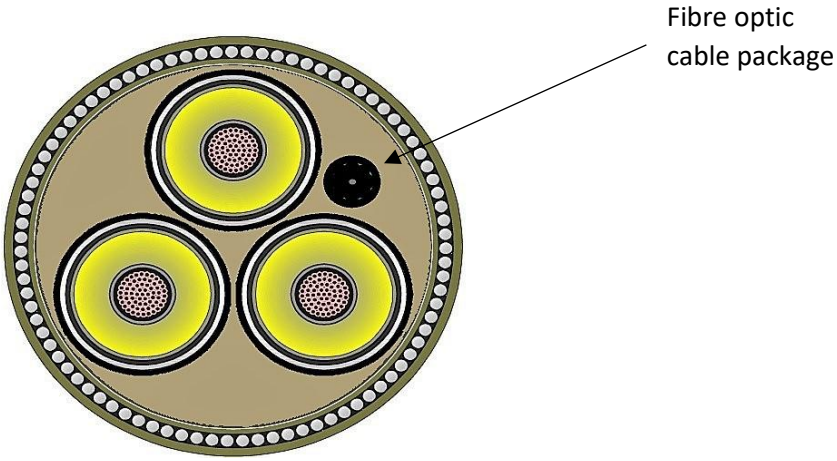
# Dataverse - DTS measurements in context

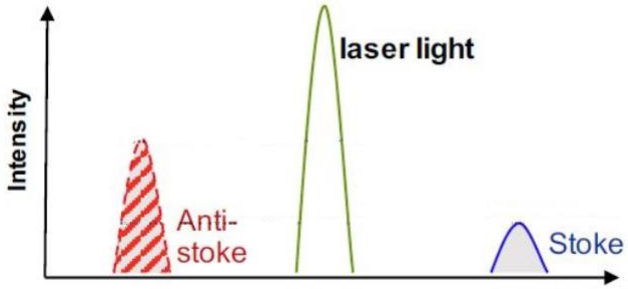
The use of fibre optic cable as a Distributed Temperature Sensor has been well recognised for many years with the technology employed in various industries such as power networks, oil & gas and construction.
It has found an easy adoption to offshore renewables installations as the design of the power cable has an integral optical fibre cable package which is mainly used for the SCADA system command and control of the offshore assets. Due to these cables having a high fibre count and redundancy, it inevitably led to the allocation of spare fibre for integrity monitoring using DTS.

DTS makes use of the fibre optic cable embedded within an export power cable and is capable of measuring temperature with a high degree of accuracy over significant distances. As fibre optics are insensitive to electromagnetic interference they are particularly useful for submarine cable power systems.

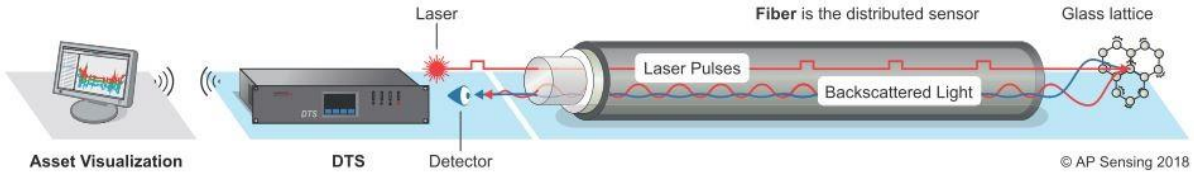



The fibre functions as a linear temperature sensor, which provides a continuous temperature profile along the entire length of the export cable.

The main measuring principles are based on detecting the back-scattering of light and utilises the Raman effect to measure temperature. An optical laser pulse sent through the fibre results in some scattered light reflecting back to the transmitting end, where it is analysed.
The intensity of the Raman scattering is a measure of the temperature along the fibre.
The Raman anti-Stokes signal changes its amplitude significantly with changing temperature, whilst the Raman Stokes signal remains relatively stable.

