Project 13-10:
Smart Grid Impact on Distribution Reliability

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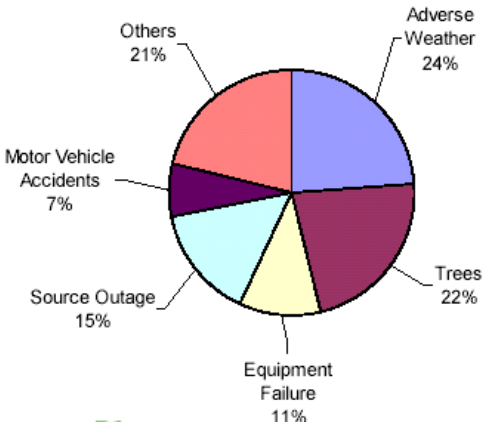
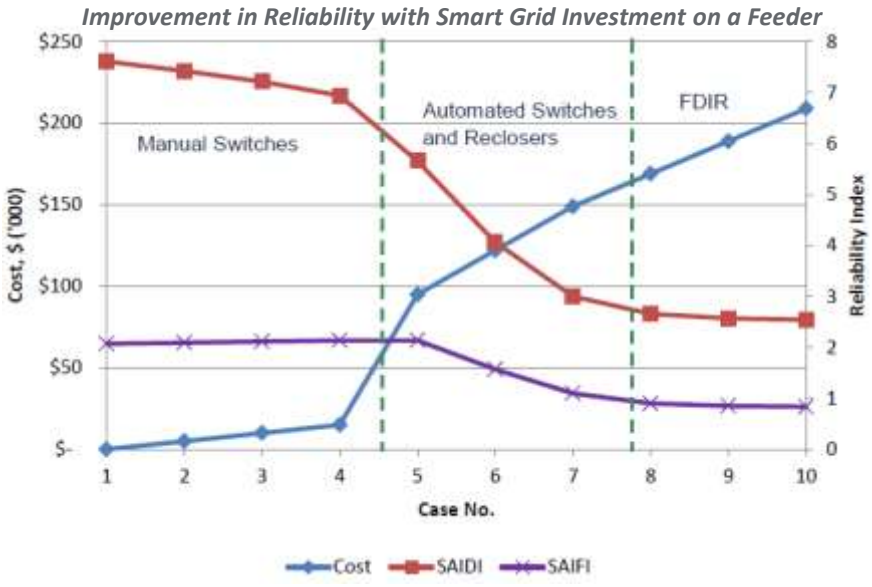
Project Summary:

According to Department of Energy (DOE) data, the total annual cost of power interruptions in the US is estimated to be about $80 billion, the majority of which is attributed to commercial and industrial customer interruptions. Since significantly more service interruptions are directly related to distribution facility failures, the reliability of the distribution system is under more intense scrutiny by customers, municipalities, utilities, and state regulators.

The most common causes of outages on distribution feeders are equipment failures, vegetation/trees, lighting, animals and human-related accidents, as shown in the figure to the right. Most of these are directly addressable by relatively low-cost measures such as inspection, vegetation management, wildlife guards, lightning protection, and education. With advancing technology, more expensive measures have become available to anticipate and prevent equipment failures. These include online monitoring and diagnostics (M&D), failure prediction and prognostics. In addition, other technologies are available to quickly locate failures and restore service by switching or reconfiguring circuits. While some of these technologies have been around for a while, and others are a natural evolution of current measures, they are nevertheless commonly grouped under the "smart grid" umbrella.



One of the promises of the "smart grid" is that it will improve the operation of the aging power delivery infrastructure by providing increased visibility and control of distributed assets. Technologies such as advanced metering infrastructure (AMI), fault location, isolation and service restoration (FLISR), and others have the potential to impact grid operations by offering near real time sense and respond capabilities to changing conditions.



This project directly and specifically addresses impacts of smart devices on distribution reliability and discusses the inherent benefit/cost tradeoffs in the applications. To achieve the desired objectives the major tasks performed as a part of the overall project were: (1) review literature, case studies and utility practice, (2) collect expert opinion through interviews, (3) quantify impacts of smart grid investment on reliability through circuit simulation.

The system impact analysis was performed on real distribution feeders provided by DSTAR members. The feeders were conditioned for a base assessment without smart technologies and reliability was assessed. Technologies such as manual and automated switches, reclosers, alternate feeds, FLISR etc. were applied to these conditioned feeders in increasing levels of investment.

The change in reliability indices was then assessed for each level of investment, and benefit-cost ratios were computed. An example of the change in reliability is shown above.

Table of Contents:

Who Should Use:

Distribution Operations, Planning, Reliability, DER/Grid Modernization Groups

For the complete report on Project 13-10: Smart Grid Impact on Distribution Reliability, visit www.dstar.org.

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