Advanced Wildfire Mitigation with Smart Grid Technologies

Tantalus
Transforming Utilities and Communities.

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Introduction

From storms and aging infrastructure to the growing use of distributed energy resources (DERs), the utility industry faces increasing challenges to grid resiliency. Among these challenges, wildfires are a standout because of the role utilities can inadvertently play in causing them.

“Although catastrophic wildfires have predominantly been a western experience, the threat of wildfires is a growing concern for other areas of North America,” the NERC Wildfire Mitigation Reference Guide states. “Ever-changing more extreme weather and the abundance of dry fuels provide two of the three necessary elements for wildfires. Due to the presence of electric current, electrical infrastructure and equipment have the potential to provide the ignition spark. While completely eliminating the risk of being the source is not possible, it is incumbent on electric utilities to proactively minimize that risk.”[1]

According to the Insurance Information Institute,[2] nearly half of the most destructive wildfires in California history were caused by electrical equipment, and 90% of the costliest fires in U.S. history have occurred since 2007, as climate conditions have begun to shift. The Center for Climate and Energy Solutions said the average wildfire season is almost three months longer in the U.S. today than it was four decades ago,[3] and the longer seasons have resulted in a 108% increase in burnable areas.[4]

In 2018, California legislators mandated that utilities create and maintain wildfire mitigation plans (WMPs) for annual review,

including topics like Risk Assessment, System Hardening, and Vegetation Management, among others. Across the country, proactive utilities are developing similar mitigation strategies and adopting data-driven solutions to reduce the risk of causing wildfires within their service territories.

Tantalus Systems supports the WMP's of utility customers by providing grid-edge data and analytics to identify risks in the distribution system and by enabling command-and-control capabilities to implement mitigation tactics. This paper details how one Tantalus customer is going "beyond AMI," using its smart grid analytics to turn grid-edge data into valuable insights for its WMP. Plus, it presents a framework for developing a comprehensive technological approach to wildfire mitigation — and system resiliency more broadly.

WMP Case Study: Town of Estes Park, Colorado

In 2020, Colorado experienced the two largest fires in state history, both of which came dangerously close to the Town of Estes Park. The town evacuated 35,000 people for four days — a smaller number of people in outlying areas had to evacuate for nearly a month. Following that close call, the municipality's utility moved to develop and maintain an updated wildfire mitigation plan (WMP) to ensure it was doing everything possible to mitigate future risks of catastrophic fire in the community.

Estes Park Power & Communication (P&C) began with an internal review of a WMP framework shared by a peer utility, working to understand how suggested mitigation protocols would affect the operations of their small staff and 20 crew members. Next, the utility worked with its geographic information system (GIS) consultant to integrate the plan with operational and planning maps covering its 300-square-mile service territory, much of which includes remote, mountainous terrain at elevated risk of wildfires. Ultimately, Estes Park P&C defined a goal for distinct mitigation strategies that minimize the risk of the utility's facilities causing or contributing to the ignition of a wildfire, with a secondary benefit of improving the resiliency of the system. "As we went through the plan, we saw that a lot of our existing improvement plans for grid

"As we went through the plan, we saw that a lot of our existing improvement plans for grid reliability overlapped with the wildfire protection and mitigation strategies"

Sarah Clark,
Power and Communications
AMI Coordinator,
Town of Estes Park

reliability overlapped with the wildfire protection and mitigation strategies," said Sarah Clark, the power and communications AMI coordinator for Estes Park.

