2022
WILDFIRE MITIGATION PLAN UPDATE

FEBRUARY 18, 2022

Contents

Executive Summary

Southern California Edison Company (SCE) is dedicated to the safety of our customers and the communities we are privileged to serve. We appreciate the opportunity to present to the California Office of Energy Infrastructure Safety (Energy Safety or OEIS) and other stakeholders our second annual update to our approved 2020-2022 Wildfire Mitigation Plan (WMP). Our 2022 WMP update builds on the successes of our WMP implementation to date, incorporates the lessons we learned during WMP deployment and reflects the continued progress we made in our analytical, engineering and process maturity prior to and during the first two years of the 2020-2022 period.

In 2021, California experienced another year of extreme wildfire activity, exacerbated by intensifying drought. California Department of Forestry and Fire Protection's (CAL FIRE) data indicates that nearly half of the 20 largest wildfires since 1932 have occurred in the past two years.[1] In October 2021, Governor Gavin Newsom declared a drought emergency across California, stating that August 2021 was the driest and hottest August on record since the state began reporting data.[2] Increasing temperatures and heightened drought conditions make areas much more vulnerable to wildfires, especially regions that the Commission has classified as having "extreme" and "elevated" wildfire risks, which comprise 27% of SCE's service area. As outlined in our 2022 WMP update, SCE continues to re-examine and prudently harden the electric grid in a risk-informed manner to help ensure safety, grid resiliency, and system readiness for these growing climate change impacts.

Despite the challenges posed by COVID-19, storms, and supply constraints this year, SCE met or exceeded the majority of goals we set forth in the 2021 plan. We installed more than 1,500 circuit miles of covered conductor, which means we have installed covered conductor cumulatively on approximately 30% of our distribution lines in our High Fire Risk Areas (HFRA). We inspected more than 200,000 transmission and distribution structures in our HFRA, and installed more than 400 weather stations, while removing about 3,400 hazardous trees that could fall into power lines and trigger a potential ignition. Further, through our Public Safety Power Shut Off (PSPS) mitigation efforts in 2021, SCE reduced the number of customers impacted in 2021 by at least 42% from what they otherwise would have been.

These risk mitigation actions, combined with a portfolio of SCE activities, helped to significantly reduce the impact of wildfires associated with SCE equipment in 2021. Overall, there were no significant wildfires associated with SCE equipment in 2021 and the total number of acres burned from wildfires associated with SCE equipment was reduced from 128,000 in 2020 to approximately 500 in 2021, despite the extreme drought and wind conditions experienced. This improvement could not have occurred without the partnership and dedicated efforts of many leaders throughout the state. SCE thanks California's leadership – lawmakers and regulators alike – for addressing critically important wildfire public safety issues. We are proud of our partnership with regulators, legislators, local governments, firefighters and other first responders, and the general public, who have come together to further reduce the risk of potentially

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[1] https://www.fire.ca.gov/media/4jandlhh/top20_acres.pdf. Five of the 20 largest wildfires happened in 2020, and four of those 20 happened in 2021.

[2] https://www.gov.ca.gov/2021/10/19/governor-newsom-expands-drought-emergency-statewide-urges-californians-to-redouble-water-conservation-efforts

devastating wildfires. We will build upon these partnerships and the work performed in 2021 to drive further risk reduction in 2022.

In this 2022 WMP update, SCE describes its overall strategy of deploying a suite of complementary mitigations to the sections of its overhead distribution facilities where an ignition has the most potential of growing into a significant wildfire. SCE's approach considers the effectiveness of each mitigation activity in addressing ignition risk factors at these high-risk locations to build a portfolio of mitigations that meaningfully, cost-effectively, and expeditiously reduces wildfire risk. These mitigations include covered conductor installation, undergrounding overhead conductor, and some new initiatives in addition to many of the successful activities outlined in our 2021 update. Many of the foundational activities SCE deployed in 2020 and 2021 continue into this year, and we are incorporating improvements and lessons learned into the 2022 WMP. SCE's 2022 WMP implements the following:

- An enhanced, comprehensive grid hardening strategy anchored in advanced risk modeling and analytics;
- Risk-informed inspection, repair and replacement programs;
- Continuation of comprehensive vegetation management;
- Deployment of improved technology, data, and risk analytics capabilities;
- Increased situational awareness and response;
- Augmented activities for PSPS mitigation, resilience and community engagement, particularly on behalf of under-represented groups and our access and functional needs (AFN) customers, and;
- New mitigations to address risks associated with transmission lines and secondary conductors.

This WMP update also outlines how we have matured in our wildfire mitigation capabilities and our long-term plan to further advance our risk-informed decision making, data management, grid hardening and community engagement efforts before, during and after wildfire-related events. The table below highlights the progress made in deploying wildfire and PSPS mitigation activities since 2018 and showcases our plans for advancement in 2022.

