Project: Electrical Treeing And Tracking In Polymeric Interfaces In Cable Joints In DC Networks

Key focus: DC networks, electrical tree phenomenon, reliability, power quality

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Background

High voltage systems are ubiquitous in the modern world and are now an integral part of all electricity power networks. They are critical in the transmission of renewable energy and intra-system connections. The use of high voltage systems is now becoming more prevalent in mass-transit systems and large electric vehicles, notably ships and aircraft. Recently the UK government announced a plan for 30% of electricity production to come from offshore windfarms by 2030 [1], which will also increase dependence on HVDC sub- sea cables and place additional importance on their reliability. Figure 1 illustrates the underwater cables connection from the offshore farms to the land.

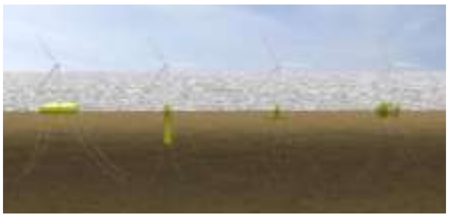

Figure 1: Offshore wind farms with under- water cables [2].

Project description

The project will investigate a major ageing effect in DC cable insulation known as electrical tree growth. HVDC links are becoming more important both for aspirational intercontinental networks, and for point-to-point links. Operating voltages have now reached 800 kV. The electricity produced by offshore wind farms needs to be transported to land by HVDC underwater cables for further distribution. In addition, this type of cable will be used to transmit energy and to connect countries around Europe. Understanding of electrical tree growth in AC networks is relatively well understood, however, there is minimal experience of DC tree growth. This project will improve knowledge in this key area and explore possible solutions for asset management with controlled power quality.

Research outcomes/impact

A key mechanism for failure of high voltage polymeric cables and their fittings (joints and terminations) is electrical tree growth. Such degradation takes the form of bifurcated channels which resemble botanical trees. There is little work published concerning the interfaces and the vulnerability of these areas in joints to the growth of such trees and tracks. In particular, whilst the role of transient power quality in DC ageing is wellestablished, but not quantified, the role of steady state power quality is not understood. Similarly the use of partial discharge analysis for understanding progression of AC tree growth is becoming better understood, but that is not the case for DC tree growth. In Figure 2, DC tree growth can be observed, as obtained by the researchers in the HV laboratory in the University of Manchester.

Figure 2: A tree growth under DC voltage [3].

<u>References</u>

[1] UK GOV, "Offshore wind energy revolution to provide a third of all UK electricity by 2030," 2020.

[2] O. R. E. Catapult and C. E. Scotland, "Macroeconomic benefits of floating off- shore wind in the UK," 2020.

[3] I. Iddrissu, H. Zheng, and S. M. Row- land, "Electrical tree growth in epoxy resin under dc voltages," IEEE International Conference on Dielectrics (ICD), pp. 820–823, 2016.

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