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Managing Evolving Complexity on the Electric Distribution Network

How utilities do more with less by using Siemens Spectrum Power™ Advanced Distribution Management System (ADMS)

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Overview
Today's distribution grid is characterized by evolving complexity. More and more resources are being added to the grid creating cost, reliability and safety challenges. How can utilities better manage this complexity, especially at a time when they are being asked to do more with fewer resources? In this paper, we explain how intelligent Advanced Distribution Management System (ADMS) software offers a one-stop shop to make it easier for utility management of distribution networks.

You can’t manage what you can’t see

ADMS software accomplishes this through visualization, automation and optimization. With just one advanced software management system, utilities can fulfill a range of operations and requirements – including Outage Management Systems (OMS), Fault Location, Isolation and Supply Restoration (FLISR), Volt/Var optimization, Distribution Supervisory Control and Data Acquisition (D-SCADA), and Distributed Energy Resource Management Systems (DERMs) functions.

Specifically, we will show how ADMS software helps:

1. Manage distribution network complexity
2. Improve grid reliability
3. Improve operational efficiencies and reduce costs
4. Ensure safety of human life and expensive equipment
5. Enable customer engagement through distributed energy resources

With a sea of data from multiple sources now available to the control center operator, organizing and providing intuitive visualization of this data becomes critical.

The Challenges

Utilities face three main challenges in managing resources on today’s increasingly complex distribution system.

First, they must meet heightened expectations from both regulators and their own corporate leadership to achieve high reliability metrics, and do so by investing efficiently and prudently**.** Second, they must install digitization technologies to handle exponentially increasing amounts of network data. And finally, utilities must optimally manage distributed energy resources to meet safety, operations and economic goals.

Let’s look more closely at these three challenges.

Challenge 1: Improve Reliability

Utilities are under pressure to keep customer rates in check, yet maintain high reliability levels, despite aging infrastructure and a retiring workforce. To overcome this problem, utilities must develop holistic digitalization strategies to more efficiently manage and operate distribution networks. The integration from field devices to control center, software is more important than ever to ensure system reliability for the future.

For example, system outages are increasingly expensive for commercial & industrial customers and frustrating for all consumers. Utilities are pressed to restore outages more quickly than ever before. This requires a system intelligence and level of distribution automation that continues to evolve with the development and deployment of new technologies.

Challenge 2: Manage and Leverage Data

Utilities distribution systems encompass a growing number of smart devices (such as smart meters) that collect network information. At the same time, they have many different software systems, which require greater amounts of data to provide advanced functionality. So to fully integrate and gain value from

the available data, a utility's digitalization strategy must focus on both collection and management.

With a sea of data from multiple sources now available to the control center operator, organizing and providing intuitive visualization of this data becomes critical. Operators need the ability to make quick decisions to ensure a safe and reliable delivery of power to their customers. For example, some utilities may want to visualize the location of every distributed energy resource (DER) on their grid. This may require real-time data transfer between a DER inverter and a utility control system, such as a DERMS or ADMS. To maximize system economics and ensure network stability, utilities can leverage this information to make optimization decisions that take into account load forecasts and DER generation forecasts.

Challenge 3: Ensure Safety

Consumers are adding grid edge devices, such as solar panels, electric vehicles, energy storage and other assets that not only draw energy from the grid but may also input energy. The addition of these devices to the utility network is expected to continue to grow more and more as equipment prices fall and technology advances. Utilities are required to manage the network in a safe and reliable manner including with the addition of these new devices. The utility network was originally designed for a one-direction (source to load) power flow, but with the implementation of these new devices, the power flow can be bidirectional. This reverse power flow can pose a risk to the network equipment and potentially endanger the utility workers. Because of this risk, utilities need to know where these devices are connected and understand the effects these devices have on the distribution network. Once the utility has visibility into the location of the devices, it then needs the ability to control the adverse effects these devices may cause to the grid. In doing so, the utility ensures the safety of people who are working on the grid.

An ADMS system can resolve these three challenges, as well as improve the efficiency and economics of utility operations. We demonstrate how in the following power outage scenario.

The Tale of Two Power Outages

This is the story of what happens on Main Street, USA when a power outage occurs -- with and without ADMS in place.

You can't manage what you can't see

A tree falls on a distribution primary line, knocking out power not only to Main Street but also 50 square miles of a surrounding rural area. The utility does not know where the tree limb came down – or even that it's a fallen line causing the outage. It only knows that the call center is inundated with customer outage calls.

The utility sends out crews which begin the long process of patrolling the network. The crews are working with limited information – only what they learned from the outage calls – as they try to locate the source of the problem. The guesswork could take hours, They finally find the fallen tree.

Fixing the line will take more time, and a 20-block region remains without power, since the crew needs to call in for more assistance. Back in the office, the operations folks are evaluating maps and trying to determine if a plan can be generated to reconfigure the network to pick up some of the customers while repairs are being made. The evaluation helps them ascertain that the adjacent donor circuits do not become overloaded as they temporarily pick up these customers. Lacking network telemetry, they must rely on historical data that may be days or even months old. Testing begins on line capacity, a slow but necessary process to guarantee worker safety. Calls are made back and forth between the operations center and the line workers.

