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Wildfire's Legacy: Paradigm Shift to a More Resilient Grid

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Many utilities in the western United State are ramping up wildfire planning and management efforts in light of increasing wildfires generally and, more specifically, to address the related risk to utility lines and the potential liability for starting wildfires. Simply "doing more" of the existing utility reliability and resiliency strategies will not be enough, especially given that some of the emerging wildfire mitigation strategies require proactive or automated power shut-off, which ultimately decreases reliability metrics. So, what does the new paradigm look like, and how can utilities build the system to a level of resiliency to maintain both reliability *and* safety in the face of increasing wildfire risk?

These questions were tackled at the GridFWD 2022 conference in Denver, which featured sessions including "Community Partnerships for Wildfire Mitigation," "Leveraging Advanced Tech to Address Wildfire Risk," and "Managing the Grid in Extreme Weather Conditions." These sessions illuminated the many ways that utilities are grappling with the thread of wildfire, including "hardening" systems through covered conductors and steel poles; "sectionalizing" the grid to enable emergency power shutoff when fire risk is imminent; and deploying remote sensing technologies to improve "situational awareness". Among the panelist insights:

- Response to wildfire and extreme weather are creating new challenges to managing the grid, and there aren't always enough trained personnel available to address the needs
- Advanced planning for outages and disaster response is increasingly important, from the mundane logistics of rapid equipment delivery to advanced monitoring techniques that allow visibility into emerging dangers
- Utilities and regulators need to become comfortable with a more agile approach to employing innovative grid management technologies and practices. In the view of one panelist, we can't prevent every fire, but we change our way of thinking about utility operations and the regulatory approval process, and we can rapidly deploy and test new techniques to see what works best to mitigate the risks.

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These insights and the increasing danger of wildfire suggest the need to shift away from a "reliability-first" paradigm to one that accepts some level of decreased reliability in the name of public safety—at least in the short term. The new paradigm embraces the concept that increased *resiliency* across the system can support both reliability *and* safety, and should be pursued through advanced planning, use of more robust equipment and materials, and changes in operational practices that provide early identification of threats and rapid adjustments to work procedures.

Safety-Reliability Paradigm Shift

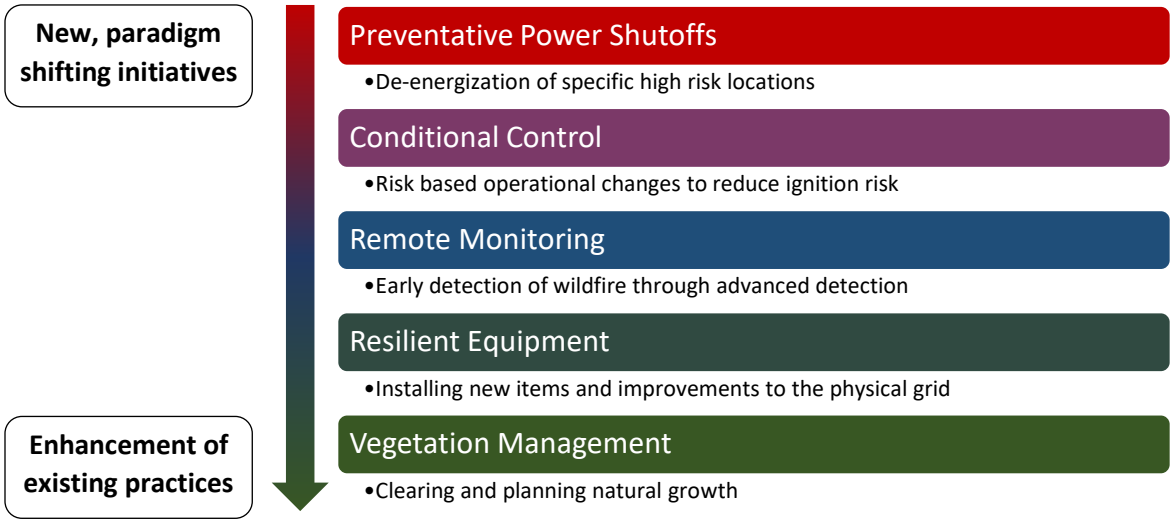
Utilities have always prioritized the safety and reliability of their electric network. Safety includes protection from the dangers from electric equipment, and reliability includes reductions in customer outage frequency and duration. However, the definition and requirements for safety have changed over time with the shifting focus on wildfires and other natural disasters. Historically, safety focused on the wellbeing of the general public and line workers through internal practice improvements and on the education of customers via informational campaigns like dig safety and downed line awareness. Today, utilities in high fire-risk areas must expand their definition of safety to include continuous risk assessments, changes in equipment to reduce ignition, and revised operating procedures—all in an effort to reduce wildfires.