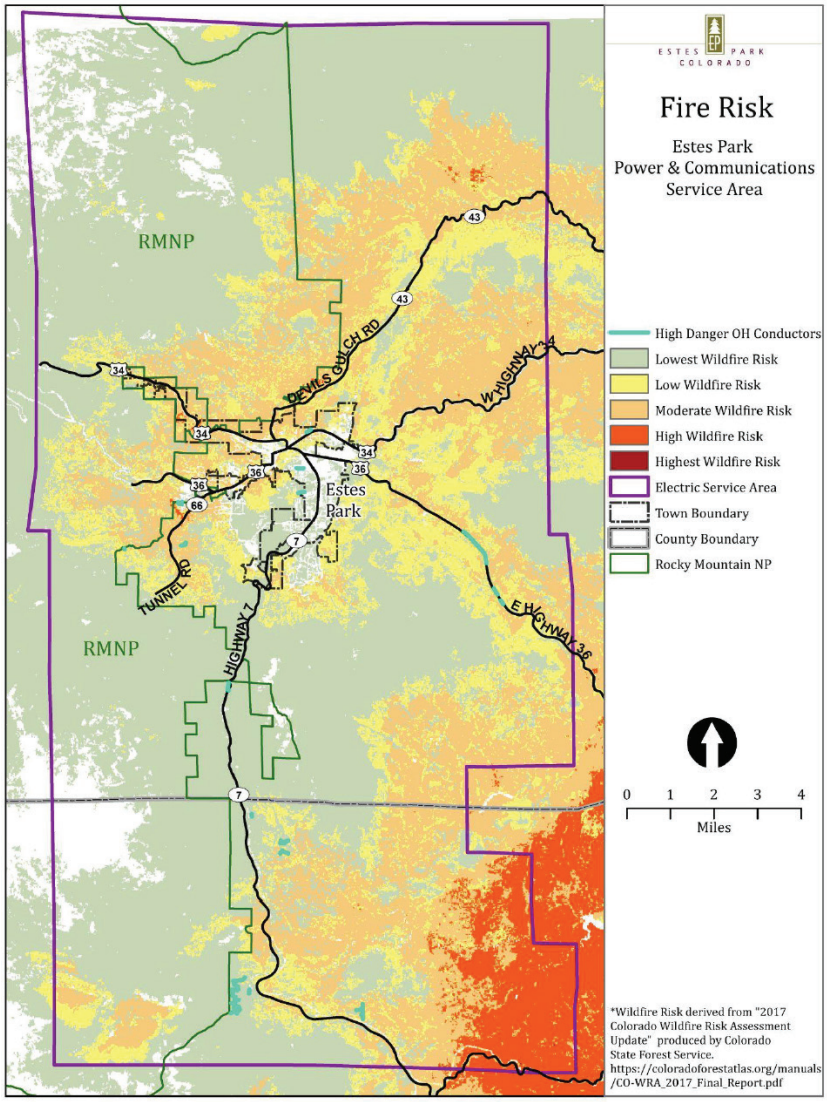
Estes Park P&C adopted Tantalus System's TUNet platform for advanced metering infrastructure (AMI) in 2015. Since then, the utility has gone beyond basic AMI functions, like automated billing and remote meter reading, to make use of the grid-edge data available from its advanced meters. Using TUNet's data analytics system, TUNet Grid Reliability Analytics (TGRA), utility staff incorporate valuable insights about the condition and performance of its distribution grid into planning and operations. The following sections explain how Estes Park P&C uses data-driven insights from its existing Tantalus TUNet smart grid capabilities to support its wildfire mitigation strategies and future grid reliability improvements.

Operational Practices

Estes Park P&C developed situational awareness tools through its GIS system that integrate infrastructure system data with the wildfire risk assessments produced by the Colorado State Forest Service. Together with fire weather forecasts from the regional National Weather Service office, the data determines risk levels and red-flag conditions that trigger changes to the utility's operating procedures in affected areas of its service territory.

Under red-flag conditions, the utility stops work on energized overhead lines, except as needed for safety or to correct outage conditions. Crews carry water tanks with them into remote areas in case they need to douse equipment or surrounding areas, and smoking on job sites is prohibited, among other specific instructions for the use of power tools and equipment. The WMP also added a wildfire briefing section to the utility's standard job briefing form to ensure that crews discuss fire risk, mitigation tactics and escape routes before arriving on a new work site.

Under extreme or red-flag warning conditions, utility staff also have procedures for disabling the automatic reclosing capabilities of specific feeder or substation breakers. When fire risks are low, automated reclosers are a safe way to clear off branches that are in contact with a line or to automatically reset fault conditions



Estes Park P&C developed situational awareness tools through its GIS system that integrate infrastructure system data with the wildfire risk assessments produced by the Colorado State Forest Service. This map illustrates the fire risk in the Estes Park P&C service area.

triggered by birds or squirrels. But when conditions are extremely hot and dry, Estes Park P&C follows the common mitigation practice of setting reclosers to non-reclose (also known as “one-shot”) which means they will not attempt to reclose a faulted breaker, thereby reducing the chance of igniting a fire.

One-shot recloser settings inherently increase the chance of power outages along feeder lines. Because many of the homes in and around Estes Park are vacation homes, the concern would be that outages go unreported, leading to the damage of customer property in empty homes. However, with its Tantalus TUNet smart grid platform, Estes Park P&C can remotely monitor residential meters for outages and send crews to clear lines and manually reclose breakers as needed.

