MONITORING OF POWER CABLES USING DISTRIBUTED RAYLEIGH SENSING, DRS

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ABSTRACT

The availability of export and inter-array power cables directly impacts the productivity of any offshore wind farm. A range of events caused by environmental and third-party involvement are known to cause failure in these cables and so suspend production from the asset, or put future export at risk [1], [2].

Current widely used monitoring techniques limit the type of events that are detectable (e.g. thermal over-rating with fibre optic Distributed Temperature Sensing) and others which are costly/occur infrequently (surveying), these all combine to leave a capability gap, increasing the risk to production [3]. There is potential for Distributed Rayleigh Sensing (DRS) to extend the capability of on-line monitoring systems using existing fibre, in or near these cables, to detect events of concern prior to cable failure and derive data about the general condition of the cable, leading to a deeper and ongoing understanding of asset integrity and risk profile..

KEYWORDS

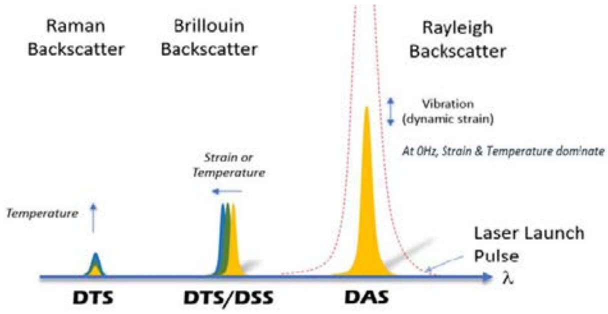
OSWF, Offshore Wind Farm, FLW, Floating Windfarms, Online Cable Monitoring, Distributed Fibre Optic Sensing

INTRODUCTION

Distributed Rayleigh Sensing (DRS)

Rayleigh backscatter is used in C-OTDR systems and is commonly associated with acoustic, vibrational or dynamic strain (Distributed Acoustic Sensing: DAS). In a Quantitative system (Q-DAS) these vibrational components provide a measure of the path length difference in the interferometer that is at the heart of the system. The measure of this path length difference is affected by strain (dynamically this is acoustics) and by temperature. These components can be resolved by system design. The use of DAS as nomenclature is therefore something of a misnomer and Distributed Rayleigh Sensing (DRS) is a more encompassing alternative.

Continuous monitoring of a stabilized DC component allows static strain and static temperature change to be monitored in each channel from a given nominal start point – at high resolution, in real time [4]



METHODOLOGY

Data was collected from five UK Offshore Windfarms (OSWFs) over the course of a three-year period as part of the H2020 funded project. In most instances, with the support of an UK local service company. In this data collection a single interrogator unit (IU, ODH-F) was used in the deployed system, capable of outputting either intensity data over a range of 50km or quantitative data over a range of 10km.

At each site the IU equipment was connected to a dark single-mode fibre core within the export power cable. The system was attached to a dark fibre on either an export power cable leading to an offshore station, in same instance up to fibre length of 47km long, data was acquired in an intensity mode with a spatial resolution of 10.2m and a sampling rate of 2kHz.

Shorter inter-array cables were linked successively to produce cable lengths of the order of 5km, sampled with a spatial resolution of 10.2m and a sample rate of 20kHz. Minimal supervision of the system was required with weekly checks to confirm its operation.

RESULTS

Presentation of data collected and analysed from subsea power cable, demonstrating a range of features of concern highlighted by DRS.

- Health/Forensic condition of the cables are shown here in that wave action indicates burial depth – refer to Figure 1.