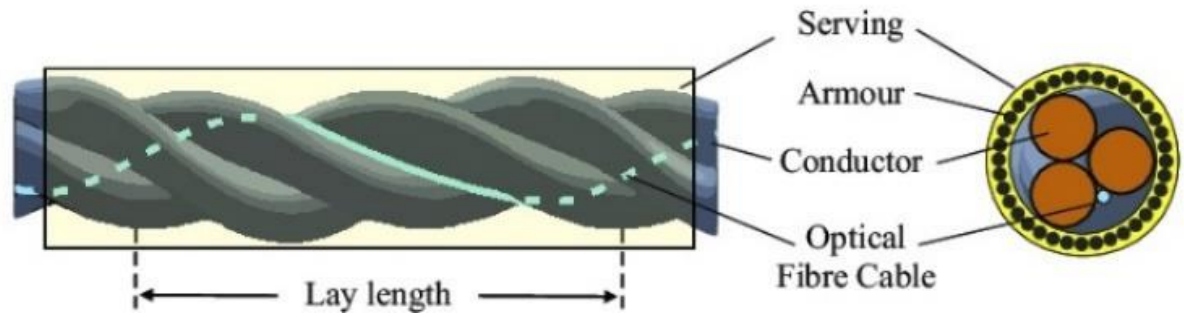


The position of the temperature reading is determined by measuring the arrival timing of the returning light pulse using Optical Time Domain Reflectometry. An Optical Time Domain Reflectometer (OTDR) operates as a one-dimensional radar allowing for a complete scan of the fibre, in this case, from only one end. The OTDR injects a short pulse of light into the fibre and analyses the backscatter and reflected signal.

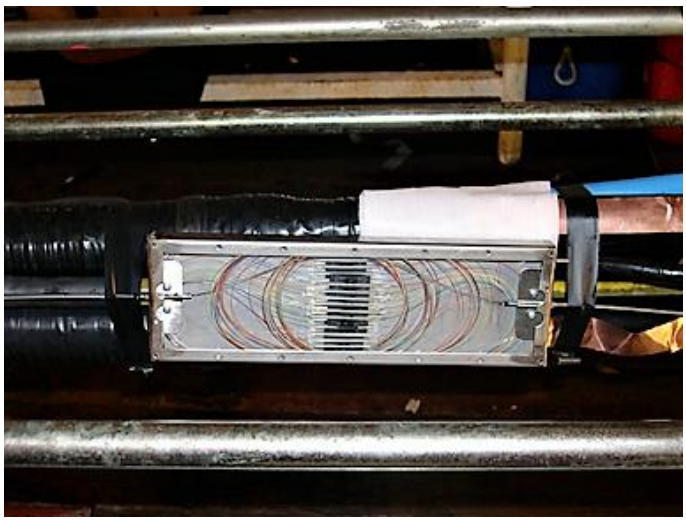



Whilst the fibre can display the temperature every metre along the cable, it should be borne in mind that the distances measured are fibre distances which will be greater than the actual terrestrial length of the cable due to the fibre over length built into the cable and

the lay length of the fibre cable within the power cable package:




and the additional fibre wound within the fibre splice boxes at any joint locations.