SCE's Foundational Wildfire Mitigation Plan Progress

	Completed Since 2018[3]	Completed in 2021	2022 Forecast
Covered Conductor	More than 2,900 total circuit miles installed	More than 1,500 circuit miles installed	Install 1,100 circuit miles
Undergrounding	Performed detailed risk and engineering analyses, designed scope, and/or constructed nearly 6 miles	Completed nearly 6 miles	Complete approximately 11 miles; potential for significant increase in miles in subsequent years
High Fire Risk Inspections and Remediations	Completed more than 764,000 inspections on distribution structures and 106,900 inspections on transmission structures; performed repairs and replacements	Inspected more than 179,600 distribution structures and nearly 20,800 transmission structures in HFRA; performed repairs and replacements	Inspect 150,000 distribution and 16,000 transmission structures in HFRA, including areas of concern; perform repairs and replacements
Vegetation Management	Expanded line clearance to recommended distances where feasible, completed more than 359,900 hazard-tree assessments and more than 15,600 removals, cleared brush at the base of more than 556,600 poles	Maintained line clearances, completed approximately 131,400 hazard tree assessments and nearly 3,400 tree removals, cleared brush at base of more than 163,100 poles	Maintain line clearances; Assess hazard trees on 330 circuits and perform timely removal; Perform brush clearing at the base of 134,000 to 170,000 poles
Public Safety Power Shut Off	Established circuit operational protocols, customer notification processes, circuit mitigation plans, risk modeling capabilities, and a portfolio of customer care offerings	Enhanced de-energization approach with fire climate zone specific Fire Potential Index (FPI) thresholds, in-event risk calculator, in addition to new circuit-specific mitigation plans and customer care programs to reduce customer impacts	Develop additional circuit-specific mitigation plans, further advance risk modeling to inform wind speed and FPI thresholds, enhance customer care programs to reduce customer impacts
Weather Stations	More than 1,460 installed	More than 400 installed	Install 150 weather stations. Expand Artificial Intelligence/Machine Learning capabilities (AI/ML) for improved forecasting.
High Definition Cameras	166 installed	0 installed	Install 10 HD Cameras
Sectionalizing Devices	More than 140 devices installed	23 devices installed	Install 15 devices
Fast Acting Fuses	Installed fusing at more than 13,300 fuse locations	Installed or replaced fusing at more than 350 fuse locations	Install or replace fusing at 350 fuse locations
Backup Resiliency Programs	Progressed in understanding customer- and community-specific needs and developed targeted programs to support critical care Medical Baseline customers and communities frequently impacted by PSPS. Launched battery and resiliency programs and pilots.	Deployed more than 6,000 batteries to Medical Baseline customers in HFRA. Expanded community outreach, resiliency, and communication channels	Enroll 2,750 additional customers in Battery Backup program and introduce in-event battery loan pilot. Improve effectiveness of notifications and expand focus on Access & Functional Needs (AFN) customers.

[3] Progress is as of December 31, 2021.

SCE's WMP Continues its Commitment to Wildfire Mitigation and PSPS Resilience

The primary objective of our WMP is to safeguard public safety. Our WMP represents an actionable, measurable, and adaptive plan for 2022 to reduce the risk of potential wildfire-causing ignitions, with appropriate urgency, associated with our electrical infrastructure in HFRAs.

At the same time, we are acutely aware of the impact of planned WMP work and PSPS events on our customers and communities, especially when compounded with the restrictions and disruptions caused by the ongoing COVID-19 pandemic. Our WMP aims to strike the appropriate balance between mitigating wildfire risk and navigating these inevitable challenges. We remain committed to enhanced transparency, communication, coordination, and resiliency to help reduce the hardships caused by wildfire mitigation activities and de-energization events.

Other key objectives of our WMP include:

- Increasing the resilience of our infrastructure to help minimize service disruptions during extreme weather and fires, regardless of ignition source
- Supporting fire agencies' ability to detect and respond to emerging fires
- Improving coordination between utility, state and local emergency management personnel
- Engaging the public about how to effectively prevent and mitigate wildfires in our HFRA

SCE added four activities to the 2022 WMP based on updated engineering and ignition risk analysis, and reasonable enhancements to our fire detection and monitoring capabilities. In summary, our 2022 WMP Update includes 39 activities[4] that underscore our commitment to reduce the risk of wildfires and support our communities.[5] We highlight some of the key activities for each of our wildfire-mitigation capabilities below that were in part shaped by the successes and lessons learned since beginning our targeted wildfire-mitigation efforts in 2018.

Grid Design and System Hardening: Expanded Measures are Expected to Further Reduce Wildfire Risk from Overhead Electric Systems

Historically, overhead distribution lines have been linked to the majority of ignitions associated with SCE's utility equipment. Through 2021, installing covered conductor has been one of our primary mitigation activities to address this risk. Based on feedback from the OEIS and the Commission in the 2021 WMP Update and the 2021 General Rate Case (GRC), benchmarking with other utilities and updated risk

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[4] Additionally, four Situational Awareness activities were consolidated into the existing Fire Science Enhancements activity (SA-8) in the 2022 WMP as these activities all contribute to enhancing SCE's fire science capabilities: Fire Potential Index (FPI) Phase II, Fire Spread Modeling, Fuel Sampling, and Remote Sensing.

