ALGORITHM MANAGES HARD-TO-DETECT FAULTS IN AUSTRALIA

S&C FEATURED SOLUTION: IntelliRupter® PulseCloser® Fault Interrupter

LOCATION: Canberra, Australian Capital Territory, Australia

"The new high-impedance earth-fault algorithm S&C developed for PulseClosing Technology is a reliable and cost-effective advantage to our bushfire-mitigation strategy."

—James Cole, Secondary Systems Manager, Evoenergy

Customer Challenge

In Australia, bushfire season lasts most of the year, resulting in some of the nation's most devastating fires. Climate change has also extended the length of fire seasons throughout Australia, drying out vegetation so it is quick to ignite and fuel the spread of bushfires. With this problem on the rise and a sensitive history with bushfires, Australia's regulators mandated that utilities implement bushfire-mitigation strategies using modern protection technology.

Evoenergy, a government-owned utility in the Australian Capital Territory, sought to meet these regulations and protect the 186,000 customers it serves. One of its greatest challenges was detecting high-impedance earth faults using Sensitive Earth Fault (SEF) protection. High-impedance earth faults are often caused by vegetation or broken power line conductors that touch the ground and generate uncharacteristically low current.

Most traditional SEF-protection schemes are unreliable because they lack the required sensing and measurement precision needed to detect very low fault current. Evoenergy's best option was conventional reclosers because they offer SEF protection. However, their fault-detection method requires high current where the resulting sparks during fault-testing can lead to dry vegetation

Evoenergy sought a new solution for detecting high-impedance earth faults and quickly interrupting power.

catching fire. Evoenergy sought a new solution that could detect high-impedance earth faults using lower fault current.

FIGURE 1. Installing an IntelliRupter® fault interrupter with the new high-impedance earth-fault algorithm.

S&C Solution

Evoenergy was familiar with S&C Electric Company from experience using its boric acid SMD® Power Fuses, which meet Australian Spark Production Standard AS 1033.1-1990. The utility was aware of S&C's IntelliRupter PulseCloser Fault Interrupters, which use high-precision sensing and measurement methods and a low-current fault-testing feature called PulseClosing® Technology. This technology uses less than 5% of the network's fault energy to test for faults, significantly decreasing the stress—and sparks—produced by fault-testing. This ability convinced the utility to pilot the fault interrupters.

Evoenergy wanted to take these innovative capabilities one step further and develop an algorithm to dramatically improve its SEF-protection response to high-impedance earth faults. The utility worked with S&C to create an operating logic map that determined how IntelliRupter fault interrupters would react to greater high-impedance earth-fault scenarios in addition to typical low or high fault-current levels. If the IntelliRupter fault interrupters detected high-impedance earth faults, they would trip and remain open rather than continue to test for the faults.

After developing the algorithm logic, S&C updated an IntelliRupter fault interrupter's firmware and tested its coding and response to ensure the algorithm enabled it to successfully detect high-impedance earth faults in the field. Evoenergy then collaborated with S&C to generate a simplified mathematical network model to simulate and analyze the network's sensitivity to high-impedance earth faults and examine how the new algorithm would react to mock field scenarios.

The studies considered high-impedance earth faults near the substation and grid edge and worst-case voltage measurements. This demonstrated the precision of the algorithm and the IntelliRupter fault interrupter's sensing. After configuring the settings of a trial IntelliRupter fault interrupter

to meet Evoenergy's network requirements, S&C successfully ran multiple 11-kV network high-impedance earth-fault tests in its high-power laboratory.

Before Evoenergy deployed the device in the field, the utility installed the IntelliRupter fault interrupter in its training yard. S&C performed a test operation to show the utility's crew how the devices would operate in the field and supported Evoenergy with commissioning services prior to energization.

FIGURE 2. An IntelliRupter fault interrupter deployed on an Evoenergy feeder in a bushfire-prone area.

Results

S&C's willingness to deeply understand Evoenergy's network makeup and requirements up front, perform necessary testing to test how the device would operate in the field, and manage the project through completion made a positive impression on the utility. The utility appreciated S&C's diligence in developing a protection analysis so the IntelliRupter fault interrupter would interoperate with the utility's network-protection devices.

Evoenergy also presented the algorithm test documentation and reports to Australian regulators. The regulators accepted and approved the test results, recognizing the IntelliRupter fault interrupter's unique capability of addressing high-impedance earth faults while significantly reducing fault energy.

With the success of initial testing, Evoenergy installed multiple IntelliRupter fault interrupters with the algorithm and is considering deploying additional devices throughout its network. By collaborating with S&C on its environmental challenges, Evoenergy is preparing its grid for greater reliability and resiliency.

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