



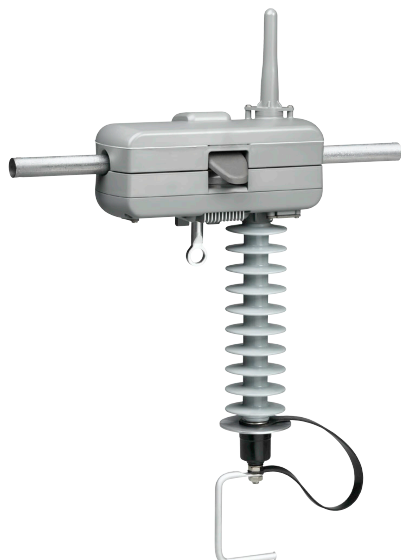
Case Study: Grid Monitoring

Detecting Transient Faults on Overhead Networks

UK Power Networks, United Kingdom

UK Power Networks is the United Kingdom's biggest distribution network operator (DNO) and delivers electricity to more than 8 million homes in London, the East and South East of England. It is transforming itself from a distribution network operator, which simply delivers electricity, to a distribution system operator (DSO), which enables a smart, flexible system that responds to customers' needs.

The company says its vision for the future proposes significant changes to enable electricity networks to enable consumers to use new and emerging technologies.



BUSINESS CHALLENGE

As part of its effort to continuously improve, UK Power Networks is constantly assessing ways to reduce the number of power outages and their duration. UK Power Networks has more than 46,000 km, or 28,500 miles, of overhead line networks that can occasionally be damaged by high winds, bird strikes or tree contact.

These can result in short power interruptions known as transient fault outages. Transient events typically include short variations of fault current without causing a sustained power outage. Transient events that are cleared automatically by very short interruptions from breakers or reclosers are referred to as momentary fault events.

It can take 6 to 10 hours, on average, to identify the exact location of a transient fault on overhead lines, especially when the outage occurs at night, is in a hard to reach location, or takes place during a storm. Once a fault is located it can then take an additional 1-2 hours to fix it. Reducing the expense and time associated with finding and repairing faults is an important component of reducing customer minutes lost.

Today, the company uses traditional fault passage indicators (FPIs), known as fault current indicators (FCIs) in the United States, to help them identify when faults occur on its overhead electrical system. However, there are several challenges with using FPIs.

While FPI alarms integrate with UK Power Networks' GE PowerOn™ advanced distribution management system, they lack capabilities to help locate transient faults. They are not effective at detecting momentary line disturbances or developing faults and do not capture fault waveforms. Due to less sophisticated triggering and classification methods, they may also generate false indications of actual outages or the true location of faults.

As a result, operational staff then must be sent out to search for the fault location. This is done through a systematic process of opening the manually operated OHL switches installed along the route, energizing segments and 'walking the line' until the fault location is found. This is a time-consuming process.

SOLUTION OVERVIEW

UK Power Networks has recently undertaken a ground breaking project to improve customer service and was looking for new technology to help reduce power interruptions and customer minutes lost on its overhead networks. Funded by the Network Innovation Allowance (NIA), an incentive of the United Kingdom's Office of Gas and Electricity Markets (Ofgem), part of the project's objective is to develop algorithms that can predict fault location on overhead circuits and that distinguish false alarms from true outages.

To accomplish its goal, UK Power Networks selected the Aclara Grid Monitoring platform comprised of smart grid sensors and Predictive Grid® analytics software. The power sensors are easily deployed on overhead lines via hot stick, even in remote locations. The data they provide, including voltages, will allow the company to develop a real-time impedance model at the time of a fault, allowing precise location of the faults without having to 'walk the line'.

"Our goal is to reduce the duration of supply interruptions by directing linesmen to the most likely fault locations. The trial will demonstrate Aclara's "distance to fault" algorithm to improve restoration times.

'We are regularly reviewing Aclara power sensor input as part of UK Power Networks' overall quality of supply improvement program and hope to make more strides in preventing network-failure conditions.'

PETER LANG
UK Power Networks' Project Manager

UK Power Networks has installed over 400 power sensors on 11kV overhead lines on 45 feeders as part of an implementation of the Aclara Grid Monitoring platform in two of its three geographical regions – its East and South East areas.

The Aclara Grid Monitoring platform will continuously monitor load and power quality in places where troublesome overhead circuits have caused many supply interruptions. They are battery-free smart grid sensors capable of monitoring real-time voltage on distribution networks to within 0.5% accuracy.



Power sensors are installed on overhead lines with hot sticks and require no calibration or additional, pole-mounted equipment.

These specific line sensors were installed for three reasons:

- 1** - To allow UK Power Networks to gain better network visibility on its overhead circuits and reduce the time it takes to identify permanent faults that are located on specific spurs or between sectionalised points on the main line.
- 2** - To reliably detect and resolve developing or transient faults caused by events including branches touching power lines, animal incursions, bird strikes, and defective equipment.
- 3** - To reduce the length of supply interruptions by directing linesmen to the most likely fault locations.

The Aclara power sensor is a highly integrated and rugged solution that is a fraction of the cost of traditional kits of equipment with equivalent functionality. It introduces additional OpEx savings due to its simple installation and highly reduced maintenance costs compared with similar alternatives. Precise measurements and events captured by Aclara power sensors, combined with

the sophisticated analytics in its sensor management system (SMS) software, including an algorithm that identifies the exact location of faults, provide highly accurate, real-time reporting of fault events. Thus, the Grid Monitoring fault location solution greatly improves restoration times.

Additionally, to build intelligence about what might cause a power failure in the future, Aclara's SMS software classifies faults and disturbances that do not cause immediate outages. For example, incidents like momentary faults or line disturbances are categorized and can be filtered to show trends across a circuit or during certain times of the year.

This Predictive Grid® analytics capability of the Aclara SMS software lets UK Power Networks identify fault locations quicker, allowing engineers to study fault waveforms to better diagnose the true cause of fault events. It can predict and alert engineers and operators to early signs of developing fault conditions based on frequent patterns of transient conditions.

In addition, Aclara smart grid sensors are easily deployed towards the end of feeders and spurs, in locations where currents may be as low as 3A. This is important because battery-powered FPIs and sensors typically require at least 10A – and some up to 30A – to successfully keep the batteries charged. Therefore, the further you get away from the substation, the harder it is to identify faults because previously there were no solutions for low-current areas.

With the continuous reporting of power conditions, the deployment of Aclara's smart grid sensors has also proven invaluable to help UK Power Networks gain better insight to the true load profile along its circuits. Better visibility of load and voltage conditions aids planners and network operators for both managing switching operations as well as long term network planning.

BUSINESS JUSTIFICATION

Use of Aclara smart grid sensors allows UK Power Networks to have much better visibility of fault

and disturbance conditions along circuits, leading to changes in methods in working and business practices at the utility. The company's engineers now can go directly to the fault location, eliminating the need to 'walk the line' to find it.

The deployment of Aclara smart grid sensors also demonstrates that transients or pre-faults can be accurately identified on the network. Analysing waveforms allows operational staff to be proactive in trying to identify the cause, allowing preventative maintenance before faults become permanent and cause network failures.

In addition, Aclara technology will help UK Power Networks meet its goals for reducing the number of power interruptions customers have and the length of the power interruption.

This project provides another key tool to support delivery of a more reliable electricity network. The solution enables UK Power Networks to implement improvements in the cost of network operations, replacing expensive manpower-intensive processes.