[5] We have worked diligently to provide complete responses to the WMP requirements regarding these activities and other information. However, given the timing of ongoing final validation of 2021 data, such as financial and outage information, if SCE identifies instances where data requires modification, SCE will promptly notify Energy Safety and other stakeholders of these changes.

analysis, SCE has further refined its grid hardening approach through its Integrated Grid Hardening Strategy.[6]

A key component of this approach is a segment-by-segment risk analysis of remaining unmitigated overhead distribution lines in HFRA. SCE has identified attributes such as egress constraints; history of frequent fires; history of wind speeds exceeding PSPS de-energization levels even after covered conductor installation; and very high expected fire spread based on latest risk modeling that further elevate the risk levels to populations residing, working in, or visiting these locations. For segments in these areas, the threat to lives and property is elevated to such an extent that SCE has determined that for public safety reasons it is prudent to not just significantly reduce ignition risk expeditiously but minimize it in the long term to the extent practicable. Unless already hardened with covered conductor, undergrounding is the preferred alternative for these locations to sufficiently reduce risk. However, certain terrains are not conducive to undergrounding and SCE will install covered conductor or similar mitigations in such cases.

We have also identified High Consequence Segments based on locations where a wildfire can propagate over large areas in a relatively short period of time and/or have the potential to be frequently impacted by PSPS. All of these segments will need a suite of mitigations to help ensure that all significant ignition risk drivers are reasonably mitigated. Based on risk spend efficiency (RSE), achievable pace of deployment, and operational feasibility, deploying covered conductor supplemented by fire resistant poles (FRPs) installation, enhanced inspections and vegetation management is generally the preferred option, similar to SCE's approach from 2018 to 2021.

SCE continues to explore other technologies such as Rapid Earth Fault Current Limiter (REFCL), which detects when one wire out of a three-wire powerline has fallen to the ground and almost instantly reduces the energy released to the ground. If deployed with covered conductor, the potential risk reduction potential can be similar to that of undergrounding. SCE is evaluating this technology and depending on the results, may transition to using REFCL on a wider scale in the future.

In 2022, we are transitioning to developing covered conductor installation and undergrounding scope in 2023 and beyond using this integrated grid hardening strategy as these mitigations have installation lead times of 18 to 24 months and 24 to 48 months, respectively. SCE will be installing 1,100 additional circuit miles of covered conductor in 2022. By the end of 2022, we expect to have replaced more than 4,000 circuit miles or approximately 40% of distribution primary overhead conductors in HFRA. Though wildfire risk reduction continues to be the primary criteria for prioritizing where we install covered conductor, we have also installed covered conductor on circuits that have been frequently impacted by PSPS de-energizations. As mentioned above, we will continue to assess circuit segments where covered conductor installation can mitigate the need for PSPS de-energizations.

Asset Management and Inspections: Inspecting Assets in HFRA with Increased Focus on Those Assets with Highest Risk

[6] Please see Section 7.1.2.1– Integrated Grid Hardening Strategy for additional information.

We perform risk-informed inspections and remediations in HFRA that go beyond minimum compliance requirements in scope, frequency, and approach. Asset conditions and location-specific fire risks can often change during the time period between multi-year compliance intervals for inspection. Even with annual inspections, we are still finding potential ignition risks, albeit fewer with each successive cycle, which only underscores our High Fire Risk Informed (HFRI) Inspection program's efficacy. Detailed ground and aerial inspections are conducted to obtain 360-degree views of overhead structures and equipment. Repairs or replacements based on safety, reliability or ignition risks identified are completed within the pre-established compliance timelines. In 2022, nearly 53% of distribution and approximately 43% of transmission structures will be inspected using a risk-informed approach. Further, SCE will continue its practice of inspecting substantial portions of its transmission and distribution lines with infrared (IR) technology to detect conditions that could lead to equipment failure.

For 2022, we will continue to perform additional inspections of assets in areas where observed risk factors associated with prevailing weather and fire conditions reach certain levels. These inspections will further reduce the POIs by targeting specific locations that present high dry fuel- and wind-driven risks ahead of and during fire season.[7] We are deploying new inspection methods for transmission lines that can identify anomalies within the conductor that could potentially lead to wire down events. SCE is also piloting remediation of ignition risks associated with secondary conductors. Finally, we are developing and implementing mobile inspection tools and data management systems to improve inspection data quality and reduce inspection cycle time.

Vegetation Management and Inspections: Continued Multi-Pronged Approach Leveraging New Risk-Informed Prioritization and Technology Platforms to Increase Efficiency and Enable Advanced Analytics

Given the importance of vegetation management in reducing the risk of wildfires, we are continuing our multipronged approach, going beyond minimum compliance requirements, in order to reduce vegetation contact with electrical lines and equipment. We reduce the risks of contact by maintaining expanded line clearances, remediating trees that can fall into lines and removing brush around our poles. We are employing a new, risk-informed methodology to inform planning and prioritization of work for various vegetation management programs. We are also seeking advances in operational and resource efficiency by implementing an integrated software platform that will help streamline scheduling and processing of the enormous volume of work, improve data management, and facilitate advanced analytics and predictive modeling across all vegetation management activities.

