Automated Fault Analysis Using an Intelligent Monitoring System

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Abstract
Distribution feeders are complex systems comprised of numerous components, which are expected to function properly for decades. Electrical, mechanical and weather-related stresses combine to degrade components. Degradation accumulates over time, gradually impairing components' ability to perform properly and ultimately leading to failures, faults and outages.

Work at Texas A&M has documented electrical parametric changes that occur as apparatus degrade. Taking advantage of these changes holds promise for helping utilities improve service quality and reliability, but intelligent algorithms and systems are required to acquire, analyze and otherwise manage the significant volume of data necessary to realize such benefits.

Keywords: Power system reliability, power system faults, incipient faults, condition-based maintenance, apparatus failure

Introduction

Distribution feeders consist of numerous interconnected components, many with expected lifetimes measured in decades. Individual component failures cause faults, interruptions, and outages, and result in degraded service reliability and quality for utilities and their customers. The sheer number of line components makes it impractical to routinely inspect, test or replace en masse.

Considerable industry efforts have defined indices for measuring reliability. In general these indices are functions of the number and duration of outages and of the number of customers affected. Some faults result from precipitous events, often external to the power system itself. An automobile striking and breaking a pole is one such example. Another is a tree outside the utility right-of-way breaking and falling across a line during a storm. Other faults, interruptions and outages occur because of component failures that result from long-term accumulation of electrical, thermal and mechanical stresses.

A reasonable hypothesis is that long-term degradation processes begin to permit subtle, unintended current flows that worsen over time, eventually reaching "break-down" conditions that result in significant fault current. In 1997 Texas A&M researchers began a large-scale project to determine whether electrical signals from incipient failures could be measured and used to predict impending failures. This effort involved instrumenting dozens of utility feeders with sensitive, high-fidelity, high-capacity devices to collect electrical waveform data when anomalies occurred on those feeders. This work, which became known as Distribution Fault Anticipation (DFA), was sponsored in large part by the Electric Power Research Institute (EPRI) and EPRI-member utility companies.