[slug] CHANNEL LINEMAN SAFETY, Outside Plant Magazine

[hed] **IMPROVING SAFETY WITH TECHNOLOGY**

[dek] Reducing hazard risk with Smart Grid line sensors

BY ERIK CHRISTIAN, Tollgrade

The distribution network spans over six million miles in North America, and, according to the Edison Electric Institute (EEI), it is where 90 percent of our outages occur. Yet, today's distribution grid is largely unmonitored.

Improving reliability and having faster restoration could be as simple as adding a new breed of monitoring and sensing capabilities through new Smart Grid line sensors that can report real-time outage and fault information to utilities so power can be restored to customers faster. Today, Smart Grid line sensors are already being installed throughout the United States, Canada, Europe, and South America.

This issue's *Lineman Safety Channel* outlines the benefits of Smart Grid line sensors, why this technology is safer for crews. Lastly, we will examine the future possibilities about how this technology can help utilities restore power faster.

[subhed] **SENSOR BENEFITS FOR LINEMAN SAFETY**

This new breed of inductively powered, Smart Grid line sensors is inherently simpler and safer to deploy than other options such as line post sensors, which are much more complicated and time-consuming. For example, in the case of line post sensors, many utilities' safety practices require linemen to de-energize the circuit to perform the installation. Typically, installations require two bucket truck crews where one bucket truck is needed to temporarily lift and support the conductor while the other bucket crew is used to replace the standard insulator on the cross arm with the line post sensor.

Cabling and ground connections need to be dressed from the bottom of the cross arm down the pole to a meter or remote terminal unit (RTU) to where a sensor must be connected. Cabling may need to be protected in conduit or u-guard. The conductor is then lowered onto the line post sensor, and secured to the top of the line post sensor. Since line post sensors have a ground connection, special care must be taken during installation to maintain all safety clearance distances between the ground conductor and medium-voltage phases to avoid an inadvertent flashover or fault.

Alternatively, the new breed of Smart Grid line sensors has no connection to ground, which helps to alleviate concerns about inadvertent shorts or faults during installation and improves safety for utility linemen. Full installation is performed isolated from the ground on live wires. A utility does not have to schedule a power outage or cause an unnecessary outage for installation. Smart Grid line sensors are extremely lightweight

and can be installed by a single lineman with gloves or a hot stick either from a bucket or by climbing a pole.

These sensors have integrated cellular communications, which means there is nothing else to hang on the line or pole. Once installed via hot stick, the Smart Grid line sensors switch on, charge automatically, and then connect and activate themselves onto the cellular network to begin transporting real-time data about grid conditions back to the utility.

Once installed, Smart Grid line sensors can identify which phase they are on. Proper phase identification is crucial to lineman safety. Particularly after storm restoration, when phase designations can be become accidentally reversed. This presents a hazard to linemen performing maintenance operations who rely on standard conventions to identify phases. Smart Grid line sensors with analytics can reliably identify phases and greatly improving worker safety.

Little additional maintenance is needed once these sensors are installed. Moreover, there are no batteries to replace since these sensors are inductively powered. Lastly, with a mean time before failure (MTBF) of 20 years, these sensors can be left on the line for two decades.

This new generation of sensor is also software-defined, meaning that it can be managed remotely at the utility data center and new software upgrades can be provided “over-the-air”. Potentially, using Smart Grid line sensors means fewer truck rolls for maintenance operations, and fewer poles to climb.

Another benefit for electric utilities is that these sensors can provide visibility in low current environments (for example, down to three amps). This improved visibility helps measure with greater accuracy the following line parameters in a single unit: current (RMS, fault and surge), conductor temperature, power quality (sags, swells, and harmonics), power factor, and voltage (e-field measurements).

[INSERT SIDEBAR]

[subhed] **ANALYTIC APPLICATIONS**
[dek] 10 key applications using analytics

1 Outages due to blown fuses or overhead laterals
2 Load imbalance
3 Blown capacitor bank fuses
4 Blown fuses from vegetation/animal disturbances
5 Improper coordination of circuit protection timing
6 Slack span faults
7 Condition-based maintenance
8 Inputs to enhanced asset management systems
9 Waveform pattern analysis

10 Detection of imbalances and operational inefficiencies

[END SIDEBAR]

[subhed] **FASTER POWER RESTORATION**
Smart Grid line sensors can help crews restore power faster because they are more accurate than fault current indicators (FCIs). The line sensors use analytics software, which greatly increases the technology's accuracy and this helps operations and distribution engineers get better, more trustworthy information to the field.

Smart Grid line sensors provide a positive combination of outage and fault detection, accuracy, configurable threshold alarming, real-time load and power quality monitoring, which can be used for a variety of distribution grid applications. Analytics rules can be defined to both filter out disturbances due to standard network operations (for example, load switching events), and alert network operators to inefficient operating conditions, system failures, or indications of anomalous behavior that may be early indications of *future failures*. In short, this intelligence provided by the smart grid sensor means you'll have more accurate information about the cause of the outage and could even begin preventing outages before they happen.

[hed] SENSOR FEATURES	Smart Grid Line Sensors	First Generation FCI
Sensors Hardware		
Inductively powered sensors with visibility down to three amps	✓	
No batteries required	✓	
Sensors include GPS location coordination	✓	
Easily installable with a hot stick (crew training rarely needed)	✓	✓
Field-upgradeable and future-proof	✓	
Flexible communications: cellular, Wi-Fi or WiMAX	✓	
Cellular sensors come pre-bundled with five-year data-plan	✓	
Blinking indicator light when sensor detects a fault		✓
Software		
Managed / hosted solution	✓	
Rules-based analytics engine (for asset management)	✓	
Aggregate view of multiple sensors across all three phases: This, combined with post-processing analytics that includes waveform analysis provides a more accurate picture and eliminates false positives	✓	
Google Maps for fault location detection	✓	
Real-time load planning & monitoring (asset management); on-demand	✓	
Waveform pattern analysis	✓	

[subhed] **LAST LOOK**
What you'll like about new Smart Grid line sensors is they'll make your job a little easier. Not just because they are easy to install, but also because they'll reduce your drive

times in hazardous situations. Rather than driving a circuit looking for the outage or chasing false alarms from FCIs, the information these new sensors provide will get you directly to the location of the fault. The operations center and engineers will get the information to better assess outage situations and this means you'll be a little more prepared for "unknowns" in the field. Finally, this technology will help to prevent unnecessary patrols of lines through woods, right-aways and other dangerous or unsafe areas such as ice covered or inaccessible areas. All of this adds up to faster power restoration that will be safer for utility linemen.

[BIO] *Erik Christian is the vice president of Tollgrade's Smart Grid business. Tollgrade has been recognized for their innovations in the Smart Grid. Learn more by visiting www.tollgrade.com.*

-30-