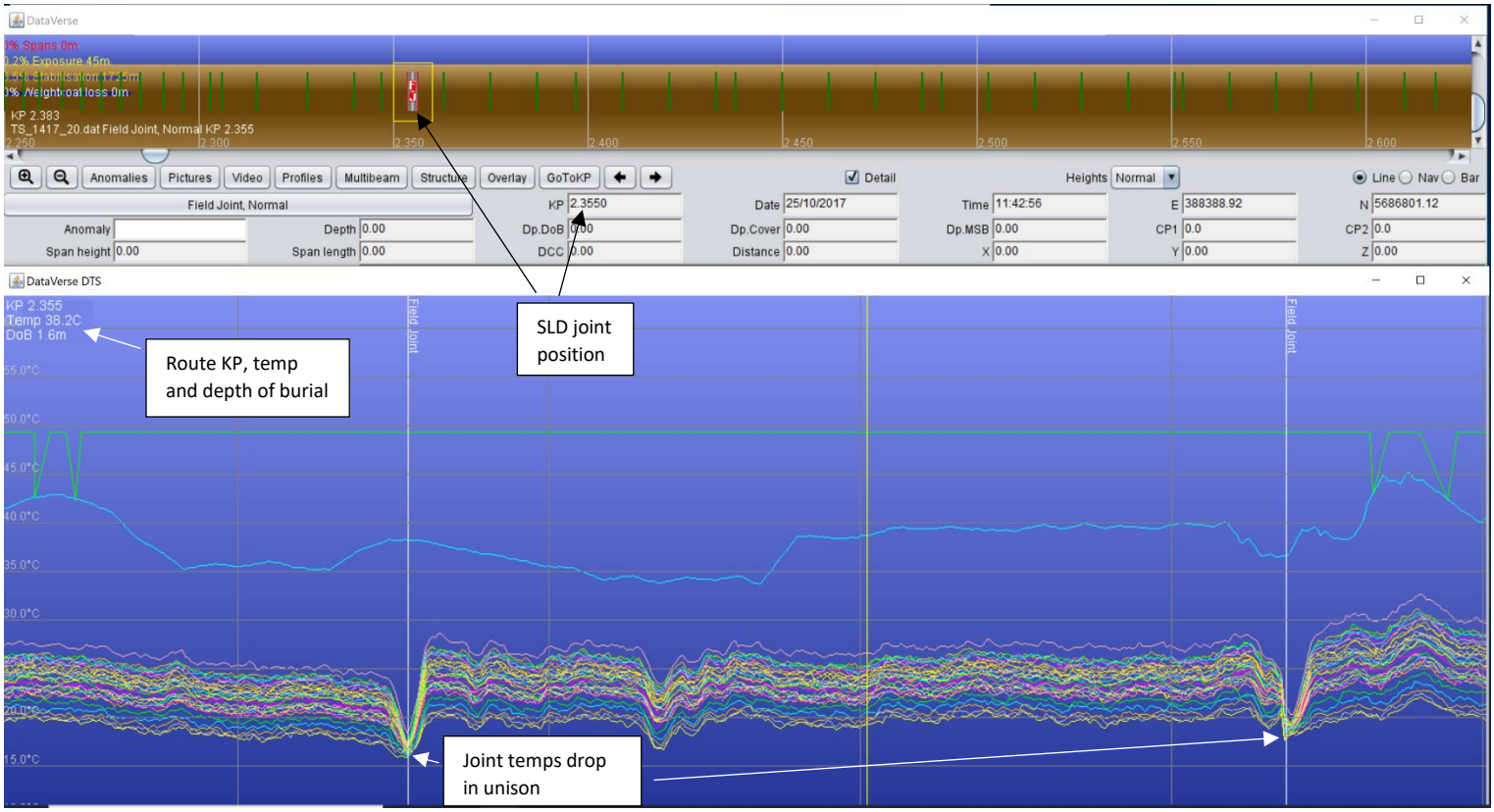
It is therefore necessary to take account of these length differences to precisely map the temperature profile to the terrestrial and subsea route of the cable.

Dataverse can import raw DTS temperature profiles from any DTS system and display these graphically in context of the terrestrial or submarine cable route. This provides more meaningful information to the asset engineer in determining what other aspects may be of interest along the route where a high temperature anomaly may be present.

