



SCADA Systems Automate Electrical Distribution

PC-based supervisory control and data acquisition systems increase uptime, cut costs and improve utilization.

A White Paper from InduSoft

Fabio Terezinho is the Vice-President of Consulting Services and Product Manager at InduSoft.

Electric utilities must meet increasing demand for reliable power distribution while coping with decreasing tolerance for disruptions and outages. More than ever, utilities are squeezed to do more with less, and recognize the need to improve the efficiency of their power generation and distribution systems.

Fortunately, many areas of the existing electrical distribution system can be improved through automation. Furthermore, by automating the distribution system now, utilities will be ready to meet the challenges of integrating intermittent supply sources like solar, wind and other distributed energy resources (DERs).

Automating electrical distributions systems by implementing a supervisory control and data acquisition (SCADA) system is the one of the most cost-effective solutions for improving reliability, increasing utilization and cutting costs. (Figure 1)

How SCADA Works

A SCADA system for a power distribution application is a typically a PC-based software package. Data is collected from the electrical distribution system, with most of the data originating at substations. Depending on its size and complexity, a substation will have a varying number of controllers and operator interface points.

In a typical configuration, a substation is controlled and monitored in real time by a Programmable Logic Controller (PLC) and by certain specialized devices such as circuit breakers and power monitors. Data from the PLC and the devices is then transmitted to a PC-based SCADA node located at the substation.

One or more PCs are located at various centralized control and monitoring points. The links between the substation PCs and the central station PCs are generally Ethernet-based and are implemented via the Internet, an intranet and/or some version of cloud computing.

In addition to data collection, SCADA systems typically allow commands to be issued from central control and monitoring points to substations. If desired and as circumstances allow, these commands can enable full remote control.



Figure 1: Utility power transmission and distribution system must collect and distribute power from a variety of generation sources, many of them intermittent, creating a need for automated monitoring and control.

Increase Uptime, Cut Costs

Many utilities still rely on manual labor to perform electrical distribution tasks that can be easily automated with SCADA systems. In addition to cutting labor costs, automation facilitates smoother operations while minimizing disruptions. Modern SCADA systems feature built-in redundancy and backup systems to provide sufficient reliability, and can be much faster-acting and consistent than manual processes.

SCADA systems, however, do more than simply collect data. They also deliver automated control that greatly benefits utilities. Their alarms detect problems in the system, and analysis of these problems enables adjustments and corrections, often preventing an outage.

In the event of an outage caused by an unforeseen event like a storm, a SCADA system's advanced data collection capabilities help field workers quickly identify the exact location of the outage without having to wait for customer calls.

Moreover, a SCADA system can significantly increase the speed of power restoration following an outage. SCADA-enabled switches and line reclosers can help operators isolate the outage and open adjacent automatic switches to reroute power quickly to unaffected sections—all without the need for a line worker to visit the site to perform a lengthy visual inspection, often followed by an educated guess as to the exact nature and location of the problem.

Improved Operations Meet Demands

Modern SCADA systems provide powerful tools that give operators a real-time view into operations in order to optimize the power distribution system for maximum efficiency. Trending tools arrange data in various ways, and graphical interfaces simplify analysis.

Historians store data from past events, facilitating comparisons among various operating scenarios. For example, excess capacity can be identified more easily, so power can be rerouted from areas approaching overload.

Analyzing trends and historical data also helps maintain desired power factors, voltage levels and other distribution system parameters at desired levels. These parameters are becoming more difficult to maintain because power supplied to the distribution system now comes from multiple sources in addition to large base-load power stations.

These new sources are primarily DERs, small scale decentralized power storage and generation sites, typically 15MW or less per unit or site. DERs usually aren't owned by the local utility, but by end users. Power from DERs is used to meet local on-site end user needs, and excess power is sold back to the utility via the local power distribution grid.

Types of DERs include but aren't limited to gas turbines, diesel engines, micro turbines, flywheel energy storage systems, fuel cells, batteries and super capacitors. Rooftop solar photovoltaic, small

wind power and geothermal sites are also part of the DER mix. These DERs can cause havoc with the electrical distribution system due to the intermittent nature and the quality of the supplied power. On the demand side, DERs also have a significant impact because they can cause power needs at a site to go from full load to negative as local generation sources are started up to supply power back to the grid. Automating DER monitoring in real-time with a SCADA system enables operators to make more informed adjustments faster, and to uncover trends and address issues before they occur.

Implementation Considerations

While a modern SCADA system provides multiple benefits in a cost-effective manner, there are factors to consider. At the substation level and at DER connection points, data must be collected and made available to the SCADA system.

This is typically done by bringing all desired data points into a local controller such as a PLC. This may necessitate replacing manual monitoring devices such as gauges and meters with new power monitoring hardware compatible with the PLC. In other cases, automated devices may communicate via protocols not recognized by the PLC.



Figure 2: Much of the data needed to effectively monitor and control a power distribution system is found at substations, but collecting these data can be challenging.