What does this expanded safety definition mean for utility practices and prioritizations? With the additional consideration of wildfire, the safety concern is no longer limited to this localized and limited scope. Depending on conditions, a single spark can ignite a wildfire impacting thousands of people across a large area. Therefore, new and greater measures must be taken to mitigate ignition events in those high-risk conditions. These measures represent a ***paradigm shift*** in utility prioritization to focus on an expanded definition of safety. Ultimately, the goal is to create a resilient, reliable, *and* wildfire-safe grid, but addressing all potential safety and reliability upgrades presents a severe challenge. In the near term, utilities will need to prioritize as they develop practices re-imagining the safety risk for wildfire. For example, to address near term risk mitigation a utility may enact planned power shutoffs to prevent wildfire ignition. Though this decreases reliability, it is seen by many utilities as a last resort, stop-gap measure, until a more resilient grid can be developed. Therefore, while the immediate impact of wildfire planning may be a lowering of reliability, the long-term end-result will be a more resilient and reliable system.

> *Public Service Company of Colorado is committed to delivering electricity to our customers that is first and foremost safe, but also reliable and cost-effective. It is with this focus on safety that the Company is implementing measures to reduce the risk of fire ignitions caused by the operation of our equipment, in order to minimize the potentially devasting impacts caused by wildfires.*
>
> From Xcel Energy's *2020 Wildfire Mitigation Plan*

Given this shift, what are the outcomes? What are utilities doing to mitigate wildfire risks? In this article we highlight five example categories of initiatives: preventative power shutoffs, conditional control, remote monitoring, equipment installation, and vegetation management. These initiatives and others represent new and additional measures taken by utilities to reduce fire risk. For each initiative, we discuss what it entails, what the benefits are, how the safety and reliability shift is at play, and examples in the field today.

Figure 1. Examples of Utility Wildfire Mitigation Actions



Emerging Utility Wildfire Mitigation Actions

Preventative Power Shutoffs. The temporary reliability loss to prioritize safety is most glaringly evident in preventative power shutoffs, one of the most controversial wildfire prevention, last measure, taken by electric utilities. During conditions of extreme wildfire risk a utility may de-energize lines in the most high-risk areas. De-energizing lines ensures the utility will not be the source of ignition, but at the cost of intentionally turning off power to a large number of customers. Preventative power shutoffs immediately mitigate worst case wildfire risk without large capital investment or long project lead times. However, this strategy shows how prioritizing wildfire prevention can have a large negative impact on reliability. For customers who are used to utilities prioritizing keeping the lights on, the shift to sacrifice reliability for safety is disruptive and upsetting.

Utilities have always had the ability to shut off power for imminent threats (for example, a motor vehicle accident involving a live wire). With expanded safety considerations for wildfire, *imminent threat* now includes climate events and the action taken is preventative rather than responsive.

PG&E has been front and center in the discussion around preventative power shutoffs. In their July 2022 "Your Guide to Public Safety Power Shutoffs" article they outline plans to reduce public safety power shutoffs (PSPS), including: operational changes, vegetation management, undergrounding or rebuilding lines, and installing microgrids. Many of these ideas fall under the other initiative categories within this article and show how developing wildfire resilience measures can reduce the need for shutoffs and the associated reduction in reliability. Once a certain level of resiliency is achieved, PG&E is expected to reduce PSPS frequency since the *imminent threat* of wildfire due to electric lines has been sufficiently reduced.

Conditional Control. Similar to preventative power shutoffs, utilities are also implementing condition-dependent control strategies. A common target of these control strategies are breakers and reclosers. Under low fire risk conditions, breakers and reclosers act to resolve momentary outages caused by wire slap and debris by automatically re-energizing after an outage. If the issue has cleared, the customer

experiences only a brief lapse in power. If the issue has not cleared, the outage will re-trigger and the breaker and recloser will stop restoration after a certain number of attempts.

