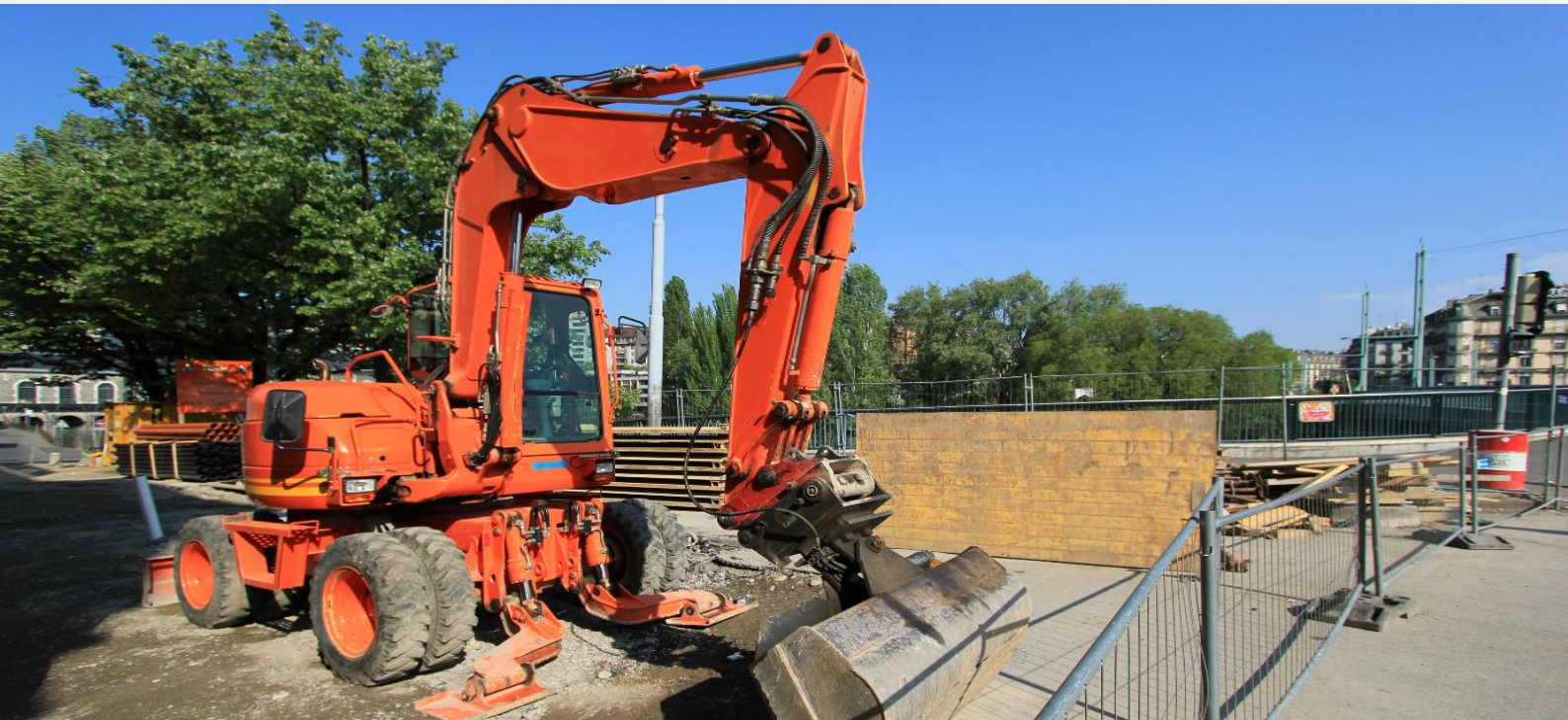


Third Party Interference (TPI) System For Protection of Buried Power Cables



The Scenario

The client, a South East Asian based electrical utility, had made an extensive network of transmission cables across the country and was experiencing damage to buried power cables primarily from unauthorised construction activity. The network consists of 400kV and 230kV cables, which are buried at a depth of between 1m and 3m along the cable lengths.