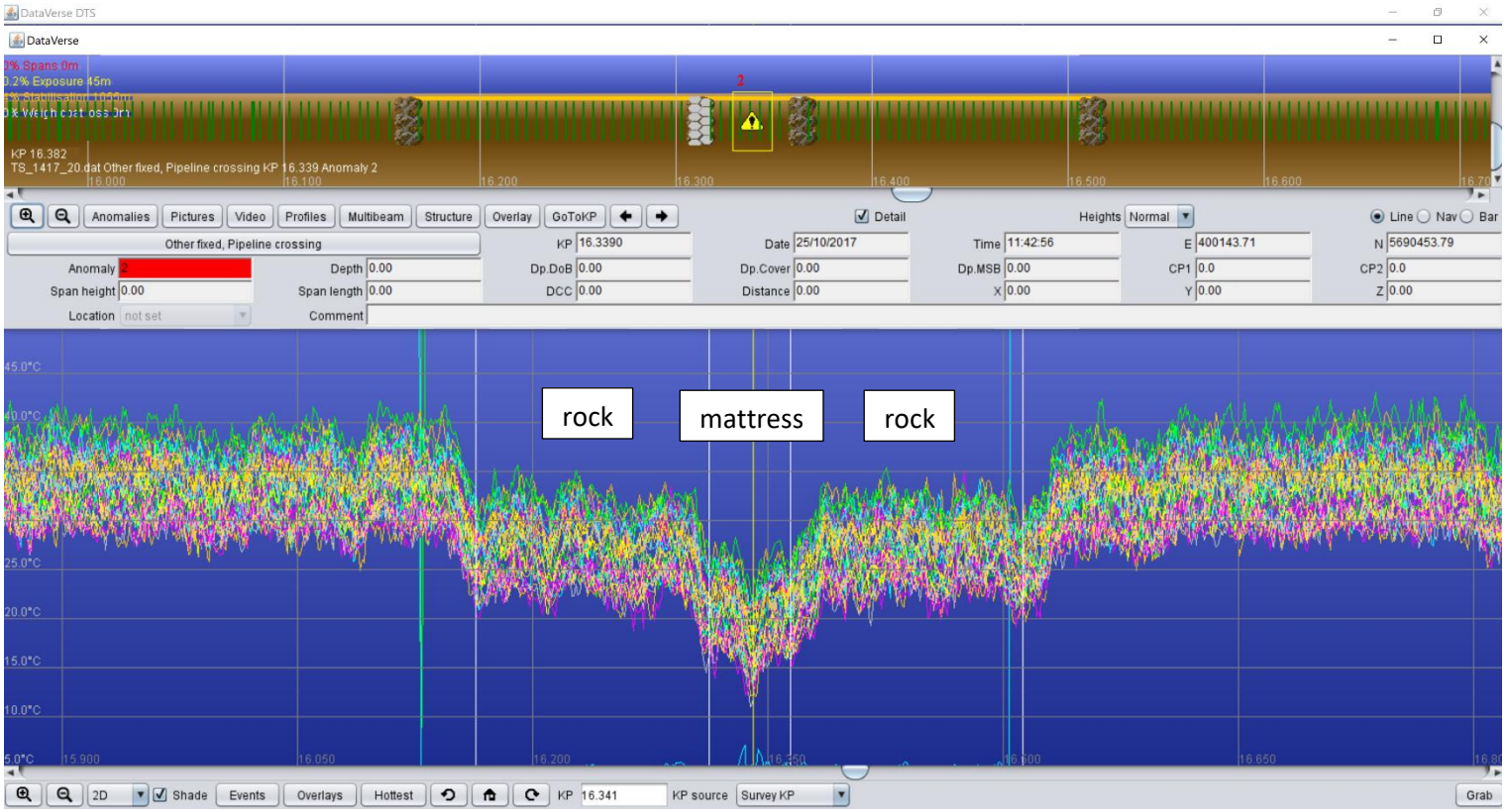
This is achieved by creating a bespoke cable system compensation by referencing OTDR test results, DTS temperature profiles and physical hardware locations recorded from terrestrial or subsea surveys.

This can be demonstrated in the chart below which shows a cable system built into Dataverse with compensation applied. The field joint locations, depth of burial of the cable and the DTS temperatures profiles are all shown simultaneously.
At each joint location it can be seen that all of the temperature traces drop in unison and converge together. This is indicative of a subsea cable joint, as the embedded fibre cable diverts from the trefoil power cores and is spliced into its own joint housing. This deviation from the power cores explains the drop off and change in the temperature profile as the fibres at this point are further away from the heat source created by the current flowing through the conductors.