While this technology allows almost immediate restoration of power in many cases, it increases risk of ignition when the line is re-energized. If the issue has not cleared, restoring power can cause sparking and burning of debris leading to wildfire ignition. To address this, utilities implement a specific wildfire control mode disabling reclosing. When the control mode is active reclosers will not activate, and instead the line must be patrolled and confirmed clear before power is restored.

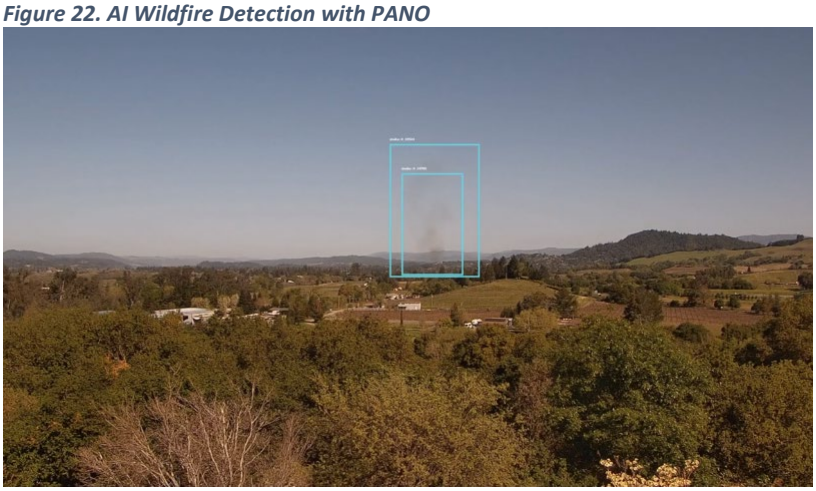
Using advanced control measures, such as the selective disabling of breaker and reclosers, can prevent ignition events under high-risk conditions. These controls do not shut off all power like a preventative outage, but will extend outage duration from a momentary loss of power to a sustained outage. Xcel Energy, for example, has implemented Wildfire Safety Settings in select regions of their service territory. During high-risk conditions, the enhanced safety settings are activated and reclosing will not occur. The line will remain de-energized until a crew is able to patrol the line and confirm that it is safe to re-energize.

Remote Monitoring. Remote monitoring uses a network of cameras or other detectors paired with an identification process to notify operators and emergency responders of wildfires at the earliest possible time.

Historically, utilities have established contact with emergency services for response to specific emergency situations. Effective wildfire mitigation requires much more extensive, ongoing cooperation between utilities and local groups to prevent and respond to fire. Implementing remote monitoring is part of this expanded cooperation between the utility and local emergency response personnel. In some states, the monitoring cameras or sensors are installed by utilities, and then a non-utility centralized group monitors the cameras and notifies the fire department and other first responders. Additionally, the remote monitoring systems are, in theory, capable of detecting all fires, not only those that may have been ignited by a utility. Therefore, remote monitoring improves safety and resilience for the entire region.

There are a variety of ways to execute remote monitoring. One example, manufactured by Pano, is an emerging fire detection platform that uses strategically placed cameras and an AI/computer vision data processor to identify and locate wildfires across a large territory. Pano presented at the GridFWD *Managing the Grid in Extreme Weather Conditions* huddle session, where they discussed how remote monitoring with automated detection allows utilities and emergency services to broaden their surveillance and improve response speed. Figure 2 below shows an example of AI wildfire detection in action.

Figure 22. AI Wildfire Detection with PANO



Source: https://www.pano.ai/

In the Colorado mountains, electric cooperative United Power is partnering with local agencies to prevent, identify, and respond to wildfires more rapidly and effectively than ever before. As the chief of the Timberline Fire Protection District explained at GridFWD 2022, firefighters are *trained to put out fires, not to prevent them*. Given utilities' increasing focus on fire *prevention*, the utility-fire district partnership is a great fit. The two organizations teamed up to remove trees from remote transportation corridors to improve ingress and egress for fire crews and the community. The collaboration with United Power has included partnering with local Firewise Communities to reduce hazardous vegetative fuels by organizing chipping events.

