INSIGHT

The Impact of Wildfires on Utilities: Causes, Risks and Preventive Measures

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Wildfires have become an increasing risk each year in the United States with around 68,000 wildfires reported in the United States annually. This number is expected to rise, as forecasts predict a major increase in wildfire activity in the U.S. by the end of the century. Utility companies have already seen tremendous damage in their industry over the past decade, and with the frequency and impact of these fires only expected to increase, utility companies have both tremendous pressure and duty to prepare for these risks and take charge of the situation.

From water systems to railroads to electrical infrastructure, Bartlett & West uses engineering, architecture, construction and technology to solve problems for real people, their communities and their businesses. In this article, we'll discuss the cause of wildfires, how some states and utilities are mitigating the impacts, and how we see utilities using new methods for prevention.

What is causing wildfires?

The U.S. Government's Fourth National Climate Assessment, released in November 2018, notes that the annual area burned in the United States could increase from two to six times from the present conditions in the next 25-to-100-year timeframe of the forecast, depending on the geographic area, ecosystem and local climate. Many regions are likely to face growing danger, notably the Southeast and Northwest parts of the country, with losses surpassing multiple billions of dollars. The U.S. Forest Service continuously studies wildfires across the United States and their recent findings demonstrate how dangerous and destructive frequent wildfires are. The state of California is at the epicenter of wildfires, although every state is at risk. While a number of sources can cause wildfires, humans are by far the largest contributing factor.

Natural wildfires typically occur during times of drought combined with lightning strikes that ignite dry grass or brush, but this scenario accounts for less than 10% of all wildfires. Nine out of 10 wildfires are caused by humans.

Utility infrastructure can ignite a fire in a multitude of ways.

- **Downed power lines:** Power lines may become damaged or fall due to severe weather conditions, strong winds or equipment malfunctions. When they contact the ground or vegetation, especially if conditions are dry, power lines can start a fire.
- **Equipment failure:** As equipment ages or becomes faulty, it can malfunction and cause sparks or overheating. As energy consumption grows, there is additional stress on the power grid, increasing risks of failure or fires.
- **Conductor slap:** During conditions of high wind or other disturbances, power lines can come into contact with each other, causing high-energy arcing, which can ignite nearby equipment or vegetation.
- **Foreign Objects:** Objects such as tree branches, animals or their nests, debris or other foreign materials become hazards.
- **High Impedance Faults:** Faults that do not draw enough current to trip a circuit breaker or fuse, but lead to high energy, can cause high temperature arcing that can ignite fires.
- **Environmental Factors:** Extreme weather conditions, such as lightning strikes can also result in electrical fires by directly hitting power lines or other electrical infrastructure. Floods can also pose a threat as water can breach electrical installations during floods, causing short circuits.

Several states in the U.S. have linked wildfires to utility causes. For example, California has experienced several devastating wildfires linked to utility infrastructure, including the 2018 Camp Fire, and in Texas, the Smokehouse Creek wildfire in 2024 was linked to a decayed utility pole. Wildfires in Lahaina, Hawaii, in 2023 were sparked by downed powerlines, and a jury in Oregon found PacifiCorp liable for damages for negligently failing to cut power to its 600,000 customers during a windstorm over the 2020 Labor Day weekend. These states have acted to reduce wildfire risks from utility infrastructure, but challenges persist due to climate change and old infrastructure.

How does it affect us?

Power outages

Power outages are one of the major reasons frequent wildfires need to be prevented. Wildfires pose a serious threat to reliable electricity service. Fires can disrupt electricity, but a growing issue is preventative power shutoffs. One of the tools the State of California is increasingly using to combat wildfire ignitions is its Public Safety Power Shutoff (PSPS) program, in which the state's utility companies preemptively shut off electricity service when high-risk weather conditions suggest a heightened possibility of electrical equipment wildfire ignition, leaving the whole area in utter darkness.

Damage to utility infrastructure

Burnt debris and trees may fall directly on utility infrastructure such as power lines and substations, causing damage and long periods of time before they can fully recover. Wooden poles are easily ignited, and prolonged exposure to high temperatures increases the risk of damage or destruction. This can be especially true for more weathered and older poles.