Situational Awareness and Weather Forecasting: Additional High-Definition Wildfire Cameras, Weather Stations, Satellite Imagery and Advanced Technology will Boost Capabilities

We continue to advance our weather modeling and situational awareness capabilities to better understand the factors leading to increased wildfire risk. These advancements more precisely target PSPS de-energization events, thereby minimizing the impact to customers while still addressing dangerous fire threat conditions. Since the program's inception in 2018, we have installed more than 1,400 weather

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[7] Wildfires are a year-round threat in California. Historically, wildfires have been more prevalent during the third and fourth quarters of the year, though each year is different based on weather and fuel conditions. For internal planning purposes, SCE generally considers the wildfire season to start around mid-to late second quarter and peak in the fourth quarter.

stations in our HFRA. In 2022, we will deploy an additional 150 weather stations and utilize machine learning (ML) to further advance our predictive modeling capabilities of potentially dangerous winds and elevated fire potential. In 2022, we will deploy additional high-definition wildfire cameras as well to enhance early fire detection in areas with limited coverage; currently our cameras provide visibility to about 90% of our HFRA, and with SCE's planned installations in 2022 and beyond, that coverage will increase to nearly all our HFRA. We will also continue to enhance our fire spread modeling and other weather modeling applications to increase our situational awareness of weather, dry vegetation, and fire activity.

Grid Operations and Protocols: Dedicated Team Continues to Refine Circuit-specific Measures

We are continuing to assess and adjust our operational protocols to prepare for extreme fire risk events including circuit-specific plans for sectionalization, equipment settings and patrols ahead of potential PSPS events. Our protocols and efforts include a dedicated and trained incident management team (IMT), heightened efforts on community engagement, and enhancements to customer care programs, as well as customer communication before, during and after events. SCE will continue to use sectionalizing devices to help limit PSPS de-energization to fewer and smaller circuit segments. Additional details about our PSPS-related efforts are described in more detail below.

Emergency Planning and Preparedness: Trained Workforce Is Ready to Restore Power and Assist Customers

SCE remains prepared to serve our customers and help them face emergencies that disrupt their electrical service. In the event of a major emergency, we have a dedicated customer support team to assist impacted customers. Our highly qualified workforce is trained on protocols to restore power safely and quickly after de-energization events. And after each event, we have a process in place to learn and improve on our response. We discuss this in more detail below.

Stakeholder Cooperation and Community Engagement: Strong Partnerships Increase Outreach to Access and Functional Need (AFN) Customer Groups, Provide Aerial Resources for Fire Agencies

We are working ever-more closely with our customers, local and tribal government agencies, fire agencies, community-based organizations (CBOs), and other utilities for emergency planning, incident management and outreach.

In 2021, SCE conducted 11 virtual wildfire safety community meetings and held 28 PowerTalks with residential and business customers to provide information on outages and outage management. Additionally, SCE led eight resiliency workshops for water agencies, telecommunication companies and school districts, and met with government and business associations to discuss their concerns and offer solutions. We have developed strong partnerships with approximately 50 CBOs to increase the effectiveness of our customer outreach and education on wildfire mitigation and PSPS, especially by focusing outreach and providing resources to customers with AFN, such as seniors, those with limited English proficiency, those with disabilities, and/or those who are transportation disadvantaged. We have also instituted a formal feedback process to help address specific critiques and recommendations. In 2022, we are targeting much of our engagement efforts on communities heavily impacted by PSPS and actively evaluating and refining our stakeholder coordination and customer outreach approaches based on feedback received regarding past PSPS events. We are also partnering with telecommunications providers to help minimize the potential for service disruption for communities impacts by PSPS. In addition, we are maintaining and broadening active collaborations with state, national and global utilities, industry groups and research organizations, to benchmark, learn best practices and share information.

Finally, after a successful roll-out of the program in 2021, we are continuing our partnership with fire agencies in our service area to provide temporary mitigation with up to five aerial resources. These include helitankers to bolster firefighting capabilities to primarily protect electrical infrastructure during fires for service resilience to our customers.

Risk Assessment and Mapping: Advancements in Risk Modeling Capabilities Will Allow for More Robust Evaluation of Mitigations at Specific Locations of the Grid

In 2021, SCE met significant milestones in enhancing our risk analytics. We achieved this by incorporating the risks associated with PSPS into our wildfire risk models and using those models to inform our decision-making process. These improvements drove consistent risk-informed decision making at the enterprise and program levels, helped more accurately estimate risk along the grid and to the communities we serve, and assisted in better targeting where, how, and when to perform necessary work. In 2022, SCE will update its risk models with the updated and improved ML model, weather and fuels information, and forward-looking climate scenarios. SCE will also incorporate additional qualitative factors not fully captured by ignition modeling alone. Such qualitative factors include identification of locations with egress concerns and/or locations subject to frequent high wind and dry fuel conditions.