United Power is also teaming with the county office of emergency management to install dozens of remote N5 Shield sensors mounted on utility poles around the county. Manufactured by N5 Sensors, the sensors use infrared, chemical signatures, and other means to detect heat and fires from a mile or more away. Alerts are sent to county and utility personnel, and in one case provided firefighters with a 30-minute head start on a burn pile prior to it growing out of control. Sensors were initially placed at approximately 1-mile intervals in the highest sensitivity areas, and more tightly in sensitive areas. Homeowners can place sensors on their homes, adding additional points on the county sensing grid.

Resilient Equipment. Equipment installation for increased resiliency is a standard utility investment process that has be adapted for wildfire prevention and mitigation. Among other initiatives, this targeted equipment installation includes fire mesh for wooden poles, installing covered conductor, and selective undergrounding of wire. Fire mesh is a coated wire net used to wrap the bottom segment of utility poles. When exposed to fire, the coating reacts to protect the pole and maintain its integrity through the fire. Fire mesh is a tool used to protect utility equipment during active wildfire.

Covered conductors is electrical overhead primary wire, coated in a protective insulating material. When tree branches or debris land on bare wire they spark and burn, creating a potential ignition source for wildfire. Similarly, if a bare wire were to break and land on the ground, it has the potential to ignite any brush it comes in contact with. Covered conductors reduces or prevents these ignition scenarios by insulating the wire from contact with its surroundings.

Selective underground wire is the replacement of overhead wire with the installation of underground cables. Underground cables is protected from most weather events and is not exposed to the flammable vegetation above-ground. Undergrounding does present challenges especially in the rocky, mountainous areas where wildfire mitigation is often a higher risk. The undergrounding process is costly and time consuming, but extremely effective at both increasing reliability and decreasing wildfire ignition risk. Though some investments, such as fire mesh, is beneficial for protecting equipment (poles) in recovering from a wildfire, selective undergrounding improve reliability as well. The paradigm shift to prioritize equipment upgrades for wildfire mitigation still includes reliability as a co-benefit. Covered conductor is more robust in reducing ignition arcing from vegetation contact but may be more vulnerable to damage from lightning strikes. Therefore, there is a small sacrifice in reliability during a lightning event bur provides improvements to prevent wildfire ignition.

For example, the California Power Line Fire Prevention Guide includes exemptions to vegetation clearance requirements where covered conductor is used. In areas where vegetation cannot be sufficiently cleared from around the lines, covered conductor serves to mitigate risk from contact across the conductors.

Vegetation Management. Vegetation management, one of the ongoing line maintenance practices undertaken by all utility, is undergoing a change. Historically, utilities execute tree trimming within a given clearance of lines, and may clear pathways for installation and maintenance equipment along major corridors. Now within the context of wildfire prevention, utilities must now go a step further: creating resiliency corridors and grubbing poles among other vegetation management initiatives. Resiliency corridors completely remove vegetation in a wide path along an existing utility corridor. Not only does this protect the utility infrastructure, but it also creates a barrier preventing the spread of wildfire. These resiliency corridors offer increased protection from all wildfires, regardless of cause. Pole grubbing removes vegetation from the immediate vicinity of wooden utility poles, reducing the susceptibility of equipment (i.e. fuses) resulting in a fire and increasing protection for utility equipment during active wildfire.

These additional vegetation management practices may not have the same reliability impact as traditional tree trimming since ground vegetation is unlikely to cause an outage. However, generally increasing clearances from lines and increasing focus on vegetation maintenance does have the potential to reduce outages from falling branches and other organic hazards. Therefore, though the primary goals of additional vegetation management may shift to safety rather than reliability, increased reliability is still a co-benefit of these measures.

Figure 3. Fire crew clearing vegetation around utility lines

Source: *https://thisisreno.com/2020/06/living-with-fire-truckee-meadows-launches-fuels-reduction-division/*

Nevada Energy has enacted a partnership with local fire crews to enact vegetation management around their equipment. Partnerships with local organizations allow faster and more effective vegetation removal to improve wildfire mitigation. These partnerships also include the co-benefit of increasing fire department crew familiarity with the utility's electric system. The figure below from *This Is Reno* shows the newly founded Truckee Meadows Fire Wildland Fuels Reduction Division clearing a resiliency corridor around NVE lines.