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Vegetation Management

Trimming vegetation that encroaches on power equipment is a never-ending part of utility work and an important part of wildfire mitigation. Estes Park P&C follows industry best management practices for trimming and uses TUNet Grid Reliability Analytics to proactively target the work to areas of greatest need both before and during wildfire season.

Before integrating Tantalus's grid-edge analytics into its operations, the utility's vegetation management plan was based solely on historic data. That meant prioritizing rights-of-way that had not been trimmed for the longest amount of time. But with grid-edge awareness, Estes Park P&C knows exactly which rights-of-way need the most work, based on hard data.

TUNet Grid Reliability Analytics monitors minute changes in waveform data across the utility's entire service area. It then uses AI-driven pattern recognition to identify specific feeders that are experiencing momentary blinks on windy days caused by encroaching vegetation. Integrated with the utility's GIS maps, the grid-edge analytics take the guesswork out of prioritizing trimming work performed by the utility's relatively small crew. "Information from the reliability analytics on the worst-performing circuits or devices can lead to more frequent patrols for reactive trimming and clearing before the next scheduled trimming year," the Estes Park P&C WMP states.

System Hardening

In addition to evaluating design and construction standards for its infrastructure, Estes Park P&C's mitigation strategy for system hardening includes using smart grid analytics to prioritize equipment upgrades that improve system reliability and simultaneously reduce fire risk. "The TUNet data that we access from the Tantalus system opens our eyes to everything that's happening on the distribution system," said Joe Lockhart, line superintendent for the Town of Estes Park. "Not only does it tell us about outages and blinks, but also if voltage is low, and where transformers or circuits are overloaded."

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Utility staff use this data to identify weak spots in the distribution infrastructure that also represent fire risks. For example, they are using low-voltage notifications from TUNet Grid Reliability Analytics to prioritize the replacement of small-gauge copper lines that are at risk of causing an outage and possibly igniting a fire. Similarly, they can find cracked porcelain insulators via analysis of blinks recorded at corresponding residential meters. The utility has a small budget to gradually replace the failing insulators with new, poly-composite models that are more resistant to cracking and will lower the risk of pole fires. Without the grid-edge analytics, Estes Park P&C would have no feasible solution for finding and replacing individual insulators that are cracked, but not yet completely broken. "In short, the data tells us what we need to be doing to harden the system," Lockhart said. "It simply removes the guesswork."

As part of its system-protection approach, Estes Park P&C is also implementing a plan to replace older hydraulic oil devices and expulsion fuses with modern reclosers that can be set to non-reclose mode remotely when red-flag conditions occur. Currently, the utility's entire crew must work for three days to manually switch all recloser settings in the service territory. Then another three days are needed to switch them back to normal operating mode when fire conditions improve.

Field Inspections

Estes Park P&C uses regular field inspections to complement the analytics-driven approach to identifying equipment and vegetation maintenance needs. Maintenance crews and consultants in the field performing other work are trained to walk the lines looking for broken or loose hardware, mechanical damage to components, and the condition of guy wires, anchors, insulators, transformers, switches, reclosers, and other equipment.

When crews find damaged or faulty equipment in the field, they flag it in the utility's GIS system for review by crew supervisors. "It's the other side of the coin for the smart-grid data analytics," Clark said. "Having boots on the ground doing visual inspections is an additional way of proactively finding issues on the system."
The utility also has tested the use of infrared cameras and drones to potentially increase the speed and scale at which it can perform routine inspections with limited staff.

New Technology

Recognizing the amount of research and development going into fire mitigation tactics in the industry, the Estes Park P&C WMP notes the importance of new technology. “With the deployment of the TUNet AMI system, Estes Park P&C is building a robust communications network that will be leveraged to implement future technologies,” it states.

Ultimately, the utility wants to add more smart devices to the network to enable greater data collection for analytics and command-and-control capabilities. First on the wish list are distribution automation (DA) devices that will link to the utility’s SCADA system via Tantalus bridge modems. Enabling remote setting changes to reclosers will enable the utility to respond more quickly to worsening fire conditions and save hundreds of crew hours in the field.

“With all the fires in California, there’s a lot of money going into mitigation technology,” Lockhart said. “We’re keeping an eye on the direction and potential of emerging technology, so we’re set up for future integration of more smart devices that can work on our communications network.”

Workforce Training & Public Outreach

The final topics in the WMP are related to human resources and communications. Estes Park P&C is training all its field personnel in the use of fire suppression gear and mitigation tactics. In addition, they receive ongoing training in the implementation of updated inspection plans and procedures for outage response and wildfire response. The WMP also calls for improved messaging to customers on vegetation management activities and the need to clear not only the right-of-way, but also remove hazardous trees outside the right-of-way. Lastly, the WMP notes the need for coordination with local agencies to discuss emergency management and preparedness.