Resource Allocation Methodology: Risk Analysis Along with Operational Considerations Helps Us Productively Direct Our Resources

As mentioned in the Risk Assessment and Mapping sub-section above, SCE has progressed from risk analysis based on HFRA-wide *averages* of ignition probability and consequence estimation to a more granular *asset- and location-specific* risk evaluation. We have performed RSE calculations using this granular approach, which is one of several factors that helps us examine and analyze risk and deploy mitigations in a more specific and targeted manner at particular locations on the grid. In 2022, SCE expanded the number of mitigation activities for which RSEs were calculated, from 23 in 2021 to 38 in 2022, an increase of approximately 65%. In concert with RSE, we evaluate certain operational considerations including planning, permitting and execution lead times, resource constraints, work management efficiencies, risk-reduction potential of mitigations on targeted risk drivers, and regulatory compliance requirements to determine the type and volume of work to undertake. We use the results of this collective evaluation to make more informed decisions when selecting and validating wildfire-mitigation activities and prioritizing resources within a WMP activity and across WMP activities. This comprehensive analysis is performed to reduce as many wildfire and PSPS risks as reasonably possible at a pace that reflects appropriate urgency.

Data Governance: **Focus on Data Quality Will Enable Next-Generation Geospatial and Risk Analytics and Support PSPS Activities**

SCE continues to improve the consistency and quality of our data to enable next-generation geospatial and risk analytics and automate data sharing and reporting capabilities by developing a centralized cloud-based data repository and data platform that integrates information from disparate sources. This will also enhance our data-management capability for asset inspection using remote sensing by automating image processing, which will increase efficiency and reduce human error. For example, in 2021 alone, our aerial inspections generated approximately seven million images. Having centralized geospatial data eliminates the need to extract and consolidate data for each instance of data sharing and enables standardization and automation of reports. Going forward, we will be able to store such large and growing volumes of data, as well as increase the accuracy and productivity of analyzing the images to determine repairs and replacements needed. This also enables us to enhance our risk modeling capabilities using high-quality asset condition information.

SCE Continues its Goal to Reduce PSPS Impacts with Urgency

PSPS is a necessary mitigation to protect public safety under extreme conditions. It is a measure that we use only as a last resort and recognize the impact that such events have on our customers and communities. Keeping the lights on, and everything else electricity powers, is in our DNA, and we do not take lightly any decision to proactively de-energize portions of the grid. We have taken to heart the lessons from past PSPS events and the feedback received from customers, cities, regulators, legislators, and other partners, and we are working persistently to make several modifications to the process. Though the frequency and scope of PSPS events are lessening as we execute our WMP activities, PSPS will remain available as a tool of last resort to mitigate wildfire risk during severe weather and high FPI events. In 2021, our post patrols found 46 incidents of wind-related damage on lines de-energized during PSPS events that could have potentially caused ignitions and there were likely many more potential incidents prevented that could not be observed after the events.

Our highly trained PSPS IMT plans and executes protocols designed to maximize a de-energization event's effectiveness while reducing the impact to customers by targeting specific circuit segments and facilitating the swift and safe restoration of power. SCE continues to maintain a dedicated IMT model for knowledge continuity and operational consistency from event to event, as well as to help focus on continuous improvement between events.

In 2021, California again experienced extreme drought conditions. These conditions, coupled with exceedingly low fuel moisture and very strong wind gusts, increased the risk for ignition and spread of wildfires. This put us on alert for, and at times necessitated, PSPS events. The risks posed by these weather conditions meant that many customers were affected on multiple occasions, including holidays and times when customers were trying to work and attend classes from home due to the COVID-19 pandemic.

Despite the adverse conditions, 2021 demonstrated the extraordinary efforts of our company to prepare for and conduct necessary PSPS to protect life and property, partner with communities, fire agencies and other stakeholders, and support our customers in time-tested, novel, and sometimes individualized ways. However, to minimize impacts to customers, SCE made extensive investments to reduce the frequency, scale and duration of PSPS events in 2021, including:

- Expanded circuit-specific grid hardening and PSPS mitigation plans; in 2021, we accelerated PSPS mitigation work on 72 of our frequently impacted circuits (FICs) by installing about 685 miles of covered conductor, 25 new switches, and other equipment;

- Reduced or eliminated the likelihood of de-energization at 96 circuits based on circuit-specific mitigations and improved weather and fire modeling;
- Improved situational awareness by developing and using more than 60 ML models and leveraging new technology to double weather forecast resolution on the grid;
- Expanded customer offerings to minimize the impacts of PSPS by deploying more than 6,000 backup batteries to Medical Baseline (MBL) customers, and activating 22 Community Resource Centers (CRCs) and 31 Community Crew Vehicles (CCVs) during PSPS events;
- Improved availability of emergency notifications for public safety partners and enhancements to customer notifications and communications, including specific webpages and communications for Access & Functional Needs customers, and supported a new 211 program to respond to customer needs during PSPS events.

