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How Entergy Battled the Hurricanes



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There are millions of miles of distribution lines in the United States. They weave through every neighborhood, office complex and industrial park in the country. As the demand for electricity increases, so too do expectations for the reliability of the electricity which is delivered on these lines. To operate these growing distribution systems while maintaining or increasing reliability, utilities are turning to distribution automation.

Isn't it Time You Took Another Look at Distribution Automation?

By Nathan Bingham, P.E., POWER Engineers

Distribution automation is a broad term which includes various different types of automation systems such as automated meter reading (AMR), fault sectionalization, auto-restoration and automatic capacitor control. The purpose of each is to automate functions that previously were done manually as well as increase reliability (by limiting the scope of outages and aiding in restoring power more quickly) and safety (by reducing opportunities for human error through use of automated switching routines and reducing human interaction with overhead switches).

The primary benefits of distribution automation are well known. What is less known is that by using distribution automation in secondary applications, owner/operators can increase reliability and justify their installation in ways which could not have been done before. This article will discuss how to achieve greater functionality out of two particular distribution automation systems: AMR and fault sectionalization/auto restoration. The costs savings of AMR are well-known, as are the reliability benefits of fault sectionalization and auto restoration. The trick is to make each type more easily

justifiable from both a cost *and* reliability standpoint. The goal is to provide a reason for your utility to take a second look at distribution automation.

Maximizing the Benefits of AMR

The primary purpose of AMR is to automatically read meters to compile customer electric usage data for billing purposes. Historically, electric utilities have used meters that require a utility to dispatch field technicians to conduct monthly visits to each and every meter to collect customer usage data. Customer data from these meters is then compiled and used for billing. The problem with this system is that manually reading meters and inputting data into billing systems requires a huge amount of labor and increases the likelihood of errors. AMR systems automate the entire meter reading process by not only automatically reading the meters but also incorporating billing software so that a customer's bill can be generated at the same time every month with minimal human interaction and data input errors.

There are various types or styles of AMR implementation choices, each with comparative advantages and disadvantages. Fixed AMR systems consist of a system server that resides in an operations center and communicates to meters using a dedicated infrastructure, such as a radio or power line carrier system. In this type of AMR, automated meters provide customer usage information (kVAh, etc.). In addition, line voltage at the meter and power quality information is also available.

Since the meters—along with the communications module on the meter—run on line power, if one stops communicating with the server, a utility can deduce that there has either been an equipment failure somewhere within the AMR system or the customer is out of power. By linking this meter communication status into a geographic information system (GIS) or other outage management

software, the impact of an outage can be quickly identified. With affected customers shown on a GIS map with other system infrastructure (fuses, switches, etc.), the possible fault locations become easy to identify and repair crews can be more accurately dispatched, resulting in shorter outage durations.

For example, suppose a tree limb brushes up against a distribution line which causes a fuse to blow on the line. With conventional methods, the outage is first identified only when a customer calls to notify the utility that their power is out. If this customer is at the end of the feeder, the utility would be forced to check all of the fuses on the feeder and then patrol the section down line from the blown fuse to find the cause of the outage. If an AMR system were tied to a GIS or outage management system, a utility would be able to view a system map showing each fuse on the feeder combined with every affected customer making it easy to identify which fuse was blown. Repair crews could then be dispatched to the precise location, significantly reducing outage times.

As software and communication systems continue to evolve, so do the uses for AMR systems. AMR could also be used for peak demand billing of customers, closed loop voltage regulation or load shedding for specific customers, each helping utilities to provide more reliable power with better returns.

Reaping Reliability Rewards with Fault Sectionalization/Auto Restoration

Like AMR, utilities have used fault sectionalization on distribution lines for years. But this technology, too, has functionalities beyond its intended design. In its most basic form, fault sectionalization is accomplished by fusing a distribu-

tion line, such that when a fault occurs beyond a given point, a fuse will blow, keeping the lights on for customers ahead of the fuse. By replacing fuses with automated switches or reclosers, a utility gains the added benefits of reclosing as well as auto-restoration capabilities, further reducing the possible impact of an outage.

