Underground Temperature Measurement Optical Cable

Overview

At the same time, many underground distribution line faults can be corrected by on-line monitoring the cable itself.

Key Takeaways

Optical fiber-based systems, such as Distributed Temperature Sensing (DTS), enable continuous, real-time monitoring of underground power cable temperatures, enhancing safety, reliability, and predictive maintenance.Overview of Optical Temperature Monitoring

Underground power cables are critical infrastructure, and their temperature directly affects ampacity, ageing, and operational safety. Optical fiber-based monitoring systems embed or attach optical fibers along the cable to measure temperature continuously over long distances. These systems provide a distributed temperature profile, allowing operators to detect hotspots, thermal bottlenecks, and abnormal conditions in real time .

Key Technologies
• Distributed Temperature Sensing (DTS) DTS uses optical fibers to measure temperature along the entire cable length. It can detect hotspots with high spatial resolution and monitor distances up to 40–70 km per system. DTS systems, such as the Luna EN.SURE, provide real-time thermal ratings to optimize cable load and prevent overheating .

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• Fiber Bragg Grating (FBG) Sensors FBG sensors are point-based optical sensors that can measure temperature, strain, and other parameters at multiple locations along a cable. They are often used in multi-parameter monitoring systems to track conductor temperature, external temperature, and transformer conditions .

• Distributed Temperature & Strain Sensing (DTSS) DTSS combines temperature and mechanical strain monitoring, enabling detection of hotspots, cold spots, mechanical stress, and external impacts, which helps prevent cable degradation and failures .

• Distributed Acoustic Sensing (DAS) DAS detects vibrations and acoustic signals along the cable, identifying third-party intrusions, digging, or mechanical damage. This complements temperature monitoring by providing early warning of potential hazards .

Advantages

• Real-time monitoring: Continuous data allows operators to respond quickly to abnormal conditions.

• Predictive maintenance: Early detection of hotspots and strain reduces downtime and maintenance costs .

• Long-distance coverage: Optical fibers can monitor tens of kilometers with high resolution .

• Electromagnetic immunity: Optical systems are unaffected by high-voltage interference, ensuring reliable operation .

• Integration with control systems: Data can be fed into SCADA, DCS, or APM platforms for automated alerts and analytics .

Applications

• Thermal profiling and ampacity optimization: Operators can safely increase cable load during peak demand while avoiding overheating .

• Fault detection and safety: Identifies hotspots, insulation degradation, and mechanical stress before failures occur .

• Grid reliability and efficiency: Supports renewable energy integration and decentralized energy systems by providing accurate real-time data .

• Asset management: Extends cable lifespan and reduces replacement costs by monitoring ageing and environmental impacts .

Conclusion

Underground temperature measuring optical cables, using DTS, FBG, DTSS, and DAS technologies, provide comprehensive, real-time monitoring of power cable conditions. These systems enhance safety, reliability, and operational efficiency, enabling predictive maintenance and optimized load management for modern electrical distribution networks .

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