Challenge

Over the last several decades, the western United States has become a region of widespread, high-intensity wildfires. Specifically, since the 1970s, the western US has experienced three times the amount of “large fires” (fires that burn 1,000 acres or more) that are now burning on average more than 1.7 million acres of land per year. The region has also experienced wildfire seasons that are 78 days longer than they were in 1970. It has been found that throughout the whole United States, 84% of these wildfires are started by humans. [https://assets.climatecentral.org/pdfs/westernwildfires2016v2.pdf]

The problem has been complicated by climate change, forest management, outdated and neglected electrical infrastructure, and local land-use decisions that allow communities to sprawl deeper into fire-prone areas.

Being prepared for the wide array of urgent issues and problems that can arise during severe weather and other emergencies is not easy for electric utilities. Their widely dispersed equipment and infrastructure creates possible points of vulnerability.

The concerns of those affected (e.g., communities, utilities, regulators, etc.) by wildfires can be summarized as:

1. **Safety** – Proactive response to wildfires within grid boundaries and safety coordination with first response teams
2. **Reliability** – To keep critical infrastructure (e.g., hospital, fire, police, gas stations, etc.) running
3. **Resiliency** – Ability for all entities to be up and running as soon as it is safe.

Once it is safe, utilities should be available to allow buildings to repower, even if the utility does not have their local grid running.

4. **Flexibility** – React to wildfires by implementing local dispatchable/non-dispatchable assets to reduce reliance on energy imports that are at risk of being compromised

Utility challenges and use cases vary in their potential to add value. The use cases outlined in this whitepaper can be generally divided into three levels that represent increasing difficulty and value:

- **Strategy & Planning** – e.g., Spark Risk Mitigation
- **Operational Efficiency** – e.g., Predictive Maintenance
- **Transformational Services** – e.g., Outage Management
**Solution**

Implementing new technology for these use cases while maintaining normal ongoing reliable operations can be a major challenge. Dramatic changes to utility architectures are rarely possible and innovation must be done via an evolutionary and overlay approach for basic monitoring infrastructure.

Leveraging existing systems and assets while implementing advanced solutions rapidly is a complex balancing act. The focus of the holistic Siemens approach for wildfire mitigation is to be a complementary overlay to the entity’s (e.g., utility, community, commercial & industrial customer, etc.) distributed generation architecture to enable better outcomes.

**Risk Mitigation Planning**

Although many customers do not currently have stated mitigation goals because they do not know where to start, the following are elements of the solution that risk mitigation planning could uncover as potential solutions to unique problems for each entity. The entity should have identified sparking risks based on assessment of existing equipment condition, connected infrastructure, region, weather data, network operation data, and protection coordination settings in response to variable conditions/scenarios.

**Environmentally-Aware Distribution Automation**

The entity should be able to automatically command SCADA to operate the grid in accordance with environmental conditions (e.g., real-time weather, red flag days, etc.), wherein the SCADA can coordinate with microgrids to island the feeder, if necessary. Additionally, the entity should be able to detect, open, and clear faults as quickly as possible with advanced protection schemes that can adapt to insights from ignition probability curves supplied for an array of environmental data sets.

**Intelligent Microgrid Controllers**

Microgrids enable relatively fast deployment of distributed energy resources (DERs), improve grid cybersecurity, and strengthen distribution-level systems. Microgrids can pair climate mitigation (e.g., GHG reductions) with adaptation for proven economic, social, and environmental benefits. They allow leverage of infrastructure investments to achieve real resilience.

Entities should be able to use microgrids in order to mitigate risk in high fire threat districts by enabling islanding, black starting, grid resynchronization, etc. based on real-time coordination of generation, storage, and loads. An intelligent microgrid controller enables customers to understand the potential impact of emergency events in real-time, predict possible outcomes, and act in real-time to mitigate problems and avoid outages before they cause major disruptions. Additionally, an intelligent microgrid controller coordinates with the SCADA system to preemptively island.

**Case Study: Blue Lake Rancheria’s Intelligent Microgrid Management System**

Blue Lake Rancheria is a century-old Native American reservation in Northern California equipped with a low-carbon community microgrid to help power government offices, economic enterprises, and critical Red Cross safety shelter-in place facilities across 100 acres. The microgrid includes a 500-kilowatt solar photovoltaic system and a 1,000-kWh Tesla battery storage system, all managed and controlled with a microgrid management system. The microgrid uses decentralized energy resources and intelligent software to provide its residents and economic enterprises with reliable power without interruption. In fact, the Rancheria achieved 100% resiliency during the recent Shasta and Trinity Counties ‘Carr Fire’ in the summer of 2018 by utilizing its microgrid management system to enable the six following benefits:
Data Processing

Blue Lake Rancheria’s microgrid controller enabled them with the ability to ingest data from monitoring devices connected to DERs and transmission equipment at speed and volume, including the abovementioned solar PV array, battery energy storage system, legacy diesel generation sets, and the larger PG&E grid at point of common connection.