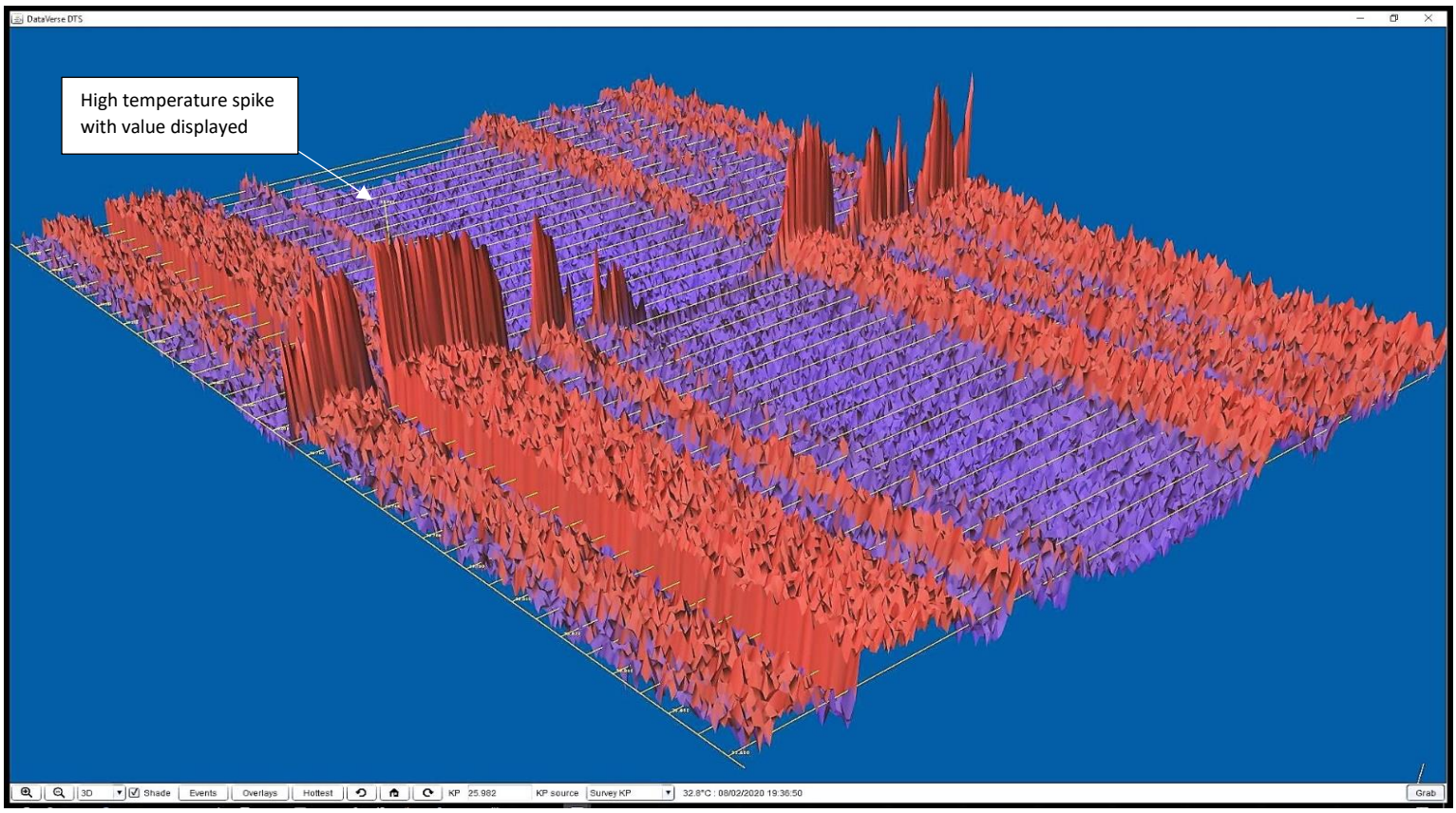
The straight-line diagram for the cable is easily overlaid by a click of the Events button.

