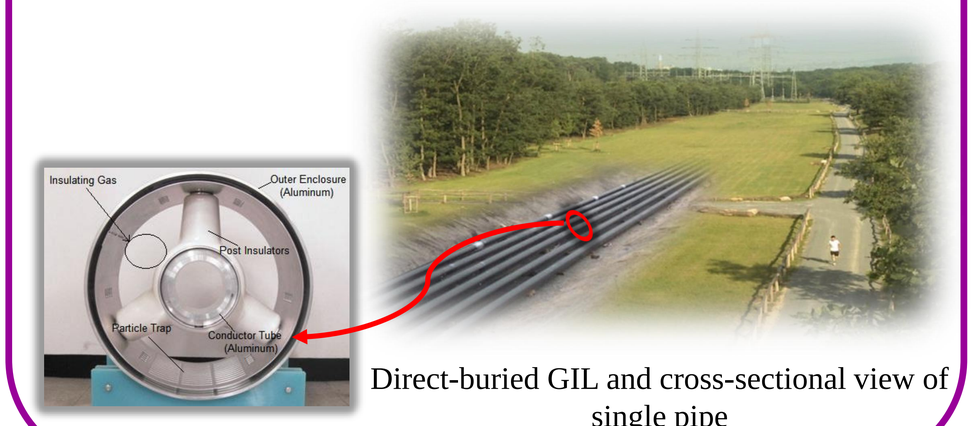
The University of Manchester

Gas Insulated Transmission Line (GIL): Alternative High-Power Transmission Technology

What is GIL ?

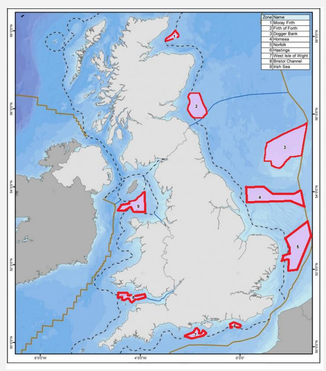
Gas insulated transmission lines (GIL) are reliable and flexible alternative to overhead lines (OHL)



Direct-buried GIL and cross-sectional view of single pipe

Project Background

It is already presented to use clean energy using renewable resources to tackle the greenhouse gas emissions. However, the power plant using renewable energy is often constructed far from the loads.
Overhead line (OHL) was widely used for long-distance power transfer, but this transmission system faces difficulty in securing appropriate land to construct by its environmental issues



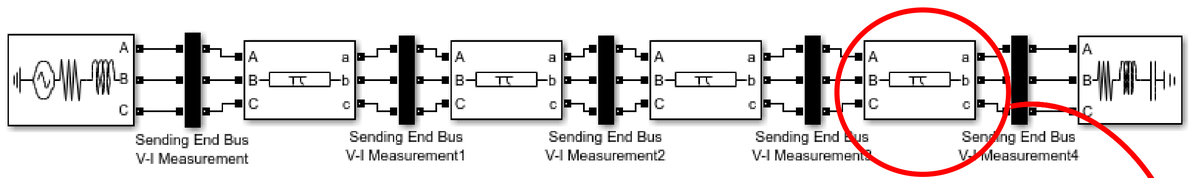
UK windfarm zones

An alternative is gas insulated transmission line (GIL). There are advantages that proves GIL can be an alternative transmission technology.
•High reliability and long operational lifetime
•Low electromagnetic field
•High level of personal safety
•Low transmission losses and capacitive load

Aims and Objectives

The aim of this project is to evaluate gas insulated transmission line by comparing with overhead lines (OHL) and XLPE cable using Simulink
Objectives:
•Modelling GIL using Simulink after calculating line constant by PSCAD
•Simulating GIL in different conditions
•Cost comparison between GIL, OHL, and XLPE cable
•Electrical power transfer capability comparison with overhead line and XLPE cable

GIL simulation using Simulink



Simulation model for 200 km GIL transmission line using Simulink

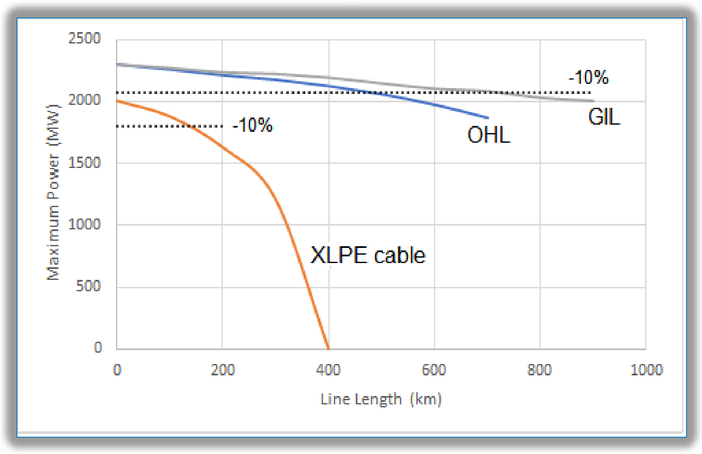
Three-phase Pi-Model

Cross-sectional view of GIL and its geometric dimension
A section of three-phase pi-model represents 50 km of GIL

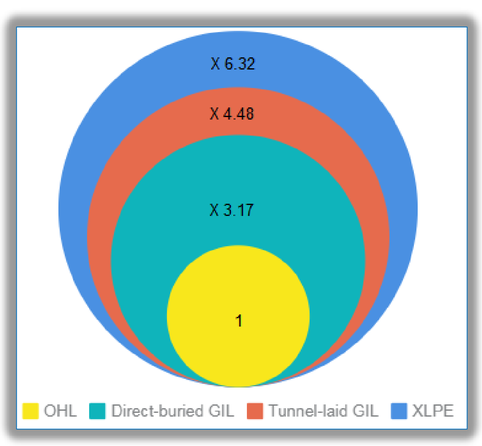
Simulation Results for GIL

the GIL can be operated for the offshore wind farm transmission line (300km) without reactive compensation on the conditions at:
•Low loading conditions from 20% to 60% at lagging power factor 0.8
•From 0.95 lagging power factor to 0.9 leading power factor at 100% loading condition

Comparison with OHL and XLPE cable



Maximum real power transfer capability for GIL, OHL, and XLPE cable as 750, 500, and 150 km respectively by simulation using Simulink



For 40 years lifetime of transmission technologies
•Direct-buried GIL is 3.17 times more expensive than OHL
•Tunnel-laid GIL is 4.48 times more expensive
•XLPE cable is 6.32 times more expensive

Conclusion

The electrical power transfer capability of GIL is outstanding in comparison to XLPE cable and providing similar power transmission with overhead lines. In addition, it hardly impacts on landscape (that main issue of overhead lines brings about necessity of an alternative power transmission line) since low electromagnetic field. The lifetime costs of 40 years for direct-buried is 3.17 times more expensive than overhead lines.

The GIL is worthy of notice for an alternative to overhead line for long-distance high power transmission lines despite its expensive cost since its guaranteed reliability (GIL can avoid unexpected costs) and outstanding power transfer capability.

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