Improving safety and reliability with distributed fiber sensors

DarkPulse Chairman and CEO Dennis O'Leary discusses the potential for sensor technology to change the way wind turbines are monitored and maintained. Being able to keep a close eye on structures in real-time means that, even from afar, maintenance downtime can be reduced, safety can be increased and costs can be kept to a minimum.

PES: Firstly, could you give a brief background to dark-pulse sensor technology and how it is beginning to be applied to the wind industry?

Dennis O'Leary: Brillouin sensors historically failed due to low resolutions and temperature/strain cross sensitivity issues. This is inherent with Brillouin optical time domain analyzer (BOTDA) bright pulse systems. Within the last decade, an innovative approach towards improved spatial resolution was invented, called dark pulsing, that allowed spatial resolutions in the sub-meter range. Without these, conventional BOTDA sensing systems are only practical for large-scale strain changes.

BOTDA dark-pulse sensor technology provides a data stream of critical metrics for assessing the health and security of infrastructure and has already been applied successfully in various industries, including structural health monitoring of infrastructure, mining, oil and gas, pipeline and security.

PES: What technology and solutions does DarkPulse offer the wind industry? How does the tech work and what are its benefits?

DO'L: Specifically for the wind market, our sensors can provide real time monitoring of structural health changes of turbine blades, structural health and corrosion of towers,

temperature changes of turbines, and integrity of cables so that repair and replacement can be conducted before a critical failure occurs. This protects assets and lowers costs.

We also offer perimeter security and surveillance, which combine intrusion detection systems with video surveillance and access control, together with bespoke services for optimal protection of offshore wind farms. Our surveillance capabilities will evaluate conditions on the remote site and safeguard personnel, whilst monitoring operations. It is also used for planning and potential incident evaluation.

PES: How does the tech work in terms of monitoring and maintenance?

DO'L: Our technology monitors cable health in real-time, with resolution down to 10mm to detect potential issues on the cable that would allow for preventative maintenance rather than a reactive failure. The technology can also be installed during wind farm construction or retrofitted; the only requirement is a single mode optic fiber installed with the electrical cable that can be tuned for detection purposes. Our detection service capabilities extend across weather and collision monitoring, as well as on-platform security monitoring of critical areas.

Observation services are delivered via CCTV technology, sending customers a security alert or providing a high-resolution visual verification for things like blade inspections and access detection as a response to danger management systems. With the implementation of card access systems to secure site control, achieving alignment of site access management and people tracking, our solutions provide remote asset protection.

Dennis O'Leary

All our systems are remotely accessible by cloud, a distinct control centre, or client corporate PC and mobile communication methods. This guarantees immediate access to both live and historic data to manage situational awareness and evidential and trend analytics.

Our consultancy team can provide a full and bespoke solution for all onshore and offshore substation security and communication needs.

PES: Can you help with subsea cables too?

DO'L: Subsea power cable failure is frequently reported as an issue for offshore wind farm operators. Such failures are said to account for 75-80% of the total cost of offshore wind insurance claims. Issues associated with manufacturing and installation are reported to be the most common cause of cable failure.

Our sensor configurations are available for monitoring areas in and around buried or above ground cables that are 100km or more in length, or for localized areas. Solutions include the patented DarkPulse EREBOS™ system, which can identify stress and strain along the entire sensing cable in real-time, via our UI on any device anywhere in the world.

PES: Wind turbine failures can be costly too, can't they? Is there similar technology to help here too?

DO'L: Wind turbine blades are susceptible to several different failures, caused by lightning damage, failure of the control system to detect vibration, manufacturing defects leading to deboning, environmental events, crane impact during scheduled maintenance or on-site repair. All types of blade failures can cause significant economic loss and incur negative social impact.

Blade inspections are often conducted for warranty purposes and then every three years. Despite these regular inspections, 85% of blade failures are due to poor maintenance. These failures are extremely costly, ranging from £80,000 to £811,000, with the highest reported failure costing £4.8m (TWI Global, 2020).

Our blade inspections can be achieved with long range CCTV, AI robotic and drone technology, offering reliable, early detection and real-time identification to ensure an immediate and correct incident response by operating staff.

PES: Can the sensors be used in other industries?

DO'L: Once our system is in place, it will monitor the stress and strain of structures, highlighting internal anomalies before catastrophic failure, including building, tunnels, bridge structures and roadbed. For example, in November 2021 DarkPulse began a pilot project in California to monitor the structural health of bridges and roadbeds with the California Department of Transportation (CALTRANS).

We launched our patented BOTDA system into the Honcut Bridge construction located outside the city of Sacramento, California, to monitor temperature changes due to the heat of hydration, or curing, of concrete in real-time, ensuring proper curing has occurred. There are likely to be more bridge installations in the future, as the pilot project expands across the State of California.

PES: Can you explain how the technology was installed?

DO'L: Working in conjunction with CALTRANS and their principal contractor, the fibers were installed into the bridge piers via live pour onsite, with safety the number one priority.

The project began with the careful installation of the reinforced fiber along the distance of the pier. The fiber is manufactured to a tailored length to give maximum coverage for stress, strain, and temperature measurement. Installation is quality checked and allows the cable to move along the length of the pier as it is lifted from the horizontal to vertical position.

The team were present across the lifecycle of the pier install, working closely with the Principal Contractor to ensure quality and consistency. The fibers were then connected to a roadside data cabinet into the BOTDA hardware. The data is converted to meaningful measurement represented by the 3D graphical user interface in real time.

PES: It sounds like a fascinating project. Do you think this is the future for sensors in the wind industry too?

DO'L: Our capabilities are not limited to just sensor technologies, we can also provide security and communication solutions across the offshore industry. But, we see our high resolution sensors playing an important role in reducing downtime associated with some common problems by offering real time cable failure monitoring, blade structural health monitoring, tower structural health and turbine heath. This technology allows for preventative maintenance before failure, with real-time data capture and alerts to conditions which will provide operators with live data which allows for fact-based decisions.

About DarkPulse

DarkPulse was established in 2010 in New Brunswick, Canada, and via a reverse merger went public in 2018. Headquartered in the USA and with a global footprint, the company and its subsidiaries provide engineering, installation, and security management solutions for critical national infrastructure to governments and industries worldwide.

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