Case Study

A Matter of Scale:

How an Investor Owned Utility in Illinois Incorporated A Scalable Approach for Distribution Automation

Challenge

Across the country, power outages are becoming the norm. Consequently, customers are growing increasingly frustrated and more costs are being incurred by utilities, leaving them with no choice but to pass that cost along to customers. That is why the goal for every utility is to constantly improve power reliability. Providing reliable power does more than keep customers happy, it helps reduce economic and productivity losses. One investor owned utility in Illinois had become all too familiar with frequent outages, but when it looked for help, it didn't have to look too far. Long-standing supplier and neighbor, Bolingbrook, Illinois based G&W Electric was called upon to help the utility provide a scalable approach to distribution automation so the utility could provide reliable power to its 1.2 million customers in Illinois.

Control Room

While it's almost impossible to predict when an outage may occur, technologies are available today that can help utilities restore power automatically and minimize the number of customers affected by sustained outages. Customers across Illinois experienced sustained outages due to not having a way of automatically restoring power. Whenever a fault or loss of voltage would occur in a non-automated system, a utility worker would need to be notified and then send out a repair team to restore power manually. Across a service territory of 43,700 square miles, it can be extremely difficult and time consuming to determine the location of an outage before traveling to fix it. While it is simple to minimize the reliability issue by implementing an automated system, this typically requires a significant capital and financial investment to install the necessary pieces of equipment.

But other solutions were possible. The utility company knew that in working with one of its long-time suppliers and partners, G&W Electric, they could collaborate to improve its power reliability on multiple existing 69 kV circuits. The electrical provider and G&W Electric had collaborated in the past and when the two companies put their best engineers together, customized, powerful solutions became possible. However, G&W Electric didn't manufacture sub transmission equipment to serve at the 69kV voltage level. In order to improve distribution system reliability, G&W Electric's engineering team worked with existing SCADA (supervisory control and data acquisition) system to provide FLISR (fault location, isolation, and service restoration) functionality —something that had not been done before at the 69kV voltage level.

A New Way to Incorporate FLISR

When it comes to reliability improvements, FLISR is one of the most effective ways to improve reliability without exhausting critical human resources. Essentially, it's an automated way of restoring power as fast as possible to as many customers as possible. While FLISR can help minimize the impact of customers affected, it cannot prevent an outage.

Reliability metrics to evaluate FLISR operations:
1) The number of customers interrupted (CI),
2) The number of customer minutes of interruption (CMI).

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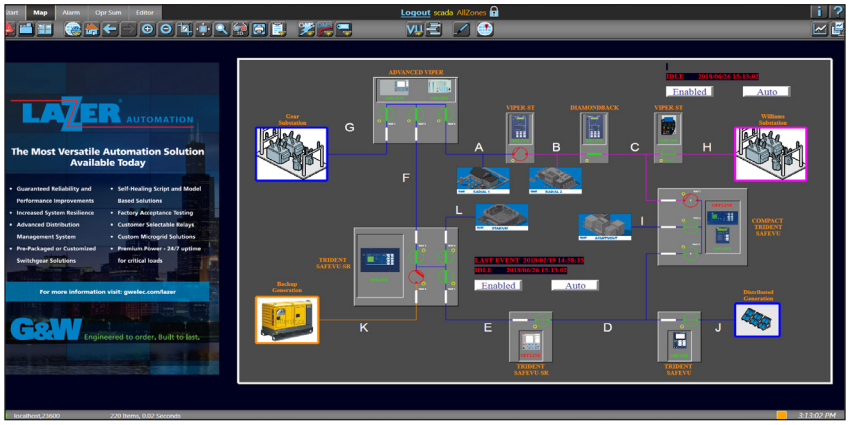
In a 2014 Department of Energy study of five utilities with FLISR functionality established, FLISR was found to reduce the number of customers interrupted (CI) by up to 45 percent and the customer minutes of interruption (CMI) by up to 51 percent for an outage event. Both metrics are components of the equations that are used to calculate System Average Interruption Frequency Index (SAIFI) and System Average Interruption Duration Index (SAIDI).

For years, the utility felt its performance of its frequent and lengthy outages were unacceptable. As mentioned before, the major reason for the sustained outages was the lack of a way of automatically restoring or redirecting power. At the time, the current system required a dispatcher to be notified of an outage. From there, a crew would be dispatched to travel to the circuit to ascertain the reason for the outage and rectify the issue to restore the circuit. This total process could take as long as six to eight hours to complete. On average, it took one-third of that time to find the location of the fault. Often times, the source of an outage may not be known until a customer flags it, such as reporting a down tree on a powerline.



