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Wildfire mitigation

Initial approaches that lower electrical distribution and transmission system threats

Introduction

The increasing frequency and ferocity of wildfires across multiple continents over recent years has driven the urgency for the development of more comprehensive wildfire mitigation strategies. Stakeholders, such as governments, businesses, utilities, municipalities and homeowners, are all looking for ways to lower risks.

The wildfire statistics are sobering. According to Verisk's 2017 Wildfire Risk Analysis, today over 4.5 million residences in the U.S. are at high or extreme risk of experiencing a wildfire. The National Interagency Fire Center reports that 8.8 million acres were scorched by wildfires across over 58,000 individual incidents in 2018. Not only are wildfires becoming more common, but also more costly. Total potential exposure for single-family residences to wildfire damage in California alone is greater than $240 billion.[1]

1. Samanta, Arindam, Dr., "Key findings from the 2017 Verisk wildfire risk analysis," July 12, 2017.

Table 1 – Top 10 states at high to extreme wildfire risk

Rank	State	Estimated number of properties at risk	Rank	State	Percent of properties at risk
1	California	2,019,800	1	Montana	29%
2	Texas	717,800	2	Idaho	26%
3	Colorado	371,100	3	Colorado	17%
4	Arizona	237,900	4	California	15%
5	Idaho	175,000	5	New Mexico	15%
6	Washington	165,500	6	Utah	14%
7	Oklahoma	153,400	7	Wyoming	14%
8	Oregon	151,400	8	Oklahoma	9%
9	Montana	137,800	9	Oregon	9%
10	Utah	136,000	10	Arizona	8%

As of September 2019.

Source: Verisk Wildfire Risk Analytics used data from FireLine®, Verisk's wildfire risk management tool.

Although the state of California garners most of the attention surrounding the wildfire threat, other states are also at risk. Table 1 Illustrates a breakdown of the top 10 states under threat.[2] In fact, over the last 15 years, a surprising number of states have lost one million or more acres of land due to wildfires. These states include Arkansas (which lost over 14 million acres), Oklahoma, Oregon, Texas, Arizona, and Nevada.[3]

Evaluating the wildfire risks posed by utility electrical systems

Government investigations into wildfires have determined that one of the causes of wildfires is overhead line-mounted electrical equipment failure. Some equipment, like conventional fuses and surge arresters, were not designed with extreme environmental factors in mind. Thus, failure modes of these components are accompanied by extreme fire risk. When subjected to environmental threats, such as high winds, storms, falling tree limbs, or other external threats like vehicles crashing into poles, risks are increased. Damage or breakage of lines can cause electrical faults, which induce sparking and, in some cases, the expulsion of molten material. The dry vegetation in the fields and bushy areas below serve as fuel for the fault-induced sparking. Then, with the help of winds, a wildfire is born.

When implementing a wildfire mitigation strategy, understanding the way power distribution and transmission infrastructures interact with the surrounding environment can help lower risk. Listed below are three considerations that stakeholders should factor into their wildfire mitigation strategies:

- Poorly maintained or faulty equipment can pose a risk – A fault in an electrical utility's power network can cause an arc that could ignite nearby vegetation. In California, the entity responsible for the equipment that sparks a fire is fully liable for the damage. This provides a strong incentive for municipalities and utilities to accelerate maintenance of their existing power networks and to search for safer equipment options when upgrading or modernizing their electrical physical infrastructure.

- Lack of environmental management can increase risk – Controlling sparks is only one aspect of the wildfire issue. The environmental conditions relating to vegetation in and around power lines and substations also play an important role. High-risk areas, where vegetation is dry and plentiful, should be maintained and trimmed on a regular basis. Mitigation planning will need to anticipate what will happen when a fire breaks out in one of the high-risk areas. What kind of path will a wildfire follow given the most likely wind conditions? What measures would be needed to contain such fires across the variety of affected geographies? These are questions that need to be considered ahead of time so that when the wildfire does occur strategies are in place to help contain the flames.

2. Verisk Wildfire Risk Analysis, September 2019.

3. National Interagency Fire Center, 2018.

- Better monitoring and control of power networks lowers risk – Many utilities today are investing in new technologies that help them gain better insights into potential issues across their networks. Modern overhead devices installed on poles can communicate status to network operations centers and are architected to contain potential sparking should an arc-fault condition occur. Remote monitoring, along with more granular protection zones enabled by advanced equipment, allows for more flexible and selective control of the network. Should the need for network de-energization present itself, for example, the number of customers affected is kept to a minimum.

Variables that influence wildfire mitigation priorities and investments

As municipalities, utilities, regulators, and the vendor community all collaborate to seek solutions that improve power network safety, reliability, resiliency, and flexibility, several key factors influence the decisions of each group of stakeholders.

- Changing regulations and accountability - As a result of increased scrutiny from the California Public Utilities Commission (CPUC), a mandatory wildfire mitigation planning process has been imposed on utilities which, along with a Governor-appointed Wildfire Safety Advisory Board, will guide and track efforts to mitigate utilities' mitigation efforts. Other state agencies are getting involved. For example, the California Board of Forestry and Resource Protection (CAL FIRE) is assisting in the collection of data, the testing and exemption of new equipment, and more. Other states are closely observing this process and are gearing up to institute new regulations as well.

- No simple and cost-effective approaches - Not all utilities face the same challenges and their wildfire mitigation costs are different. The nature of the utility (whether it is a large investor-owned utility or a smaller municipality-owned utility), its location, and the extent of its transmission and distribution networks, all impact the wildfire mitigation strategy. Burying power lines underground is an option but not a cheap one. Undergrounding of high-voltage power lines can cost up to $5 million a mile and could cost large utilities with expansive networks over $100 billion. Besides the cost, concern exists about digging up environmentally sensitive areas.

