Monitoring Optical Ground Wire (OPGW) with NITRO™ Fiber Sensing

The Challenge

Optical ground wire (OPGW) is a cable that combines the functions of a ground wire with communications. OPGW is used by the electric power industry in overhead power lines to transmit telecommunications signals and to ground electric power systems. An OPGW cable contains an inner tubular structure housing one or more fiber optic cables surrounded by layers of steel and/or aluminum wire. The conductive part of the cable bonds adjacent high-voltage line towers to earth ground and shields the high-voltage conductors from lightning strikes. The optical fibers provide high-speed communication for purposes such as grid monitoring and control, or it can be leased commercially. The cost to install OPGW can range from $200,000 to $500,000 depending on factors like cable type, length, voltage level and terrain. Maintenance of OPGW requires utilities to schedule power system outages to de-energize the line. These outages limit work to times of low energy demands that have to be scheduled weeks, if not months, in advance

OPGW is subject to environmental stress from lightning, icing, wind, tower collapse, cable corrosion, etc. Fibers within these cables are turned into distributed sensors to increase asset longevity.

While OPGW is designed to withstand mechanical and environmental stress, different challenges can arise as it is exposed to the environment. For example, though OPGW is designed to act as a path to ground, internal fibers can suffer damage from significant or repetitive lightning strikes. Additionally, “galloping” of the OPGW cable from wind over time can add to the stress and strain to the cable. Finally, cold and icy weather can affect the cable by making it more susceptible to galloping; fibers can also be damaged when water infiltrates and freezes the fiber cable.

An operator in North America needed cost-effective technology that would enable them to rapidly troubleshoot, reduce line surveillance costs, and assess cable conditions. The operator needed a tool that would enable them to monitor long distances of critical infrastructure without the need to deploy additional sensors along their assets.

The Solution

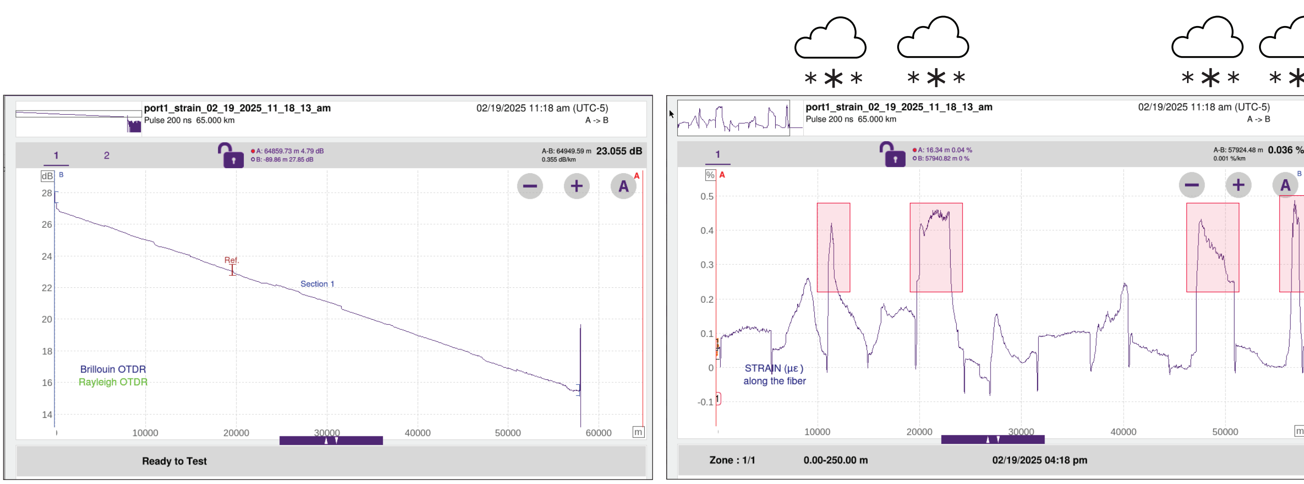
VIAVI NITRO™ Fiber Sensing technology was deployed along the client's transmission routes. Unlike basic optical time domain reflectometer (OTDR) technology used for finding optical attenuation and breaks, it uses a single-ended Brillouin OTDR to perform distributed temperature and strain sensing (DTSS) of the fibers within the cable.

It is available in a portable, battery-operated platform (OneAdvisor 1000 DTSS) for installation and troubleshooting in field locations as well as a rack mounted platform (FTH-DTSS) for permanent monitoring through our widely-deployed VIAVI ONMSi remote fiber test system, which can monitor 24/7 for changing environmental conditions along the fiber so operators can be more proactive with maintenance and downtime.

The technology also delivers high spatial resolution over a long range, enabling accurate pinpointing, within a few meters, the locations of potential future fault zones.

OneAdvisor 1000 DTSS

FTH-DTSS



OTDR and DTSS profiles along 60 km line showing anomalous strain zones. The OTDR does not show any issues with the cable. The increased strain in the DTSS reveals ice accumulation during time of survey and potential cable galloping, suggesting areas of interest for subsequent monitoring/maintenance.

The Results

The DTSS solution quickly and accurately identified which sections of cable were degraded or faulty. The operator was able to identify four locations with very high strain conditions, likely due to ice, that could fail sooner if not serviced. This surveillance illuminated specific sections of the cable for subsequent targeted maintenance, hence reducing visual surveillance costs. This enabled the operator to detect sections of cable that may be under excessive strain, but before failure occurred, enabling more proactive remediation or preemptive replacement, saving significant time and money.

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