Sample of LaZer® communication

Solution

G&W Electric and the utility's engineers jointly installed a server computer located in a secure location equipped with the software provided by G&W Electric to facilitate FLISR functionality at the 69kV voltage level. With the FLISR software installed, the server computer can now process all the information it receives from the SCADA system to determine actions that need to be taken to minimize the number of customers affected during an outage. The initial solution incorporated 12 switches and eventually scaled to 44 switches across six (6) 69kV circuits that provide real-time and critical data that can be analyzed, acted upon and corrected.

FLISR applications provide greater visibility into outages and can automatically reroute power, ultimately minimizing the number of customers impacted by outages. With fewer and shorter power disturbances, a utility can improve its standard reliability metrics such as System Average Interruption Frequency Index (SAIFI) and System Average Interruption Duration Index (SAIDI).

How it works?

The FLISR software has a simplified one-line diagram that includes all 69 kV switches that participate in this automation logic. All devices on this one-line diagram have data points mapped to them which are being exchanged with the existing SCADA system via an Inter-Control Center Communications Protocol (ICCP).

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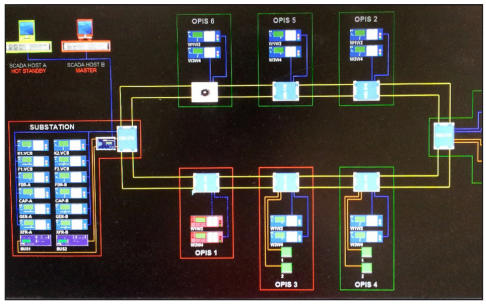
Utilizing those data points from the field, the software sends commands back to the SCADA server who then distributes the commands back out to the devices as needed.

It is unlikely that a single software package can be replicated for utilities across the country. There can even be several differences within an individual utility. One challenge going into this project was, that FLISR had never been done at the 69kV voltage level. Typically, this solution is utilized at voltage levels between 5kV and 38kV. The G&W Electric team worked with the utility engineers to design, engineer, test, deliver, and commission a LaZer® Automation system as a pilot involving twelve (12) 69kV switches.



Sample of software communication

During that pilot, G&W Electric trained utility operators to become self-sufficient and expand the system to grow the FLISR installation. The ability to scale the system independently from G&W Electric lead to significant savings for the Illinois utility provider and will continue to do so over the coming years. Completing the pilot project involving 12 switches and providing in-depth training to utility workers was completed within 12 months in 2016. With the first line being the most problematic portion of the system, the utility decided to expand to other lines in the system to try to capture more events. Over the next two years, the FLISR system was expanded to the currently participating 44 switches.

Scalable Changes Made with Positive Results

While the main benefit of a centralized FLISR system is having the ability to minimize the number of customers subjected to an outage, the biggest benefit of this solution is that it enabled the electric provider to augment the FLISR functionality to its existing SCADA system, eliminating the need to make sweeping changes to the existing system.

Another reason this software was selected was because most automation solutions that are offered with FLISR functionality only offer two modes of automatic operation, on or off. The software installed by G&W Electric provides three modes of operation: on, off, and semi-automatic mode. Automated FLISR actions typically take a few seconds, while manually validated FLISR actions can take five minutes or more. The semi-automatic mode provides control room operators a report of suggested steps (switching orders) which provides the utility with critical insights and details on how and why the system will respond to the fault. This enables them to make the best decision to minimize the outage.

The semi-automatic mode also provides another layer of peace of mind. While some utilities might be wary of switching to a fully automatic system, the semi-automatic mode provides critical data and doesn't take any action by itself automatically. Initially, the utility let the system run in semi-automatic mode for the first six months after the completed pilot installation. During these first six months, the utility encountered three automation events that were captured in semi-automatic mode. The resulting switching orders gave the electric company the confidence to use the fully automatic mode and let the system run by itself for any future events.

Utilities are facing more pressure than ever to implement effective distribution automation solutions. Severe weather conditions are becoming more common and customers and regulators are demanding that utilities increase reliability. By using this approach, G&W Electric leveraged existing switches and SCADA system to provide a very scalable approach to distribution automation without making a cost prohibitive investment. While distribution automation is typically achieved by investing in equipment in the field such as overhead and padmount switchgear, with this solution, the utility is able to use instant data from the existing SCADA system to have FLISR functionality, without making a costly investment. Using the new FLISR software system, the utility can assess the situation and make decisions to restore power faster during an outage.

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