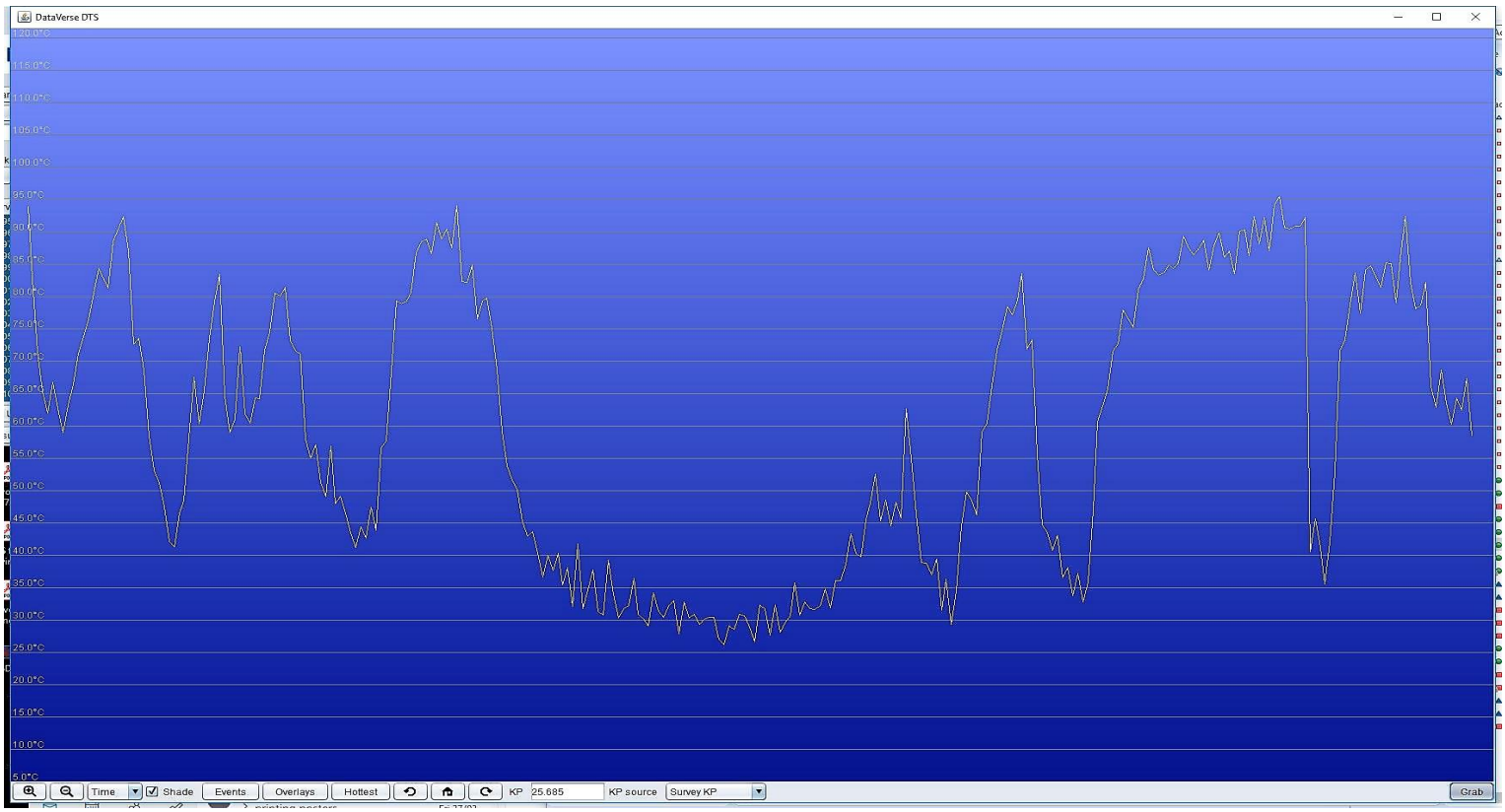


From survey data, other key features easily located during surveys are cable crossings, as these are invariably protected by either subsea rock installation or concrete mattresses. At these locations, the materials have different thermal properties to that of the surrounding seabed and tend to act as a heat sink as the temperature profiles decrease in sympathy with the rock and mattresses locations.




A further feature built into the Dataverse DTS viewer is the “hottest” button. The Integrity Engineer can immediately jump straight to the highest temperature recorded along the cable to save time scrolling through often huge datasets of temperature profiles. The DTS viewer can load multiple DTS files in one go and display these in a temperature graded 3D view to provide an overall perspective of the temperature trends along the route over multiple scans.


DataVerse DTS
High temperature spike with value displayed
3D
Shade
Events
Overlays
Hottest
KP 25.982
KP source
Survey KP
32.8°C : 08/02/2020 19:36:50
Grab


DataVerse DTS
120.0°C
115.0°C
110.0°C
105.0°C
100.0°C
95.0°C
90.0°C
85.0°C
80.0°C
75.0°C
70.0°C
65.0°C
60.0°C
55.0°C
50.0°C
45.0°C
40.0°C
35.0°C
30.0°C
25.0°C
20.0°C
15.0°C
10.0°C
5.0°C
Time
Shade
Events
Overlays
Hottest
KP 25.685
KP source
Survey KP
Grab

At any selected Kp you can take a time slice from the 3D viewer to show the temperature profile over time for points at that location. This provides an indication of how the temperature at a specific point on a cable changes over time. If available, current or power can be overlaid onto this to show how temperature varies with wind farm loading.

If a hot spot is identified it would then be possible to see how much power can be transmitted through a cable in order to keep the temperature within the operating parameters of the cable and lower the potential for cable failure.

DTS has proven itself to be an invaluable tool in monitoring the integrity of terrestrial and subsea power cables and is presently used on many inter-connector and subsea export cables. Using Dataverse, the Asset Engineer can quickly translate the information from the DTS to the physical cable route and view the locations of joints, cable protection, shallow burial etc in unison with the temperature profiles.

The ability to quickly assess where along a cable route a hotspot problem may exists helps expedite the planning process for any failure intervention or planned remedial operations to rectify any cable problem.

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