By adding communication capabilities to the switches or reclosers, utilities gain remote indication and control as well as the infrastructure for more advanced methods of auto-restoration. These more advanced auto-restoration schemes typically take on one of two configurations: a peer-to-peer configuration or a centralized configuration. In the peer-to-peer configuration, switch controllers are configured with various parameters such as feeder load limits, voltage requirements and switches which can serve as alternate power feeds if the primary source is cut off. In the event of an outage, switch controllers communicate with each other by sharing information such as last known load levels and present position. This information is used to calculate the switching required to restore power to as many customers as possible. In the centralized configuration, the distribution switch or recloser controllers for a defined area communicate to a single system controller. This system controller utilizes the collected information along with the configured system constraints to determine how to best restore power to the affected area.

Auto-restoration, combined with auto-sectionalization, reduces both the impact and duration of an outage for all customers not on an affected feeder segment. It

also identifies the exact feeder segment where the fault occurred. For utilities that are held to perfor-

mance-based rates, auto-restoration has

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been a successful method for bringing down prices, though it has been slower to take hold with utilities that are not held to reliability standards, as it is sometimes difficult to justify the costs of such a system.

However, by utilizing the switch controllers and communications systems associated with auto-restoration systems for additional automation functions, fault sectionalization/auto-

restoration costs begin to be justifiable regardless of whether or not a utility is driven by performance-based reliability standards. Take the following scenario to demonstrate this point. Suppose loading in a certain region has increased to a point where an additional substation is needed to carry load during periods of high loading or there is no longer the backup capacity in a particular station for reliable system operation. This situation would typically warrant the construction of a new substation to support the load and provide adequate backup capacity.

However, if the surrounding substations have surplus capacity that can be utilized during periods when the first station is overloaded, it may be possible to use automated switches or reclosers to dynamically modify feeder configurations to reduce loading on the overloaded substation. With this technique, a utility can eliminate the need for a new substation and justify the new distribution automation infrastructure's cost.

In 1997, Northern Indiana Public Service Company (NIPSCO) began using this type of distribution automation to eliminate the need to build a new substation in the Goshen area. Since that time, NIPSCO has installed similar systems in seven additional areas. At the time, the cost of a new substation in

Goshen was estimated at \$1.3 million. Implementing this load shifting automation cost \$1.1 million, which resulted in an immediate savings of approximately \$200,000, not taking into account the ongoing maintenance costs associated

with the new substation. In addition to the cost savings, the Indiana-based utility gained auto-sectionalization and restoration system capabilities, thereby increasing system reliability.

NIPSCO also added into the automation routine the ability for surrounding stations to pick up the load of an adjacent station in the event of a single transformer station bus fault or a station transmission outage. This feature has proven to be very valuable reducing outage durations from a typical 3.4 hours to 90 seconds for stations where this has been implemented.

Today, nearly 10 years after NIPSCO initially determined a need for a new substation in the Goshen area, one is only now being built. It is likely this new substation would have been needed even if the substation originally discussed in 1996 was constructed (instead of the distribution automation) because the area's growth shifted to the opposite side of the city, which meant the city had to construct the new substation in this growing area anyway. Distribution automation has essentially given NIPSCO the ability to locate the new substation in a more desirable location and provided an added benefit of reducing the size from a two to a single transformer station by utilizing neighboring stations for backup thanks to the load shifting routine.

A Final Word on Distribution Automation

Distribution automation has become a valuable way to extend the functionality and reliability of distribution systems. As

distribution automation technologies and techniques evolve, secondary and tertiary uses of distribution automation are now making the technology more practical in terms of both increased reliability and reduced costs. Besides reducing labor costs and errors, we see that utilities can use AMR, when paired with GIS and outage management software, to more accurately predict outage locations. By leveraging fault sectionalization/auto-restoration infrastructures for additional automation functions, such as load shifting, solid cost justifications can be made for its implementation while at the same time receiving improved reliability benefits.

Electricity is essential to our way of life, making reliability more important than ever. By seeing beyond the primary uses of distribution automation, it becomes not only a way to increase your customer's satisfaction but also a way to increase your bottom line. Isn't it time you took another look at distribution automation? <<

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