Reducing Customer Outages—Smart Distribution through Layered Intelligence™

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The current economic climate has created a challenge for electric distribution utilities in determining the right direction and choice of technologies in which to invest in order to reliably and economically manage their distribution grids. They are continually being challenged by customers and regulators to improve service reliability and quality by reducing unplanned outages.

In parallel, regulators—federal and local—are advocating policies for increasing renewable energy, including solar and wind that is connected directly to distribution voltage levels, and for energy-efficiency programs, including demand response, to further reduce our carbon footprint.

Electric distribution utilities understand that continuing to plan and invest in their existing grids for peak capacity in this challenging economic climate with increasing uncertainty may no longer be a valid investment strategy moving forward. The industry is starting to investigate solutions from advances in other industries, such as telecommunications.

To manage the growing complexity, utilities are adopting Smart Grid technologies, initially through pilot programs including those led by the Department of Energy (DOE) under the American Recovery and Reinvestment Act economic stimulus package. These pilot programs have enabled industry to innovate and deploy new technologies, whilst also proving the viability and business case for these technologies to enhance grid operations.

Smart Distribution

The industry introduced the term “smart distribution” to classify these new challenges and technology solutions. Although still an evolving concept, it addresses several industry objectives:

- support self-healing and autonomous restoration—the ability to restore healthy sections of the network after a fault without intervention by distribution operators
- support distributed energy resource deployment—the capability of incorporating generation, storage devices, demand response, and electric vehicle charging
- support bi-directional flow of energy and information—the ability to actively manage the flow of energy from distributed energy resources and to effectively use the bi-directional flow of information for enhanced distribution grid operations
- enhance security of supply and power quality—the ability of the distribution grid to maintain supply to customers under abnormal conditions and quality of power delivered at a level that meets customers’ needs
- minimize investment and operations costs—providing a high level of overall efficiency in the distribution grid through innovation, advanced energy management, and support for third-party service arrangements
- minimize the potential for delaying investment in distribution grid and centralized generation for peak load management
- minimize technical and commercial losses—utilizing efficient devices and control technologies to reduce losses at all points in the grid and reduce costs and carbon emissions
- resist physical and cyberattacks—the ability to withstand attacks to the physical distribution grid and its control systems either directly or via the internet

Electric distribution grids are complex to manage because of rural population, size of land areas covered, and the age of existing equipment. A key area in which new Smart Grid technologies have shown potential to address the above issues is the detection and isolation of faults for faster service restoration (also known as self-healing).

This is being accomplished initially with the deployment of advanced distribution automation (ADA) equipment, which includes automated feeder switches and fault-interrupting devices that actively manage and correct faults in the field. It is traditionally referred to as local fault management. Recently, the deployment of smart meters and automated metering infrastructure provide an alternative for distribution utilities to detect customer outages and potential faults instead of waiting on customers to call during outages.

To benefit from these new technologies, utilities have started to augment their basic control room SCADA (supervisory control and data acquisition). It is software with enhanced distribution management and grid optimization modules, known as integrated distribution management systems (IDMS). An IDMS platform includes SCADA, distribution management, and outage management modules, and is used for enhancing distribution control room operations.

IDMS is capable of using all available information to locate faults and automatically restore healthy portions of the distribution grid, i.e., centralized fault management. For the sections that do require manual intervention, the above information will help guide the crew to the approximate location instead of having them locate the fault manually. This helps reduce fuel costs (carbon emissions) and customer outage times, thus improving reliability indices.
Combining Real-Time Response with Regional Control

In January 2012, S&C Electric Company and Alstom Grid announced an integrated solution that combines S&C’s IntelliTeam® SG Automatic Restoration System and Alstom Grid’s e-terradistribution™ IDMS. An evolving methodology known as Smart Distribution through Layered Intelligence®, it integrates and optimizes local and centralized fault management technologies through enhanced integration between an IDMS platform and ADA equipment.

An integrated IDMS-ADA solution combines rapid, real-time response to system conditions and represents a significant step for the industry because it is a truly integrated solution, not just an interoperable solution, enhancing control room operator usability and situational awareness.

By providing an integrated solution, utilities are now able to deploy Smart Grid technologies with confidence that the true value of these technologies is realized to enhance customer satisfaction from improved grid reliability. The new solution also supports self-reporting of system reliability, efficiency, and capacity improvements. These help utilities track the benefits from investments in Smart Grid technologies. And by sharing some of this outage data including expected time for customer restoration using online social networking services, customer satisfaction has improved significantly.

The Smart Grid pilot programs have created jobs, stimulated technology innovation, fostered public-private partnerships, and renewed academic interest in electrical engineering while simultaneously re-energizing the younger generation to pursue careers in this industry. With the continued support of DOE and regulators, the industry is now looking forward to the day when customers will no longer experience sustained outages without transparent restoration information.

Thomas Edison once said, “There’s a way to do it better—find it.” Smart distribution is the better way for electric utilities.

Dr. Jayantilal is responsible for vision, strategy, product management, and business development for solutions and technologies in electric distribution utilities. A senior member of IEEE and a member of IEC, his interests include enhancing grid performance through innovation and solutions.

Mr. McCarthy, a registered professional engineer, has participated in R&D, marketing, and field application support for IntelliRupter® PulseCloser. He is also responsible for product management, application support, and strategic marketing for all automation products.