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QUICK INSIGHTS

Wildfire Risk Reduction Methods

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Wildfires threaten electric companies' ability to provide reliable and affordable electricity to the customers and communities they serve. Wildfires, regardless of ignition source, present a significant threat to electric infrastructure and public safety.

In order to mitigate these threats, electric companies continue to play a pivotal role in raising awareness of and investing in solutions. With climate change and the emergence of increased extreme weather events, the power delivery systems of the future must be more prepared for even more wildfire threats and other weather-related dangers.

Technology developers, research organizations, and electric companies continue to dedicate significant resources to exploring tools aimed at reducing ignition incidents and detect wildfire threats. One main goal of these tools is to minimize contact with external materials by using insulated coverings and clearing ignitable vegetation away from the energized lines. Improved data collection, communication, and imagery allows electric companies to better understand risks of ignition incidents, impacts of implemented solutions, and more quickly detect high fire threat conditions or the presence of fire.

Using fire-safe designs and materials in construction can remove some sources of electric wildfire risk, but are not alone sufficient when dealing with unintentional discharges of energy. Faults, or unintended flows of electric current, can discharge as bursts of electric arc energy and heat. This may spark nearby combustible materials which can ignite and under adverse conditions result in an uncontrolled wildfire. To reduce risk, several power system hardening strategies are useful to lessen the number of faults, known as Fault Count Reduction. Other technologies can restrict the energy being released in the fault, known as Fault Energy Limiting. Improved Situational Awareness technologies encompass imaging and sensors to give companies a better picture of what is happening on and around energized power lines.

Depending upon the types of terrain and the associated fire potential, electric companies can implement a coordinated combination of these technologies to better prepare for, detect, and respond to wildfires that are particularly suited for their service territory. The following chart provides a high-level overview of available wildfire mitigation technologies for electric companies based on EPRI research.

Please note this list is not exhaustive and vendor-specific products are not identified in favor of discussing general implications rather than distinctions within that technology category.

Covered Overhead Conductors and Covered Accessories

FAULT COUNT REDUCTION

TECHNOLOGY

Covered conductors reduce fault risk due to vegetation, airborne objects or wildlife contact as compared to a bare conductor. This mature technology has been used since the 1970s, though it has evolved with improvements in chemical makeup and iterations, such as spacer cables and multi-layers designs

CONTEXT

The covers provide insulation against foreign object contact and against wind induced conductor slap.

KEY CONSIDERATIONS

- Early opportunity
- Capital intensive
- Partial solution

Strategic Undergrounding

FAULT COUNT REDUCTION

TECHNOLOGY

Underground lines have relatively low risk of igniting a wildfire or of having the fire impact the lines. Areas of high fire risk and/or those with high fault counts are prioritized for undergrounding. Sometimes a mix of overhead and underground lines, called strategic undergrounding, is implemented.

CONTEXT

While splice failures still may pose a fire threat, putting lines underground mitigates the majority of overhead fault-caused fire risk. Costs for undergrounding can be 3 to 10 times that of overhead bare designs. Service drops, diagnostics, and mainline connections are more complicated with undergrounding.

KEY CONSIDERATIONS

- Capital intensive
- Implementation challenges
- Partial solution

Enhanced Vegetation Management

FAULT COUNT REDUCTION | FIRE-PROTECTIVE MATERIALS

TECHNOLOGY

Proactive, targeted clearing of vegetation can reduce tree contact-related faults, decrease damage to overhead systems, and remove ground fuel. Clearing to the sky, hot spots, cylindrical and dimensional targeted trimming underneath electric arc producing assets, and hazard species management are examples of EVM.

CONTEXT

Implementations must weigh feasibility and costs of time and maintenance. Decision makers may use vegetation at risk, growth rate analytics, and vegetation strategy efficacy to determine management strategies. Technology like vegetation management AI Sandbox can help determine best management strategies.

KEY CONSIDERATIONS

- Capital intensive
- Implementation challenges
- Partial solution

Fault Reduction Construction Practices (System Hardening)

FAULT COUNT REDUCTION | FAULT ENERGY LIMITING | FIRE-PROTECTIVE MATERIALS

TECHNOLOGY

Additional measures can be taken when constructing electrical infrastructure to reduce fire risk. These include features such as span distance crossarm length, and physical spacers to avoid conductor slap and galloping, as well as using resilient materials on wires and around poles.

CONTEXT

These measures provide fault count reduction, but can be costly to install. More research is needed to evaluate lifetime performance.

KEY CONSIDERATIONS

- Implementation challenges
- Partial solution

Reclose Blocking

FAULT ENERGY LIMITING

TECHNOLOGY

This practice disables the normal reclose feature for a protective device. This reduces the chances of more arcing and sparking if a fault source is still bridging the gap across power conductors.

CONTEXT

Adaptive reclose blocking is being considered to automate re-energizing lines after a fault only if certain environmental and fault clearing verification conditions are met.