Overall, non-weather normalized outcomes of the 2021 season were substantial, with Customer Minutes of Interruption (CMI), customer outages, and circuit de-energizations dropping by 73%, 76%, and 79% respectively. By analyzing the conditions and events of 2021, SCE was able to determine that our targeted 2021 PSPS mitigation efforts likely reduced CMI by at least 45%, number of customers de-energized by 44%, and number of circuits de-energized by 33% from what they otherwise could have been.

In 2022, SCE will continue the strategies deployed in 2021, including further investing in circuit mitigations, customer care, external communication notifications and advanced risk analytics to quantify the risks and benefits of PSPS de-energizations for specific events. SCE plans to use ML algorithms and observations from SCE's weather station network to enhance weather forecasts generated at an additional 500 weather station locations over 2021 levels. We are also implementing end-to-end automation solutions to streamline PSPS event management and customer and public safety partner notifications. Further, we will expand on successful customer program offerings, with a special focus on AFN customers, as well as introduce an in-event battery loan pilot program to support AFN customers who rely on a medical device or assistive technology for independence, health, or safety during a PSPS de-energization.

In 2021, we made available temporary backup generators to customers, not only during PSPS events, but also during maintenance outages required to implement our WMP. In this WMP update, we are expanding our customer care portfolio to better support medical-baseline customers and help with community-resiliency zones. We will continue to refine our grid protocols and customer-notifications processes to address specific concerns and feedback from county partners. We are also collaborating with heavily impacted communities for education, outreach and critical infrastructure planning support to help other entities provide critical services to be more resilient.

As compared to the average PSPS impacts experienced from 2019 to 2021, planned mitigations are likely to reduce customer outages by about 53,000 in 2022, accounting for about 44 million fewer CMI.[8]

[8] From 2019-2021, PSPS events resulted in an average of approximately 253 million CMI and approximately 210,000 customer outages, per year.

Further Advancements in SCE's Wildfire Capability Maturity Expected Through 2025

SCE has made great strides in developing our wildfire mitigation capabilities, going beyond the minimum regulatory requirements as appropriate in several key areas. We are increasingly relying on data and advanced analytics to plan and prioritize resources for wildfire risk mitigation and refining robust operational processes for planning, preparedness, and customer/stakeholder engagement. We have also incorporated risk factors (as determined by predictive modeling of equipment failure and consequences) when scheduling inspections. We are maintaining our advanced capabilities in several areas including emergency planning and preparedness. We will continue to focus our efforts this year, and in the near future, on better data management, advanced analytics, and automation. These elements will be foundational to our continued progress in grid hardening, asset management, vegetation management and grid operations, among other activities.

We continue to support the refinement and utilization of a wildfire mitigation capability maturity model. This will help us identify and share best practices and continually improve lessons learned to combat the risk of utility-caused wildfires. Our responses to the survey questions for 2022 maturity reflect the progress we made in 2021, and overall demonstrate that SCE exceeds minimum expectations across all categories and has a high level of maturity consistent with best practices in several capabilities. Our assessment of our expected 2023 capability maturity assumes full deployment of the activities proposed in this WMP update. As outlined in our long-term plan for wildfire-mitigation capability maturity, we expect to achieve high maturity across all categories by 2025.

SCE will Remain Adaptable in 2022 to Improve and Address Emergent Issues

Based on new information, stakeholder feedback and analysis, SCE's understanding of wildfire and PSPS risks, and the efforts needed to undertake and effectively mitigate these risks, has evolved over the last year. Accordingly, the scope and cost forecasts for 2022 found in this update may necessarily differ from the authorized amounts in our Test Year 2021 GRC Track 1 decision (issued on August 20, 2021) which was based on forecasts developed in early 2019, as well as our 2021 WMP update submitted in early February 2021. We will continue to re-evaluate asset- and location-specific risks, benefits, and mitigation needs, and modify or adjust our plan accordingly to better utilize constrained resources and funds for risk reduction. While SCE and other utilities are expected to continue to improve their wildfire mitigation strategies, requiring increased scope of wildfire mitigation activities, we are always looking for operational efficiencies. And the aim to prudently execute the appropriate scope of work is no different from our approach to wildfire mitigation activities.

Finally, as evidenced in 2021, unexpected challenges such as the COVID-19 pandemic, supply chain challenges, and severe weather events may require us to change the work we do and how we do it. We remain committed to vigilance and flexibility in meeting emergent needs of our customers and the grid that serves them.

Conclusion

The 2021 wildfire season clearly demonstrated the continued urgency of wildfire prevention, event response and emergency preparedness. We at SCE work hard to help protect our customers and communities from the threat of wildfires. Despite the challenges presented by COVID-19, we met or exceeded the majority of goals set forth in our 2021 plan.