Client Requirements

The client wanted an early warning system against Third Party Interference (TPI) based on the Horizon Distributed Acoustic Sensing (DAS) system. The primary threat to the cable was construction activity and so the algorithms were to be tuned to the specific construction activities. Typically, in this region the construction activity was a 3-stage process with the following steps and timings:

1. Power saw
2. Pneumatic jack hammer
3. Mechanical excavator/digger

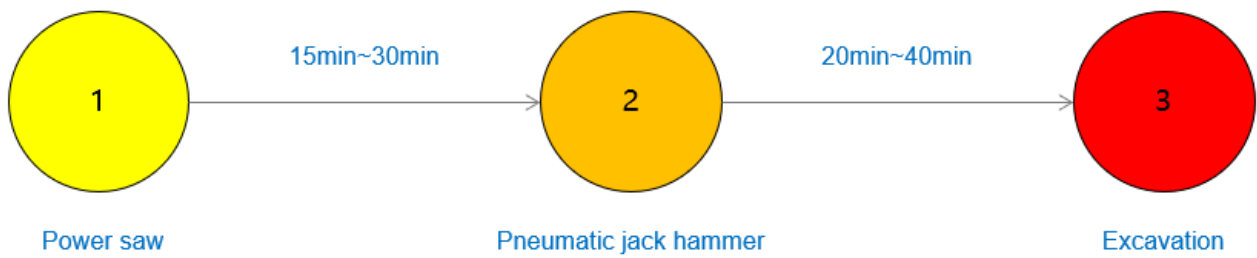


Figure 1 - Construction Steps



Power Saw



Pneumatic jack hammer



Mechanical Excavator

Figure 2 - Details of construction equipment

The customer wanted to detect, identify, and locate the construction process as early as possible in order to deploy a prevention team to the location to cease the construction process before damage occurred to the cable.

What Did We Do?

Bandweaver supplied a Horizon DAS system to monitor the cable and to tune the algorithms to detect each of the specific activities. The customer set up a trial location where each of the activities were carried out and then measured by the Horizon DAS.

The following shows some of the results of the calibration tests for the different construction tools. The images show the data obtained from the waterfall display of the Horizon DAS software.

Power Saw

The power saw had the lowest energy and highest audio signature of the respective machine tools. This was detected by the Horizon DAS but the ability to effectively alarm was dependent on the depth of burial and environmental noise. Due to the variability of signal strength, it was decided not to employ a detection algorithm for the power saw.

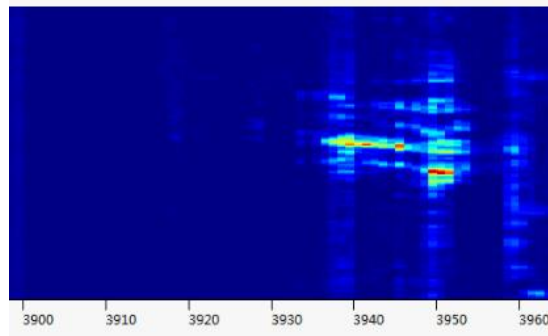


Figure 3 Waterfall display of power saw signature

Pneumatic Jack Hammer

The jack hammer had a much stronger signal and lower frequency (which typically means it transmits further). It also operates on a sustained continuous basis, which gives it quite a distinctive signature. It was much more practical to set up a detection algorithm and alarm for the jackhammer.