The entire Estes Park P&C Wildfire Mitigation Plan is available to the public online at **https://estespark.colorado.gov/wildfiremitigation.**

Two Smart Grid Capabilities for Advanced Wildfire Mitigation

Successful wildfire mitigation requires accurate information, strategic planning and timely execution. Regardless of the size of their staff or budgets, utilities can improve their ability to deliver and integrate these key elements by developing two foundational smart grid capabilities — grid-edge awareness and remote command-and-control.

Grid-Edge Awareness Allows for Prioritization

When a utility inadvertently starts a wildfire, it typically is not the result of a large system failure. Rather, it is typically the result a single hot spot on the grid encountering the chance environmental conditions for ignition. Comprehensive manual inspections and equipment replacements are rarely feasible, which is why utilities need a data-driven solution to analyze and monitor what is unfolding all the way to the edge of the distribution grid, where a cracked insulator or an overloaded circuit represent a significant risk during peak fire season.

Utilities that capture high-resolution data from substations to meters and analyze the data effectively can gain valuable insights for implementing cost-effective mitigation efforts. The NERC Wildfire Mitigation Reference Guide states: “New technologies and increasing data capture have enabled companies to perform risk analysis at the asset level, allowing them to prioritize activities and develop initiatives for specific lines and equipment. This granularity provides for more effective and efficient mitigations.”

The following strategic practices recommended by the Canadian Electricity Association in the 2020 Utility Wildfire Mitigation Guide[5] benefit from the grid-edge capabilities of advanced metering infrastructure (AMI) and the insights provided by data analytics.

Risk Modeling

Advanced risk models include assessments of equipment health and condition based on more than just age. Data analytics tied to GIS systems can generate risk maps that grade individual assets across an entire distribution network.

System Monitoring, Maintenance and Hardening

By feeding granular data into sophisticated algorithms, utilities can monitor the performance of feeders, transformers and other assets in real time and even predict imminent failures. As a result, the guesswork is removed from deciding what equipment needs maintenance, replacement or upgrading.

Vegetation Management

Similar to equipment, the condition of rights-of-way deteriorates over time as vegetation growth encroaches on utility assets. Using pattern recognition, AI-driven analytics can actually “see” where vegetation is beginning to contact power lines and other equipment. This allows utilities to prioritize vegetation trimming with more accurate information than just calendar cycles.

Animal Management

Wildlife can ignite and become ignition sources if they touch certain distribution equipment. As with vegetation management, sophisticated data analytics can identify the times of year and areas on the grid that are most affected by the movement of wildlife and inform where animal deterrence gear should be installed.

Fire Detection

The Canadian Electricity Association recommends: “Utilities should consider installing fire detection cameras on high-risk assets to facilitate early notification to first responders and other partners.” For this purpose, cameras can be linked to broadband AMI communication networks.

An additional benefit of grid-edge awareness is the ability to confirm a utility’s protection coordination schema. Old oil-filled mechanical reclosers, for example may or may not be functioning as desired under red-flag conditions (or at other times). By examining momentary outage data from residential meters, engineers or analytics applications can determine whether mitigation tactics are being implemented as planned.

When active wildfires threaten a utility's service territory or assets, sending crews into the field needlessly puts their lives at risk, when the same actions can be achieved remotely.

Remote Command-and-Control Saves Time and Lives

Once a utility has incorporated data-driven insights into its wildfire mitigation plan (WMP), another smart-grid capability enables faster and safer execution. When a utility receives information that its service territory will experience extreme fire weather, it must act quickly to implement mitigation tactics. With remote command-and-control capabilities, utilities can change the behavior of the grid instantaneously from its headquarters, instead of needing hours — or even days — for crews to manually switch the operational settings of equipment in the field.

Furthermore, when active wildfires threaten a utility's service territory or assets, sending crews into the field needlessly puts their lives at risk, when the same actions can be achieved remotely. The following fire mitigation and safety tactics benefit from the speed and safety of command-and-control capabilities.

Setting Recloser Schemes

Utilities frequently disable or limit reclosers on feeders during wildfire season. Integrating reclosers into supervisory control and data acquisition (SCADA) systems allows system operators to quickly disable reclosing, sectionalize high-risk fire areas, and adjust other settings manually or automatically without the time-intensive work of field crews. Automation can also indicate to operators which devices are complying with mitigation schemes, and which devices may need to be repaired or replaced.