At the same time, SCE is aware that there are still areas for improvement and more work that needs to be done. Our 2022 WMP update builds upon our Grid Safety and Resiliency Program (GSRP), previous WMPs and our 2021 GRC decision, incorporating progress made and lessons learned regarding wildfire mitigation since 2018. The 2022 WMP prudently includes inspections and remediations in targeted areas based on emergent fire weather conditions; augments our system hardening activities to target certain conductor spans, switches and hardware; provides for aerial fire suppression resources such as helitankers to fire agencies; and establishes central data platforms for next-generation analytics and governance. The 2022 WMP update also represents a practical and integrated approach to safely and reliably operating the grid, as well as providing customer care with measurable and actionable targets.

SCE is committed to reducing the impact of PSPS events on our customers. With an additional year of PSPS data to analyze, we will continue to review opportunities that accelerate mitigations for circuits that are frequently subject to PSPS events so we can reduce the size, frequency and duration of these events. We will continue to offer battery backup programs and provide additional services to further reduce PSPS impact. Community outreach will continue, especially to access and functional-need customers, emphasizing both PSPS readiness and emergency preparedness.

We appreciate the opportunity to provide our 2022 WMP update for Energy Safety's consideration and look forward to continuing our work with state and federal policymakers, local and tribal government officials, public safety partners, community-based organizations, and other stakeholders to help build a more resilient California.

1 PERSONS RESPONSIBLE FOR EXECUTING THE WMP

Provide an accounting of the responsibilities of the responsible person(s) executing the plan, including:

- *Executive level with overall responsibility*
- *Program owners specific to each component of the plan*

Title, credentials, and components of responsible person(s) must be released publicly, but other contact information may be provided in a redacted file attached to the WMP submission.

Due to the broad nature of the work being outlined in this WMP, multiple Organizational Units within SCE are responsible for executing the specific wildfire activities. The accountable areas include: Transmission & Distribution (T&D); Customer Service; Safety, Security, & Business Resiliency; and Generation. Overarching execution and oversight of this WMP is provided under the direction of Jill Anderson, Executive Vice President of Operations.

The program owners of the components of SCE's wildfire mitigation strategies and programs are outlined below by the WMP initiatives and subsections in Section 7.3.1, which includes the details of SCE's wildfire mitigation activities. The data and descriptions included in Chapters 2 through 6 and Chapter 8 support these WMP activities. Certain subsections in Section 7.3.1 do not have specific wildfire activities but have important supporting roles. Therefore, they are included in Table SCE 1-1[9] and reference multiple organizational units due to the cross-functional nature of several of those sections.

Table SCE 1-1

2022 Wildfire Mitigation Plan Overall and Section Responsibility

Wildfire Mitigation Plan Section	**Program Owner(s): Name and Title**	**Contact Information: Email and Phone Number**	**Component** (if entire section, put "entire section"):
Overall WMP Oversight (Executive-Level Owner)	Jill Anderson, Executive VP (Operations)	(626) 302-0606 Jill.C.Anderson@sce.com	Entire Section
Section 1: Persons Responsible for Executing the Plan	Jill Anderson, Executive VP (Operations)	(626) 302-0606 Jill.C.Anderson@sce.com	Entire Section

[9] In this WMP, SCE has included several of its own tables and figures separate from Tables 1-12 included in the Guidelines. Because the Guidelines tables are numbered in sequence without regard to the WMP numerical sections, SCE's tables and figures are labeled Table SCE and Figure SCE and then the first number in the section they appear, i.e., Table SCE 1, Table SCE 5, etc., in order to differentiate between the tables required in the Guidelines and SCE's tables and for consistency regarding figures.

Wildfire Mitigation Plan Section	Program Owner(s): Name and Title	Contact Information: Email and Phone Number	Component (if entire section, put "entire section"):
Section 2: Adherence to Statutory Requirements	Gary Chen, Director (Safety & Infrastructure Policy)	(626) 302-7214 Gary.Chen@sce.com	Entire Section
Section 3: Actuals and Planned Spending	Brent Fielder, Director (Operational Finance)	(626) 302-7128 Brent.Fielder@sce.com	Entire Section
Section 4: Lessons Learned and Risk Trends	Rajdeep Roy, Director (Wildfire Safety) Robert LeMoine, Director (Enterprise Risk Management & Public Safety)	(626) 302-1636 Rajdeep.Roy@sce.com (626) 302-4476 Robert.F.LeMoine@sce.com	Lessons Learned Risk Trends
Section 5: Inputs to the Plan and Directional Vision	Rajdeep Roy, Director (Wildfire Safety)	(626) 302-1636 Rajdeep.Roy@sce.com	Entire Section
Section 6: Metrics and Underlying Data	Rajdeep Roy, Director (Wildfire Safety)	(626) 302-1636 Rajdeep.Roy@sce.com	Entire Section
Section 7: Mitigation Initiatives			
7.3.1 – Risk Assessment and Mapping	Robert LeMoine, Director (Enterprise Risk Management & Public Safety)	(626) 302-4476 Robert.F.LeMoine@sce.com	Entire Section
7.3.2 – Situational Awareness and Forecasting	Donald Daigler, Managing Director (Business Resiliency) Erik Takayesu, VP (Asset Strategy & Planning)	(626) 302-1389 Donald.Daigler@sce.com (909) 274-3482 Erik.Takayesu@sce.com	• Weather Stations (SA-1) • Weather and Fuels Modeling (SA-3) • Fire Science (SA-8) • High Definition Cameras (SA-10) • Distribution Fault Anticipation (SA-9)