Finally, the line is repaired, but the amount of time it took will reflect poorly in the utility's annual performance review at the public utilities commission. Financial penalties are possible, on top of the expense incurred in sending multiple trucks to the scene for switching. Add to that the burden on utility staffing because of the time it took for the fault to be repaired.

With ADMS – You are in control

ADMS Heads-Up Display (HUD) allows operators to manage the flow of all resources for maximum cost efficiency and safety

But what if this utility had an ADMS system with SCADA devices in place to intelligently manage the outage?

Same story but with ADMS...

Immediately after the tree falls and the power goes out, the ADMS system becomes aware of the outage from a social media post and/or telemetered data from SCADA. The ADMS makes the control center operator aware of the issue by indicating the problem on the system dashboard through an alarm. Because of the software's ability to narrow the location of the outage based on information from grid devices and evaluate the surrounding network's available capacity, the ADMS system can automatically plan and execute a switching scheme to reroute power using alternative feeder lines. Within seconds, power is restored to all of the customers beyond Main Street. Only the customers that are affected by the small section of network that the tree damaged are out of power. The outage has been isolated and the self-healing grid functionality within ADMS has done its job to minimize the outage footprint in seconds.

Meanwhile, the utility operator mobilizes a repair crew. Because ADMS has determined the fault location based upon telemetered information and calculations, the crew is sent directly to the correct fault location the first time – no need for patrolling with several trucks in a needle-in-the-haystack expedition. One utility repair truck heads to Main Street, and the workers quickly see the damaged line. The workers are able to glean necessary data from the ADMS system via their mobile devices, making interaction with the utility operations center much more efficient.

Bottom line? With ADMS, repairs are more efficient and customers are more satisfied. ADMS not only reduces operation and maintenance costs, but the utility also is spared penalties (and perhaps wins performance incentives) when its reliability metrics undergo review by state regulators.

Additional Benefits of ADMS

Visualizes and manages resources on the distribution grid

Not too long ago, in a simpler time, distribution utilities had full visualization of resources on their grid. In fact, in vertically integrated markets, utilities owned all the equipment, simplifying management and operations. But today, especially in deregulated markets, resources may be added to the grid by any number of entities -- from independent power plant developers to households with rooftop solar to EV drivers. System operators need to monitor and manage these devices. But they cannot

interact with these devices unless they can see them within their management systems. This lack of visibility can endanger line workers, damage expensive equipment and cause power disruptions.

ADMS allows distribution utility operators to visualize, within the control center, all of the resources on their system – from rooftop solar on homes to large-scale wind farms. Operators can see where they are, their current operations and their capacity. They can use this information to manage the flow of resources for maximum cost efficiency and safety.

Achieves greater efficiencies and lowers capacity costs

Electric utility commissions define the limits that utilities must operate within to provide power to customers. One of these mandatory limits is voltage level supplied to the customer. The utility must manage customer voltage levels, for all customers, all the way to the end of the line. When they lack network visibility, utilities must maintain a higher voltage at the source of the network to ensure that they meet voltage requirements at the end of the line. (The voltage may drop because of network line losses.) With ADMS, end of line measures can be calculated or measured with automation devices that use set points. With this visibility, the utility can now lower the voltage at the source while still maintaining the voltage at the end of line. This reduces demand on the network. The utility saves money because it does not need to secure as much capacity. The utility may even receive demand reduction incentives, if it is located within a state that offers this type of energy efficiency program.

An integrated solution makes decision-making quicker, easier and more accurate

A typical utility has dozens – or more – of utility applications running for a range of critical functionality – OMS, SCADA, crew management systems, mobile data systems, and more. But often one application does not integrate or ‘speak’ well, or at all, with another. As a result, each desk may end up with multiple workstations, creating a need to ‘swivel chair’ between each application. To address the growing complexity of distribution networks and ensure operators can enable advanced functionality in the future, these systems must start to share data.

Siemens ADMS removes many of these inefficiencies by acting as a fully flexible, one-stop shop for all of a utility’s network operations systems. It integrates Distribution SCADA, OMS, Advanced Applications and DERMS solutions into one overarching system, creating situational awareness that enables more efficient management and advanced functionality in the system. With scalable ADMS architecture, Siemens’ software solution achieves integration with a utility’s existing software, no matter the vendor. The utility’s control center software becomes less complex and therefore less costly to operate and maintain.

Let Siemens ADMS simplify the complexity for you…

Your utility can gain these advantages with no disruption to your normal operations. When Siemens installs an ADMS system, its onsite team spends the necessary time to thoroughly understand the unique characteristics of your distribution system and tailor our software solution to your operations. We gradually integrate ADMS functionality in parallel with your legacy system until you have full access to the robust visualization, automation and optimization of Siemens ADMS.

For a demonstration of how Siemens ADMS manages the complexity and helps you do more with less, contact your local account manager or visit www.usa.siemens.com/adms.

Siemens Industry, Inc.
10900 Wayzata Boulevard,
Suite 400 Minnetonka, MN 55305
Email: smartgrid.energy@siemens.com