Their technology is based on that of GIS. Their intrinsic physical characteristics (low linear capacity and high unitary transmission capacity) make them apt to transmit electricity over long distances, up to a hundred kilometres. GIL may be installed outdoors on frameworks or in ducts, or underground in tunnels or directly buried in the ground. In order to make this product really attractive for power transmission, research is being carried out to optimise it and reduce the cost of investment, which is still too high compared to that of overhead lines.

2. An already well-proven technology

2.1 From the substation to the line

GIS technology has been under development since the 1960s when the properties of insulating gas SF_6 [2] were revealed. The excellent performance of this gas in electrical insulation, as well as the extinction of arcing in circuit-breakers revolutionised the field of switchgear for power grids. Since then, many GIS have been installed around the world. Their compactness makes them easy to install in urban areas, even right in the heart of the greatest cities.

GIS consist of active elements such as circuit-breakers and disconnectors that are intended to protect the grid, as well as passive elements called busbars which are insulated electrical links between elements in the substation itself or between lines and the substation. When the length of busbars exceeds 500 metres, they take the name of gas-insulated lines [3].