Proactive De-Energizing

Public Safety Power Shutoffs (PSPS) are generally a last resort mitigation strategy used when the risk of intense fire weather is deemed greater than the public risk caused by shutting off power. Utilities also de-energize assets when water-bombers and firefighters are working in the vicinity of transmission or distribution assets. The ability to de-energize and re-energize sections of the grid remotely saves valuable time and keeps field crews safe.

De-Energizing Distributed Generation

When utilities choose to de-energize the grid, large, distributed generation resources tied to those grid sections also need to be shut down to protect equipment and the safety of first responders working in the area. Again, being able to do this remotely saves time and lives.

Remote command-and-control of grid behavior has additional resiliency benefits. Grid operators, for instance, can selectively turn off feeders to shed load as needed to avoid black-out scenarios. During severe storm outages, they also have the ability to island microgrids around distributed energy resources (DERs) and keep the power on for hospitals and other critical facilities.

Comprehensive Solution for Grid Awareness and Remote Command-and-Control

Tantalus Systems offers a comprehensive solution for public, cooperative and investor-owned utilities seeking to “go beyond AMI” by implementing data-driven wildfire mitigation strategies. The combination of the TUNet smart grid platform and Congruence.IQ (C.IQ) distribution automation provides everything a utility needs to build advanced capabilities from the ground up or integrate them with existing equipment and systems.

TUNet Grid Reliability Analytics (TGRA)

TUNet Grid Reliability Analytics (TGRA) is the key to complete grid-edge visibility for Tantalus customers. Built into the TUNet platform, the analytics software uses AI and pattern recognition to turn rich, waveform data from TUNet-enabled devices into actionable insights for risk modeling, asset monitoring and system hardening, as well as vegetation and animal management. “The insights we get from TUNet have become such an integrated part of our operation, it’s hard to think about what we did before we had it,” said Sarah Clark of Estes Park P&C.

To learn more about TUNet Grid Reliability Analytics, download the white paper, **Intuitive AMI Analytics for Greater Reliability and Efficient Operations.**[6]

Congruence.IQ (C.IQ)

Congruence.IQ (C.IQ) serves as a gateway to acquire, transport and present complex operational data across the grid, giving utilities remote and automated control over substations and grid edge assets. In use by some of the largest utilities in California, C.IQ unifies the communication between SCADA systems and devices in the field and can be used to provide command and control capabilities via the TUNet platform for utilities operating without a standalone SCADA system.

To learn more about Congruence.IQ visit **https://www.tantalus.com/smart-grid-solutions/ciq/.**

Investing in Grid Resiliency Today

While wildfires are a serious concern for utilities today, the good news is the smart grid technologies used to implement advanced mitigation strategies are not single-use investments. Rather, they support multiple use cases that go beyond basic AMI operations to improve grid resiliency. Furthermore, all the necessary technologies and system hardening costs are eligible for significant amounts of new federal funding for grid modernization under the American Rescue Plan Act (ARPA), Building Resilient Infrastructure and Communities (BRIC) and most recently, the Infrastructure Investment and Jobs Act (IIJA).

Ultimately, grid modernization investments are necessary for modern utilities to respond to society's need for full electrification and decarbonization, and leading utilities are aware of the community costs associated with not investing in advanced technology solutions. They are asking whether their mitigation efforts are predictive and proactive in nature, or reactive. And they are developing clear visions for what it means to be a truly sustainable utility. Tantalus is here to help.

Resources

1 North American Electric Reliability Corporation: “Wildfire Mitigation Reference Guide,” https://www.nerc.com/comm/RSTC/Documents/Wildfire%20Mitigation%20Reference%20Guide_January_2021.pdf

2 Insurance Information Institute: “Facts + Statistics: Wildfires,” https://www.iii.org/fact-statistic/facts-statistics-wildfires

3 Center for Climate and Energy Solutions: “Wildfires and Climate Change,” https://www.c2es.org/content/wildfires-and-climate-change/

4 Nature Communications: “Climate-induced Variations in Global Wildfire Danger from 1979 to 2013,” https://www.nature.com/articles/ncomms8537

5 Canadian Electricity Association: “Utility Wildfire Mitigation Guide,” https://www.electricity.ca/knowledge-centre/publications/utility-wildfire-mitigation-guide-2020/

6 Tantalus Systems: “Intuitive AMI Analytics for Greater Reliability and Efficient Operations,” https://www.tantalus.com/smart-grid-solutions/grid-reliability-analytics/

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