Financial impacts

It's clear that wildfires are destructive to life, homes and infrastructure, but they also are a unique threat to United States power and utility companies, as they are the one type of climate-related disaster that can be proven to have been directly caused by the utility company's existing infrastructure. These increased costs will place financial stress on utility companies and crowd out essential investment infrastructure updates. Over the past 50 years, direct damages from wildfires remained steady at $1 billion per year, adjusted for inflation. However, we have seen a huge leap in damages, to more than $10 billion per year.

Legal and financial reforms

Another impact is the increasing number of lawsuits and financial liabilities associated with wildfire damages. These cases have prompted calls for both legal and financial reforms. Proposals presented have included creating a no-fault system similar to workers' compensation, which would provide basic compensation to wildfire victims regardless of fault.

Insurance and zoning regulations

New discussions focus on reforming insurance regulations and zoning laws to encourage fire-safe practices and ensure fair cost distribution. If a utility were to be found to have operated its system imprudently, the company could conceivably be held for such damages, likely totaling billions of dollars. In either case, climate change-driven wildfire activity will increase costs to

utility-sector stakeholders, including investor-owned utilities, co-ops, municipalities, state and local governments, ratepayers and taxpayers.

Stricter compliance and oversight

As we learn more information about what causes wildfires, regulatory bodies, such as the California Public Utilities Commission (CPUC), have imposed stricter compliance requirements and increased oversight on utilities. This includes regular inspections, maintenance schedules and adherence to safety standards to minimize fire risks. These changes aim to enhance safety, reduce the risk of wildfires and ensure fair compensation for affected individuals.

How do we prevent utility-caused wildfires?

Effective fire prevention measures include best utility design practices, proper installation, regular maintenance and vegetation control, timely inspections and system operations.

Design Considerations

- Choose materials such as Fiberglass Reinforced Plastic (FRP) poles. Concrete and steel can also be used to mitigate the impacts of fires.
- Replace fuses and cutouts with low fire options.
- Install underground power lines.
- Use covered conductors.

Proper Installation

Proper installation practices are critical to prevent future issues. Ensuring that electrical systems are installed correctly can reduce the risk of equipment failure and subsequent fires.

Regular Maintenance and Vegetation Control

Regular maintenance is essential for maintaining electrical systems. By regularly inspecting and servicing equipment you can address issues early. This means performing systematic inspections of all components, such as transformers, circuit breakers and power lines to ensure they are operating both efficiently and safely. Technicians look for wear and tear, corrosion and other signs of potential failure. Servicing may also involve cleaning, lubricating moving parts, tightening connections and replacing worn or faulty components.

In addition to inspecting equipment, vegetation management is an essential part of maintaining electrical systems, especially for overhead power lines. Overgrown trees and plants can interfere with power lines, causing outages or even dangerous situations like fires. Regularly trimming trees and clearing underbrush around power lines helps prevent these issues and

ensure uninterrupted service. Clear access to equipment enables swift emergency repairs. Regular maintenance and vegetation management not only prolongs the lifespan of electrical systems but also enhances their reliability and safety.

System Operation Prevention

Placing reclosers on one-shots can prevent a power line from repeatedly closing on a fault, thereby reducing the number of opportunities to ignite a fire.

Preventative power shutoffs are one tactic that some utilities have been using to combat wildfires. These public safety power shut off programs preemptively shut off electricity service when the area experiences high-risk weather conditions that might cause a heightened chance of electrical equipment igniting.

Inspection Methods

Visual inspections: Performing regular visual checks can reveal issues like normal wear on moving connections, lightning strike damage, rot and decay, vandalism and environmental damage. Traditional inspections have been performed by qualified inspectors driving to each location and using binoculars to visually inspect for damage. This process can identify issues such as loose grounds and certain aspects of corrosion that are difficult to quantify from aerial patrols. Aerial patrols with planes, helicopters, and drones are more cost-effective for spotting above-ground issues like vegetation encroachment, damaged conductors and hardware deficiencies.