- Current technologies provide specific solutions offering partial protection - Fire mitigation technologies that are beginning to emerge are new to the marketplace. Although progress is being made, the current challenge is to determine the right combination of technologies to address possible gaps and areas of exposure.

New technologies that help mitigate wildfire risk

Although no simple, one-size-fits-all solution to the wildfire mitigation issue currently exists, utilities and municipalities can take steps to lower risks by modernizing and better maintaining their electrical infrastructure. Several approaches to help reduce threats at both the substation and power line levels are available today in the marketplace.

Updated recloser technology, for example, is now being looked at as a possible solution for better management of potential wildfire situations. Multiple vendors offer solutions in this realm. With some of the more advanced solutions, when a device trips and opens because of a fault downstream, it can serve as an alarm back to the control room. It also allows the control room to open and close the devices remotely to cut off power to a particular area if they suspect a wildfire risk exists.

These types of overhead protection technologies bring together medium-voltage switching with the intelligence to decide when and how to make that switching happen. According to Stephen Pell, Product Lifecycle Manager at Siemens Industry, Inc., speed is of the essence in wildfire mitigation situations. "If a fault can be cleared in less than 20 milliseconds, then it does not have the time to build up enough energy to trigger or start a fire. The fastest recloser products have circuit breaker technology within them that forces a trip in less than 16 milliseconds. Therefore, a threatening arc fault is broken before it becomes a risk for fire ignition. Also, short-sequence reclosing helps to further reduce the danger of sparking in high wildfire risk areas," he said.

Remote monitoring, along with more granular protection zones enabled by advanced equipment, allows for more flexible and selective control of the network.

Substation level

Substations step-down high-voltage electricity from the transmission system to lower voltage electricity. That lower voltage power is then supplied to homes and businesses through distribution lines. Utilities with traditional systems currently go through a long process when it comes to locating a fault within substation networks. If a fault occurs, the utility will open up the circuit breaker of adjacent substations, and in the process, disconnect power to users linked to that substation. The idea is to open up the switches on either side of the fault to determine if there is indeed a bad fault in that location. Then, once the location of the fault is determined, utility technicians can go to that point between the adjacent circuits and shut off power while work is performed to apply the fix.

New technologies enable fast fault location, isolation, and service restoration (FLISR), which simplifies these tasks and helps to further lower wildfire risks at the substation level. According to Andre Smit of Siemens Industry, Inc.'s Digital Grid, FLISR performs such switching operations automatically. "The system, within a microsecond, will locate the fault, immediately isolate the fault, and quickly close in the adjacent feeder so that power can continue to be provided to unaffected line segments. When time is of the essence, as is the case with wildfires, such technologies can identify the threat much more quickly while minimizing disruption to power consumers. Once the utility crew has repaired the faulted segment, the system is then restored automatically," he said.

Microgrids

Microgrids represent a dual approach for both a power backup source should main utility be cut off, and a definable zone of affordability for executing wildfire mitigation practices. For example, one small Native American community in Northern California, Blue Lake Rancheria, uses diverse renewable energy resources, including a 500 kilowatt (kW) solar PV array, 950 kilowatt hours (kWh) of battery-supported energy storage, and biomass fuel cells, in addition to diesel generators, to achieve a goal of a seven-day duration of available on-site power independent from the utility. The community utilizes the Siemens Spectrum Power Microgrid Management System for controlling numerous energy sources and balancing energy loads. This advanced microgrid control solution allows community members to optimize all assets in order to minimize energy and demand charges. They also earn additional revenue by deploying the assets to participate in the local utility's demand response program.

During the Carr fire in 2018, the Blue Lake Rancheria microgrid system was cut off from the utility's transmission line network. Their system had to island itself because of a fire that was over 20 miles away. Their location supported the Internal Command System (ITS) fire response effort because they had all the critical services to support a large volume of people in the midst of a wildfire while other communities were disconnected from that transmission line.

The tribe is under constant threat from wildfire, along with many other communities in California. During autumn, seasonal winds rustle electric equipment, showering sparks onto dry brush below. The 2018 devastating Camp Fire, which virtually destroyed the town of Paradise - leveling almost 20,000 buildings and killing 85 - could have been avoided if the utility had severed power when winds near Paradise became particularly intense. Concerns about local hospitals and other emergency facilities, however, tend to prevent utilities from taking such preemptive actions. Switching to microgrids during especially dangerous wind storms could keep such mountain towns safer.

Conclusion

A unified front involving all stakeholders working in collaboration is needed to identify and codify wildfire risk factors, and to formalize best practices for prevention and abatement.

Qualified technology vendors, with expertise in both electrical and industrial control systems, can offer strategic support on multiple fronts of the wildfire mitigation issue:

- Participation and contribution to wildfire mitigation-related forums and workshops sponsored by regulators, public utilities, investor-owned utilities, and municipalities for the purpose of developing holistic solutions.
- Collaboration with municipalities to develop both electrical safety and backup power strategies.
- Development of funding options for microgrids and electrical infrastructure upgrade projects that involve wildfire mitigation.
- Joint design and development of holistic solutions to help bolster fire safety, electrical system hardening, and grid-monitoring solutions.

Third-party vendors can also offer tactical support for organizations looking to get started in ramping up wildfire mitigation efforts:

1. Assessments for establishing the ability to measure, quantify, and track risk.
2. Pilots for developing programs and initiatives that will reduce risk.
3. Deployment of new technologies and innovative ways to reduce risk.
4. Monitoring and prevention solutions that can help to lead and embed a wildfire mitigation culture.

To learn more about how wildfire mitigation tools, architectures, and products can help reduce risk, visit the Siemens wildfire mitigation solutions page.

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