

Long distance DTS measurement for offshore wind

1 Project description

As offshore windfarms are getting larger, they are also being moved further out to sea, resulting in longer export cable now in excess of 200km. Similarly, interconnectors are now transporting energy over few hundreds to thousands of kilometres. As much as possible sensing should be provided over the full distance.

Back in 2017, EOSS (then Omnisens) installed the first long distance Brillouin Optical Time Domain Analyser (BOTDA) based on measurements from both sides of long export cable using optical amplification at the loop distal end to handle the optical budget.

The first project to benefit from this new technology was the Cluster Westlich Adlergrund (CWA) in the Baltic Sea. Three exports cables, each around 93km was measured with the scheme, and performances mid-cable were much better than any other single-end based methods [1].

The method was then deployed on the Hornsea 1 windfarm offshore UK. Featuring 438km offshore cable length, 117km land section as well as 275km interlink connectors, the more than 580km are totally monitored by a total of four distributed temperature sensing system (DTS) spread between onshore and offshore [2].

In 2020, the similar system was deployed along the Crete-Peloponnese interconnector, featuring a 180km long sensing distance (see figure) [3].

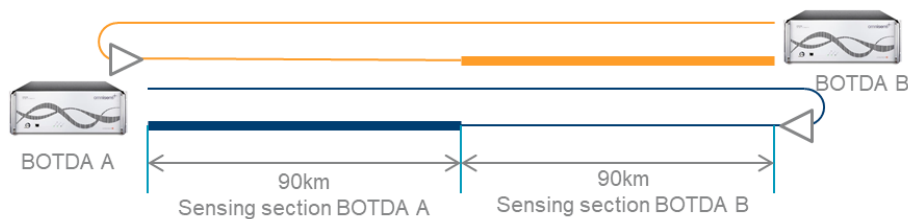


Figure 1: BOTDA scheme using optical amplification at distal end

Those results are now publicly available:

- [1] E. Rochat, Z. Robiani, A. Goy and R. Guericke, "Temperature monitoring and current rating computation for the Cluster Westlich Adlergrund," in *CIGRE*, 2022.
- [2] E. Rochat, A. Goy, F. Ravet, L. M. Domurath, M.-E. Vestarchi and H. Gorbani², "Complex cable temperature monitoring within the largest commissioned offshore wind farm," in *CIGRE*, 2022.
- [3] Omnisens, "Omnisens sets a new world record in long subsea cable monitoring," 27 08 2020. [Online]. Available: <https://www.linkedin.com/pulse/omnisens-sets-new-world-record-long-subsea-cable-monitoring-henry/?trackingId=3yBdts1%2FS%2BetZe%2BMdfcNsA%3D%3D>. [Accessed 07 01 2022].

The scheme has been further improved and is now being deployed over export cable length well in excess of 200km. No public information is available yet for those projects, unfortunately.

2 Award motivation

Distributed temperature sensing was dominated for a long time by Raman based DTS. Their range is limited to a few tens of kilometers (typically 30km, at max 60km but with downgraded performances), making it not suitable for long export cables.

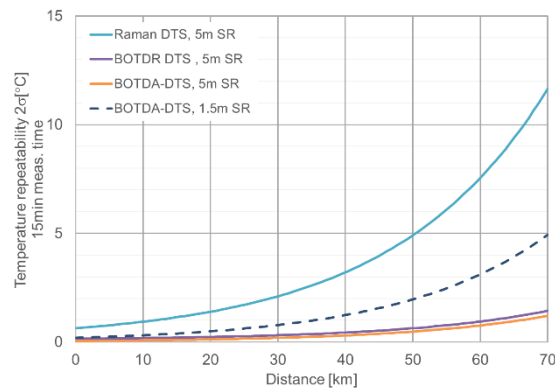


Figure 2: Raman, single end Brillouin and loop based Brillouin DTS comparison after [1]

Brillouin based DTS can handle much larger optical budget, thus longer distance. We found experimentally that BOTDA (the looped Brillouin DTS) was performing better than BOTDR (the single end Brillouin DTS). Thus, increasing the measurement distance becomes a matter of, on one side, maintaining the Brillouin probe level acceptable over the full length (thus the optical amplification at distal end) and, on the other side, improving the Brillouin pump by maximising optical power to the non-linear limit and introducing pump coding. As technology was improved, noise reduced, coding principle complexified, the advantage of BOTDA combined with amplification enabled EOSS to always be able to provide the longest field proven distance until today, and for almost the last 10 years.

In addition to constantly breaking distance record, EOSS, as shown in [2] successfully deployed the scheme at large scale in the field.

3 Miscellaneous

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People involved: EOSS/Omnisens teams (as per publication, Goy, Ravet, Robiani, Rochat) together with many field service engineers and software developers that made the schemes possible.