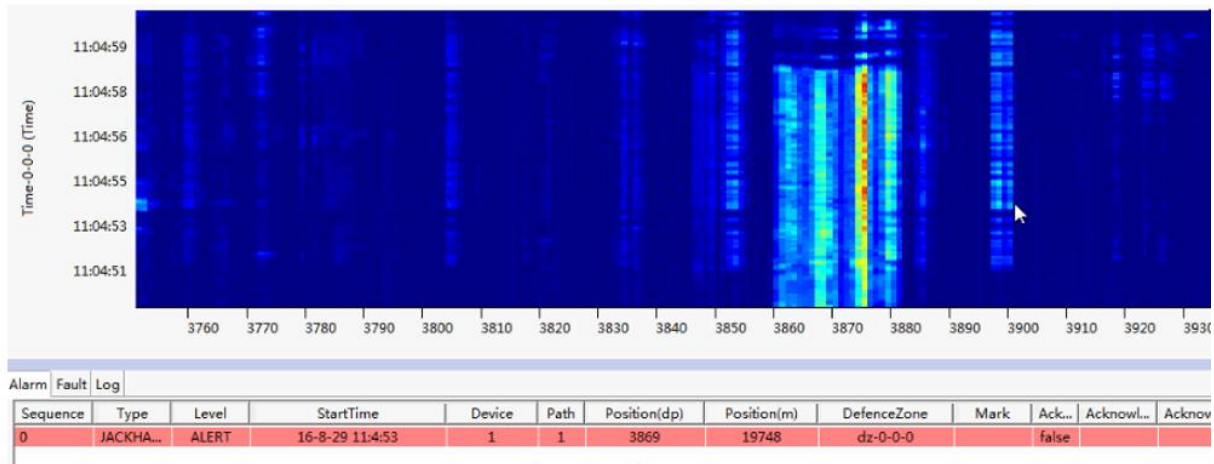


Figure 4 Example of Jackhammer signature and associated alarm

Mechanical Excavator

The mechanical excavator had the highest energy impact of all the machinery. Unlike, the pneumatic jackhammer it has more of an intermittent signature. Mechanical diggers are one of the standard detection algorithms on the Horizon DAS and so it was very simple to use one of the existing algorithms.

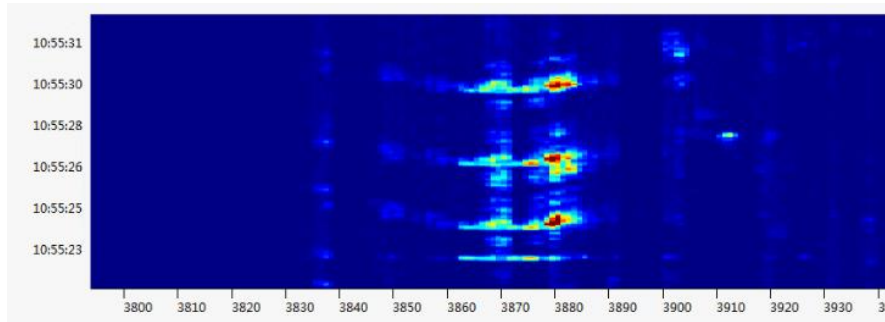


Figure 5 Acoustic signature of the mechanical excavator

Benefits to the Client

The Horizon DAS system provided an effective TPI detection system for the customer with the following benefits.

- **EARLY DETECTION:** The Horizon DAS algorithms were extremely effective for detecting both jackhammer and excavator algorithms. This provides the user with an alarm 20-40 minutes before excavation work commences and 60-180 minutes before the cable is potentially damaged
- **ACCURATE LOCATION:** The Horizon DAS typically located the event to within 5-10m (depending on the distance of the event from the cable). This allowed the customers prevention team to get to the exact site very quickly and take preventative action
- **BENEFITS OF ARTIFICIAL INTELLIGENCE:** The Horizon DAS utilises machine learning for optimising the algorithms to maximise probability of detection and minimise nuisance alarms
- **LOW COST OF OWNERSHIP:** Often fiber optics are built into power cables and so there is no infrastructure investment required and no installation costs.
- **HIGH RELIABILITY:** Fiber optic sensors are completely passive and are immune to EMC interference, not affected by dust or other environmental factors and are completely non-corrosive. Therefore, the lifetime of a fiber optic cable can be greater than 30 years, without any maintenance required. So, there is no downtime for repair of sensors and no additional operational costs.
- **FULL COVERAGE:** Due to the distributed nature of this technology they also provide complete coverage across the whole length of the asset. This lowers the overall risk and improves protection levels.

ABOUT BANDWEAVER TECHNOLOGIES

Bandweaver has been providing advanced fiber optic monitoring sensors and integrated technologies since 2002. With an installed base of over 60,000km and 8,000 systems installed, our knowledge regarding the application of distributed temperature sensing technology and linear heat detection within the fire industry is second to none. We focus on the safe integration of FireLaser DTS technologies into clients' proprietary systems and Bandweaver and our partners provide exceptional systems design support, product support during installation and provide long term maintenance packages.

For further information please contact our global team at info@bandweaver.com