Contextual Awareness

This data was then correlated with contextual and historical data to provide a baseline for advanced analytics. Contextual data includes information like maintenance history, equipment performance during previous emergencies, resilience experience at specific locations, and other historical data.

Situational Awareness

The next benefit was the addition of real-time situational data to the analytics stream to provide information that can inform real-time decisions. This could include data such as dynamic weather forecasts, transformer performance, equipment (e.g., 500-kW solar PV system by REC Solar, 1,000-kWh battery storage system by Tesla, etc.) performance, and status during emergency events.

Predictive Analytics

A critical benefit for Blue Lake Rancheria was the ability to anticipate equipment breakdowns and damage and power needs using predictive analytics that are based on machine learning. For emergencies, this usually means identifying potential failures or malfunctions in key generation or transmission assets.

Prescriptive Analytics

The next benefit was the application of prescriptive analytics to determine the next best action. The intelligent microgrid controller system allows Blue Lake Rancheria to dynamically manage generation and distribution through integrated weather data, load forecasting, and load-shed scenarios.

Automated Actions

This next best action could be a wide variety of actions. In grid-connected mode, the intelligent microgrid controller helps Blue Lake Rancheria reduce peak loads and conduct other energy management optimization to help relieve pressures on the larger grid. In cases of emergency when the larger grid is down, the system operates in islanded mode. In both scenarios, the intelligent microgrid controller prioritizes the use of the cleanest and most financially beneficial forms of energy – in this case solar and battery storage – within a portfolio of on-site generation sources. The goal is to capture value quickly and ensure continuous service.

Use Case: New Technologies that Fulfill Both Reliability & Wildfire Mitigation Strategies

An electric utility that serves 24,000+ customers in a rural and mountainous terrain in Southern California needed a drop-into-place system to help mitigate wildfires. The utility needed a system that did not rely on any reclosing operations – low energy or conventional – to accurately locate a faulted line segment and then isolate it from the grid since reclose actions could potentially cause unwanted sparks. Fault Location, Isolation, and Service Restoration (FLISR) systems seemed to be the solution to support their wildfire mitigation plan and improve reliability.

The Siemens SDFA-FLISR system was designed from the ground-up to accurately locate a system fault in milliseconds, using the patented jDiff technology, without any switching actions, which is extremely important to immediately locate a fault. The system can quickly and selectively isolate the faulted line segment and dispatch the proper authorities to the faulted line segment to perform an inspection before the segment is energized. The action to isolate only a small segment ensures that a minimum number of consumers will experience a power interruption due to a fault on the grid.

During the winter months, the Siemens SDFA system performs reclose actions to test for temporary faults, providing best-in-class reliability indices. As most faults on the distribution grid are temporary in nature, reclose actions are even more important to get power back to consumers as fast as possible.

In addition to the above requirements, the Siemens SDFA system was required for operation in open and closed loop topologies. The SDFA-FLISR has an adaptable algorithm to account for both open and closed loop topologies making the system simple, flexible, and ideal for the utility.
Siemens’s Solution for Wildfire Mitigation

With a global network of engineers and subject matter experts paired with the most extensive system hardening portfolio in the market, Siemens provides full-scope consultation services for enterprise risk management, protection and control systems, and grid network studies.

Siemens’s high-speed FLISR solution allows for immediate location of faulted line segments. An electric utility can isolate faults with or without reclose operations via simple differential protection-type schemes, automatically command SCADA to operate the network in accordance with environmental conditions (e.g., real-time weather, red flag days, etc.), and localize faults in the Cloud, enabling direct communication to maintenance crews and first responders.

Analytics on the tremendous volume of data from field devices offers great potential to mitigate wildfires, but it requires a holistic solution approach. Analytics must be executed in real-time across the value chain (historical, predictive, and prescriptive analytics) with relevant contextual and situational data. This capability paired with the next best action creates the greatest value – as shown in the above case study on Blue Lake Rancheria. Siemens’s holistic portfolio provides the fastest way to achieve these results. This project incorporates the largest solar array in currently in operation in Humboldt County (California), saves Blue Lake Rancheria over $200,000 in annual energy costs, reduces at least 150 tons of carbon per year, and has grown clean energy jobs by 10 percent.

Siemens’s wildfire mitigation solution offerings enable utilities, communities, commercial and industrial facilities, etc. to understand the potential impact of emergency events in real-time, predict possible outcomes, and act in real-time to mitigate problems and avoid outages before they cause major disruptions.

Distributed energy resources are important for emergency preparedness and recovery in a disaster, especially in rural, sparsely populated areas with rugged terrain. If a wildfire strikes, communities need to be self-sufficient, perhaps for several weeks or longer. With a robust microgrid and emergency power supplies, critical infrastructure can continue to serve thousands of people with life, health, and safety services.