Aerial patrols can include other types of inspection such as:

- **Thermal imaging:** Thermal imaging is a non-contact technology that detects heat emitted from objects and creates visual representations of temperature variations. This technology is particularly useful in identifying hidden hot spots in electrical systems, as it can capture images of temperature differences on the surface of electrical components. By doing so, it helps detect potential issues such as overheating wires, overloaded circuits or faulty connections, which may not be visible through regular inspection. Early detection of these problems can prevent equipment failures and reduce the risk of fire hazards.
- **LiDAR technology:** Light Detection and Ranging (LiDAR) utilizes laser light to measure distances and create high-resolution maps of environments. It works by emitting laser pulses and measuring the time it takes for the light to return after hitting an object. LiDAR technology is widely used in various industries, including automotive (for autonomous vehicles), forestry (for

mapping and monitoring vegetation) and urban planning (for creating detailed city models). In electrical networks, LiDAR can be employed to map out power lines and detect any physical obstructions or damages that could lead to inefficiencies or safety hazards.

- **Infrared technology:** Infrared technology also plays a crucial role in monitoring and maintaining electrical systems. Infrared cameras detect infrared radiation and convert it into images that display temperature variations across different surfaces. This technology helps pinpoint areas with abnormal heat patterns, indicating potential issues like loose connections, insulation breakdowns or electrical component failures. Regular use of infrared inspections ensures that electrical systems are operating efficiently and safely, reducing downtime and maintenance costs.

Electrical testing

Insulation resistance tests measure the resistance offered by the insulation material, which helps prevent current leakage and potential hazards. Continuity tests check the complete path of an electrical circuit to ensure there are no breaks or faults. These procedures help detect issues early, keeping these systems reliable and at a lower risk of electrical failures.

Geographic Artificial Intelligence (GEO AI)

By combining Artificial Intelligence (AI) and geographic data sets, wildfire prevention efforts can be enhanced through a process called GEO AI. Bartlett and West's extensive experience in geospatial data collection and management, combined with our employee-owners' decades of experience in the management of utility infrastructure, has led us to identify numerous opportunities for time and cost savings.

Fire Risk Assessment

AI can analyze geospatial data to predict high-risk areas, combining sensor data like temperature, humidity and wind speed with real-time sources such as vegetation density to create detailed risk maps. GEO AI revolutionizes fire risk assessment by enhancing prediction, monitoring and management. By integrating various data sources—high-resolution satellite imagery, vegetation density, weather patterns and topography—with AI techniques, it provides accurate, actionable insights. This technology enables real-time monitoring of vegetation and environmental changes, offering early warnings of potential fires. GEO AI's precision detects subtle indicators like dry vegetation and wind patterns that traditional methods might miss, improving disaster response significantly.

Vegetation Management

While GIS can map and monitor vegetation around power lines, AI algorithms can take it one step further by analyzing this data to identify areas where vegetation needs to be trimmed, or perhaps even removed, to reduce the risk of fire caused by contact with power lines. For example, AI algorithms have exhibited the capability to classify vegetation types and growth rates to target vegetation more efficiently.

Public Safety Power Shutoffs

AI can optimize the planning of public safety power shut off programs by predicting high-risk conditions, such as strong winds or low humidity. This allows utilities to proactively shut off power in specific areas to prevent potential ignition.

Fault Detection and Prevention

AI can monitor the health of electrical infrastructure in real-time, allowing for early detection of faulty lines, and addressing those issues before they lead to wildfires.

Smart Grid Management

AI can enhance the management of smart grids by predicting and responding to changes in demand and supply. This ensures a more stable and reliable power supply, reducing the risk of equipment failures that could cause fires.

Emergency Response and Decision Support

This enables authorities to make swift, knowledgeable decisions, which can save lives and property. This helps authorities make informed decisions quickly, potentially saving lives and property. These technologies help utilities prevent and respond better to wildfires. It's a strong blend that greatly impacts wildfire management.

Conclusion

Electric utility companies should consider adopting thorough inspection and preventive measures to enhance safety and reliability. Regular inspections can identify potential issues such as faulty wiring, equipment malfunctions or tree branches encroaching on power lines before they become serious problems. Preventive measures, such as maintenance programs that include GEO AI, using intelligent design principles and upgrading aging infrastructure, can help prevent outages and accidents. Advanced technologies like smart grids and predictive analytics can enhance utility system performance, providing consumers with a more stable and efficient energy supply. By taking these proactive steps, electric utility companies can reduce

the risk of unexpected disruptions and provide better service to their customers.