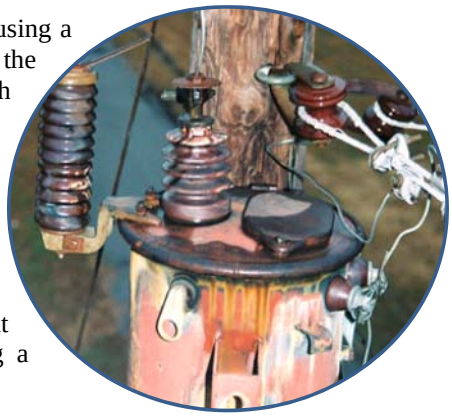
DFA Technology Alerts Utilities to Bad Bushings, Avoids Outages

Cracked and burned bushings and insulators are well-known causes of interruptions and outages. DFA technology enables utilities to avert sustained outages resulting from apparatus failures, including compromised bushings. By applying intelligent, on-line algorithms to substation-based current and voltage waveforms, the DFA system detects electrical precursors and alerts utilities of developing problems. In the case of the burned bushing shown below, the utility used the DFA to discover the problem existed, locate the burned bushing, and make repairs that preempted a likely future outage. At no point did the utility receive any customer complaints related to this issue; the DFA system provided their first and only notice.

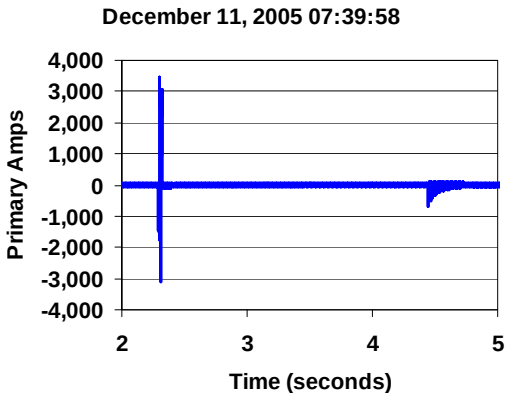


As commonly happens, the compromised bushing flashed over on a dewy morning, causing a 2,300-amp fault that tripped a hydraulic line recloser in two cycles. Two days later, the bushing flashed over again, causing another single operation of the same recloser. In each case, 24 customers saw a two-second interruption, but none experienced a sustained outage or called to report the momentary interruption. As a result, the utility had no conventional notice of the developing problem.

One component of the DFA system's function characterizes and reports individual faults and recloser operations, such as these two. Individual momentary faults generally do not cause specific concern, because they result from transient conditions and are cured by reclosing. A damaged bushing constitutes a special case, however, because it typically flashes over repeatedly, over a span of days or weeks, each time causing a momentary interruption and eventually evolving into a permanent fault.

Besides reporting individual faults, the DFA system draws special attention to recurrent faults, such as those caused by compromised bushings. In the subject case, the DFA system alerted the utility the day after the second flashover. Then, by combining fault and protection-system characteristics provided by the DFA system with the utility's fault-current maps and known recloser placements, the utility targeted a small portion of the feeder for patrol. With one hour of effort, a two-man crew found the failing bushing and scheduled the transformer for replacement. Before the replacement was carried out, the bushing flashed over again, causing a third momentary interruption. DFA-based notification of this third fault prioritized the replacement, and there were no further consequences. By contrast, the same utility documented a separate case in which a damaged bushing flashed over five times, during a period spanning six weeks, before finally causing a sustained outage involving more than 900 customers.

Running contrary to conventional wisdom, the three momentary interruptions of 24 customers generated no customer complaints. DFA research has documented this unexpected pattern on multiple occasions. Conversely, when customers on feeders without DFA make vague, non-specific reports of problems such as "blinking lights," conventional diagnosis can be challenging and time-consuming. It is difficult to know whether the problem is even on the primary feeder, much less locate the specific cause. The process of tracking down such a complaint may require significant man-hours and span several weeks. With DFA, utilities learn of problems before customers call. Moreover, if a customer complains of blinking lights on a DFA-equipped feeder, the utility can quickly determine whether there is a primary-feeder problem, such as a recurrent fault, or alternatively, that the problem must lie elsewhere, perhaps on the secondary side of the customer's service transformer.



About DFA Technology

Distribution Fault Anticipation (DFA) technology was developed at Texas A&M University as the result of analysis and characterization of thousands of high-fidelity electrical current and voltage waveforms. Researchers created this database of waveforms with extensive support by EPRI and more than a dozen utilities, which installed high-fidelity, high-capacity data-recording devices in their substations and connected CTs and PTs as inputs. Sensitively triggered waveforms were recorded over multiple years, to produce a database that documents the electrical waveform signatures of numerous failure modes and incipient-failure modes of line apparatus, enabling researchers to develop sophisticated, on-line algorithms to alert utilities about failures, sometimes even before they result in outages. The DFA system performs autonomously, to deliver actionable information without requiring human experts to analyze and interpret raw data.

For More Information

For more information about DFA technology, please contact Dr. B. Don Russell, Regents Professor (979-845-7912, bdrussell@tamu.edu), or Mr. Carl Benner, Senior Research Engineer (979-845-6224, carl.benner@tamu.edu) at Texas A&M University.