For example, if a power monitoring device has a Modbus port and the PLC does not, some type of hardware protocol translation device might need to be purchased, configured and installed. However, some SCADA software packages offer the required DNP3 and IEC-60870-5-104 protocols, eliminating the need for a hardware device by using the SCADA software as the protocol translator.

In large substations, it might be necessary to convert all digital data protocols to Ethernet, and to install Ethernet switches and routers. The router would then be typically connected back to the central SCADA stations.

Once data is collected and delivered to the central station—action is often needed at the substation, the DER connection point or some intermediate switching device. This often requires replacing manual switches with automatic switches, which can be costly and can require particular line segments to be de-energized for installation. (Figure 2)

Connections among substations, DER connection points and intermediate devices must also be installed and maintained. As noted, Ethernet is typically the network of choice; usually implemented via some combination of the Internet, corporate intranets and cloud computing.

Better Data Presentation for Improved Analysis

SCADA systems provide many advantages including increased reliability, reduced costs, improved worker safety, greater customer satisfaction and improved utilization. Their alarms and real-time views into operations can prevent small problems from becoming big ones, and can also speed restoration time.

Standard protocols specifically designed for the industry such as DNP3 and IEC-60870-5-104 enable the SCADA system to collect information with the precision and accuracy required to diagnose shutdown causes and minimize downtime. This cuts time wasted on field visits, and also improves worker safety during outages and power restoration.

Modern SCADA systems provide dynamic dashboards, consolidating historical information with online data in order to provide meaningful information to decision makers.(Figure 3). These capabilities help existing operations uncover waste, and are vital for measuring and maintaining power system parameters as DERs are incorporated into the power generation mix.

Integration with ERP systems via SQL relational databases allows the SCADA system to compare goals with the real-time actual performance, while making this information constantly available to authorized users through standard web browsers. Using these features, the SCADA system becomes an important tool not only for daily operations, but also for strategic decisions.

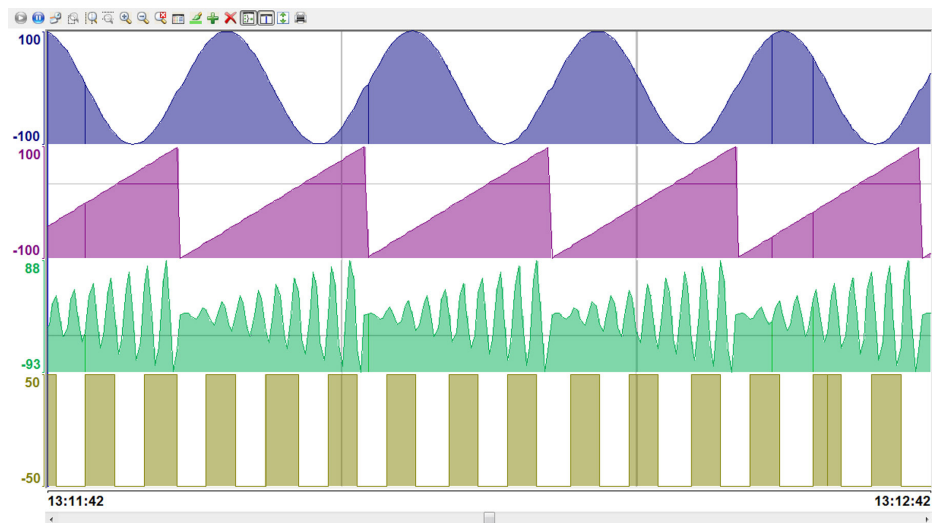


Figure 3: Trend screens allow operators and engineers to view data in a variety of configurable formats, speeding analysis and detection of problems before they occur.

Benefits of Implementing SCADA systems for Electrical Distribution:

- Increases reliability through automation
- Eliminates the need for manual data collection
- Alarms and system-wide monitoring enable operators to quickly spot and address problems
- Automation protects workers by enabling problem areas to be detected and addressed automatically
- Operators can use powerful trending capabilities to detect future problems, provide better routine maintenance of equipment and spot areas for improvement
- Historians provides the ability to view data in various ways to improve efficiency

About the Author:

Fabio Terezinho is the Vice-President of Consulting Services and Product Manager at InduSoft. Mr. Terezinho has over 16 years experience in the automation industry, 13 of them at InduSoft. Mr. Terezinho has equal experience in designing and developing software, and in application deployment. Mr. Terezinho holds degrees in both electronics engineering and electronics technical engineering from Escola de Engenharia Mauá in Brazil, as well as an EMBA from Baylor University. His work has been published in numerous industry publications, and he holds a patent for the Database Gateway Method.

About InduSoft:

Founded in 1997, InduSoft provides a powerful family of industrial software products for developing applications in industrial automation, instrumentation, and embedded systems for all Microsoft-supported operating systems. InduSoft develops tools and technologies that empower people and companies to develop graphical interfaces for embedded PCs, PCs, and mobile devices to highly redundant systems. Today more than 125,000 InduSoft Operator Interface, SCADA, control and data acquisition systems are operating worldwide through direct and partner sales.