Long power cables: exposing incipient faults and optimizing performance using extra-long fiber optic distributed temperature monitoring.

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Monitoring the temperature of power cables continuously all along their length provides condition monitoring and the opportunity for cable performance optimization using dynamic cable rating. However critical infrastructures being built or planned for the coming years, such as distant offshore wind farms (more than 60 km from the coast), ambitious interconnector projects and the growing preference for undergrounding require high performance, efficient asset management with reliable condition monitoring, whilst their length challenges the distance limits of existing temperature monitoring techniques.

At the same time monitoring the temperature of cables is becoming more critical due to the potential risks from:

- Reducing conductor diameter in order to lower the cost and the weight of long submarine cables.
- Exposure of buried wind farm array and export cables which could compromise the environment in addition to threatening their integrity due to absence of physical support.
- Changing seabed conditions which will affect the thermal condition of the cables and accelerate the cable ageing process.
- Dropped items and anchor drag in the often shallow waters where wind farms are built.

Further, floating wind farm cables will face challenges similar to those experienced by subsea power umbilicals used in offshore oil & gas production, with the potential for unseen abrasion at touchdown points and thermal bottlenecks under areas with foam protection or under mattresses/rock dumps.

Distributed temperature monitoring using fiber optic-based distributed sensing contributes to the safe and efficient operation of many onshore transmission cables and subsea cables. Extending these benefits cost effectively to longer array, export, interconnector and onshore transmission cables can be met using Brillouin-based sensing, which has demonstrated distributed sensing capabilities over more than 300 km from one interrogator, while maintaining temperature measurement performance in terms of both spatial and temperature resolution.

This papers, referring to proprietary research and supported by several Case Studies shows how Brillouin distributed monitoring can be configured from a single interrogator or using remote switch operation, amplifiers and repeaters to provide cost effective temperature monitoring of long cables, on and offshore. Case studies includes the monitoring of an interconnector, long onshore cable and wind farm export cables such Walney Offshore Windfarm 1 & 2 (>50 km), Greater Gabbard Offshore Windfarm (> 65 km), London Array Offshore Windfarm (> 70 km).

Key words: DTS, cable temperature, dynamic cable rating, condition monitor, cable performance , subsea cable, buried cable, array cable, export cable, interconnector