In The Field

Live Wire

EPRI Investigates Promising Technologies and Approaches to Detect Dangerous Downed Power Lines

By Chris Warren

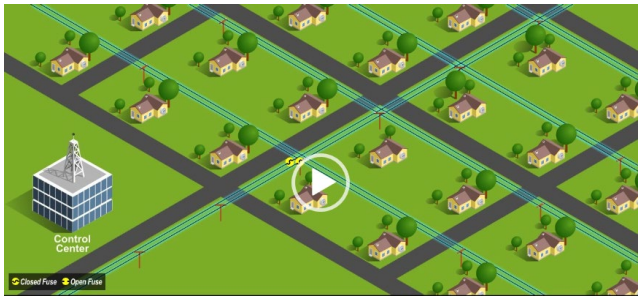
Live downed power lines (conductors) on utility distribution grids present a public safety challenge for utilities. They may not arc, sputter, or give off any other indications that they are live. This increases the possibility that someone would touch the wire, causing serious injury or death.

For decades, the electric power industry has investigated ways to improve the detection and prevention of downed conductors. Recent research has put more effective, scalable detection methods within reach.

As part of a three-year project begun in 2016, EPRI is examining approaches to high impedance fault detection. A low impedance fault can occur when a fallen tree limb forces two wires together in the air and there's little fault impedance to limit the flow of current between the two wires. Protective equipment such as a fuse or circuit breaker senses the high current and trips to end the fault.

In contrast, a high impedance fault limits the flow of current. "If a conductor breaks and falls on the ground, then it's a high impedance fault because the wire has poor electrical contact with the soil. Little current flows, so it won't blow a fuse or trip a circuit breaker," said EPRI Senior Technical Executive Tom Short, who leads research on high impedance faults. "The conductor can sit on the ground live for a long time and threaten public safety without the utility knowing it."

Today, there is no widely used method for detecting downed power lines. Most utilities publicize a phone number that customers can call when they see a downed power line, but this does not fully address the problem.



Watch an animation about a "meter pinging" approach under investigation to detect downed wires.

Following a literature review of research on high impedance fault detection, Short and his colleagues conducted tests at EPRI's research facility in Lenox, Massachusetts on newly available arc detection technologies. "When a live conductor on the ground is arcing and sputtering, arc detection technology looks for changes in the flow of current," said Short. "The tests showed that off-the-shelf technology could detect some downed conductors but not others."

For example, when live wires were placed on asphalt—which provides significant insulation—there was no current flow or arcing, and the faults were undetectable. "On a patch of freshly laid grass and sod, there was a better electrical connection that caused arcing, so the technologies were able to detect the faults," said Short. "While not a comprehensive solution, this approach offers an improvement over what is done now."

EPRI is investigating a potentially more effective detection approach that involves the use of a utility's advanced metering infrastructure and outage management system (OMS).

When advanced meters lose power during an outage, they send alerts to the OMS. Based on the meters' locations, the OMS may determine that a

blown fuse caused the outage. It can pinpoint the fuse's location, directing repair crews to replace it.

Advanced metering can be used to detect cases in which outages are caused by a broken, downed conductor rather than a blown fuse. Distribution grid operators can send messages (known as pinging) to meters just downstream from the fuse located by the OMS.

"If the fuse really is out, the meter won't respond," said Short. "If the meter responds, that means that the fuse didn't blow, and the problem is somewhere else. Operators can continue pinging meters further down the feeder until one doesn't respond. That indicates that the problem is between two meters and could be a downed conductor. That is where you send the crews."

In the project's final year, EPRI will continue to investigate methods for detecting downed conductors. Researchers plan to test the pinging approach with several utilities.

"We will work with at least six utilities to implement an automated detection system and evaluate how it works in practice," said Short.

KEY EPRI TECHNICAL EXPERTS

Tom Short