KEY CONSIDERATIONS

- Implementation challenges
- Partial solution

Protective Device Communication FAULT ENERGY LIMITING

TECHNOLOGY

Microprocessors and continuous communications enable protective devices to coordinate with each other and quickly respond if an anomaly is detected.

CONTEXT

Continuous signaling and fast response to anomalies is another tool in the ignition mitigation toolbox. For optimal performance, these systems require frequent calibration and circuit-by-circuit level fine-tuning.

KEY CONSIDERATIONS

- Early opportunity
- Partial solution

Non-Expulsion Fuse Designs FAULT ENERGY LIMITING

TECHNOLOGY

Expulsion fuse designs produce sparks and hot molten particles. Non-expulsion fuse designs, reduce the risk of wildfire by removing these sources of ignition.

CONTEXT

The development of these fuse designs requires coordination from industry in testing, deployment, and assessment to evaluate them for failure modes and life cycle performance over time.

KEY CONSIDERATIONS

- Early opportunity
- Partial solution

Fault Current Limiters FAULT ENERGY LIMITING

TECHNOLOGY

These technologies restrict current flow through the power conductors to reduce total arc and fault energy.

CONTEXT

While not applicable to all system configuration and fault types, fault current limiters (FCLs) are being developed and tested for applications across different systems and line configurations, including Electronic Fault Current Limiters and current limiting fuses.

KEY CONSIDERATIONS

- Early opportunity
- Capital intensive
- Partial solution

Powerline Carrier Signaling (PLC) FAULT ENERGY LIMITING

TECHNOLOGY

PLC uses the physical power line pair combinations for data transmission. This technology has potential to improve the speed and accuracy of the operation of protective devices and support post PSPS remote inspections

CONTEXT

This technology, in conjunction with sensors, can reduce the time it takes to detect and respond to faults. More research is needed to determine potential applications and costs.

KEY CONSIDERATIONS

- Early opportunity
- Partial solution

Imagery SITUATIONAL AWARENESS

TECHNOLOGY

Imagery technology refers to stills and video, as well as laser, radar, infrared and ultraviolet spectrums. Leveraging these technologies can improve efficiency of detecting anomalies or ignition risks with regard to vegetation management and assets.

CONTEXT

The availability of imagery from many different platforms and technologies better informs wildfire risk analytics and supports near real-time decisions and actions.

KEY CONSIDERATIONS

- Early opportunity
- Partial solution

Modeling and Simulation SITUATIONAL AWARENESS

TECHNOLOGY

Improvement in modeling, simulation, and forecasting can aid risk assessment and response planning. Developments in availability of more resolute and updated information layers for weather, fire risk, fire spread, and response may contribute to early intervention and system resilience.

CONTEXT

Improving analysis of data across weather, environment and electric systems reduces the uncertainty in these models. Real-time data helps inform PSPS decisions. Further development of these technologies is expected to follow developments in AI and machine learning.

KEY CONSIDERATIONS

- Early opportunity
- Partial solution

Grid Sensors SITUATIONAL AWARENESS

TECHNOLOGY

These detection systems monitor physical and electrical conditions of grid infrastructure with the goal of aiding prevention or faster awareness. Advancements include differentiation in source of contact (animal, vegetation), equipment failure and fault alerts, protective shutdowns after infrastructure failure, and predictive analysis to anticipate faults.

CONTEXT

Grid sensing clarifies the understanding of incipient failures and of current conditions, but is not sufficient individually. Detection technologies provide large amounts of data. Improving the analysis of and response process to this new data can inform responses and improve intervention speed and efficiency.

KEY CONSIDERATIONS

- Early opportunity
- Partial solution

Environmental Sensors SITUATIONAL AWARENESS

TECHNOLOGY

Improved sensor technology can provide a more accurate evaluation of environmental conditions. Main aspects monitored are weather and air quality. These may indicate increased risk for wildfire or presence of wildfire, allowing responders to pinpoint location of issues.

CONTEXT

Environmental sensors and imagery work together to improve monitoring efficiency over traditional human patrolling. Micro-weather sensors can indicate if conditions are of a certain risk level for fire and inform need for power shut offs or for extreme protection settings. Remote smoke detectors and smoke detection cameras can aid in early detection and faster emergency response.

KEY CONSIDERATIONS

- Early opportunity
- Partial solution

Flame Inhibitors SITUATIONAL AWARENESS FIRE-PROTECTIVE MATERIALS

TECHNOLOGY

Physical equipment and infrastructure are susceptible to fire damage when wildfires pass through an area. Application of flame-resistant materials can mitigate some of this risk.

CONTEXT

Solutions, such as sprays, fabric wraps, sleeves, and barriers aim to add a layer of fire protection to the most critical assets such as wood poles. Fiber-reinforced polymer provides a non-conductive, strong fencing material for substations.

KEY CONSIDERATIONS

- Early opportunity
- Partial solution

About EPRI

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