Wildfire Mitigation Plan Section	Program Owner(s): Name and Title	Contact Information: Email and Phone Number	Component (if entire section, put "entire section"):
7.3.3 – Grid Design and System Hardening	Heather Rivard, SVP (Transmission & Distribution) Erik Takayesu, VP (Asset Strategy & Planning) Jim Buerkle, Director (Generation)	(626) 302-0766 Heather.Rivard@sce.com (909) 274-3482 Erik.Takayesu@sce.com (626) 302-0500 Jim.Buerkle@sce.com	• Covered Conductor (SH-1) • Undergrounding Overhead Conductor (SH-2) • Branch Line Protection Strategy (SH-4) • Installation of System Automation Equipment – Remote Controlled Automatic Recloser/Remote Controlled Switch (RAR/RCS) (SH-5) • Circuit Breaker Relay Hardware for Fast Curve (SH-6) • Circuit Evaluation for PSPS-Driven Grid Hardening Work (SH-7) • Transmission Open Phase Detection (SH- 8) • Tree Attachment Remediation (SH-10) • Microgrid Assessment (SH-12) • C-Hooks (SH-13) • LSI (SH-14) • Vertical Switches (SH-15) • Vibration Damper Retrofit (SH-16) • REFCL (SH-17) • Legacy Facilities (SH- 11)

Wildfire Mitigation Plan Section	Program Owner(s): Name and Title	Contact Information: Email and Phone Number	Component (if entire section, put “entire section”):
7.3.4 - Asset Management and Inspections	Heather Rivard, SVP (Transmission & Distribution) Erik Takayesu, VP (Asset Strategy & Planning) Jim Buerkle, Director (Generation) Tim Boucher, Director (Business Integration & Delivery)	(626) 302-0766 Heather.Rivard@sce.com (909) 274-3482 Erik.Takayesu@sce.com (626) 302-0500 Jim.Buerkle@sce.com (626) 543-6790 Timothy.Boucher@sce.com	• Distribution Ground / Aerial Inspections andRemediations (IN-1.1) • Transmission Ground /Aerial Inspections and Remediations (IN-1.2) • Infrared Inspection of Energized Overhead Distribution Facilities and Equipment (IN-3) • Infrared Inspection, Corona Scanning, and High-Definition Imagery of Energized Overhead Transmission Facilities and Equipment (IN-4) • Transmission Conductor & Splice Assessment (IN-9) • Generation Inspections & Remediations (IN-5) • Inspection Work Management Tools (IN-8)
7.3.5 – Vegetation Management & Inspections	Heather Rivard, SVP (Transmission & Distribution) Greg Ferree, VP (Veg, Inspections and Operational Services) Jim Buerkle, Director (Generation)	(626) 302-0766 Heather.Rivard@sce.com (714) 267-3579 Greg.Ferree@sce.com (626) 302-0500 Jim.Buerkle@sce.com	• Hazard Tree Management Program (VM-1) • Expanded Pole Brushing (VM-2) • Dead and Dying Tre Removal (VM-4) • VM Work Management Tool (Arbora) (VM-6) • Expanded Clearances for Legacy Facilities (VM-3)
7.3.6 - Grid Operations and Protocols	Donald Daigler, Managing Director (Business Resiliency) Katie Sloan, VP (CustomerPrograms and Services)	(626) 302-1389 Donald.Daigler@sce.com (626) 302-0615 Katie.Sloan@sce.com	• Grid Operations and Protocols • Customer Care Programs (PSPS-2)
7.3.7 - Data Governance	Albert Ma, VP (IT Enterprise Services)	(626) 221-0597 Albert.Ma@sce.com	• Wildfire Safety Data Mart and Data Management (WiSDM/Ezy) (DG-1)

Wildfire Mitigation Plan Section	Program Owner(s): Name and Title	Contact Information: Email and Phone Number	Component (if entire section, put "entire section"):
7.3.8 – Resource Allocation Methodology	Robert LeMoine, Director (Enterprise Risk Management & Public Safety)	(626) 302-4476 Robert.F.LeMoine@sce.com	Entire Section
7.3.9 – Emergency Planning & Preparedness	Donald Daigler, Director (Safety, Security & Business Resiliency) Thomas Guntrip, Director (Transportation Services)	(626) 302-1389 Donald.Daigler@sce.com (626) 302-9434 Thomas.H.Guntrip@sce.com	• SCE Emergency Response Training (DEP-2)
7.3.10 – Stakeholder Cooperation and Community Engagement	Larry Chung, VP (Local Affairs) / Katie Sloan, VP (Customer Programs and Services) Beth Foley, VP (Corporate Communications) Jendy Burchfield, Director (Customer Experience) Donald Daigler, Director (Safety, Security & Business Resiliency)	(626) 302-9371 Larry.Chung@sce.com (626) 302-0615 Katie.Sloan@sce.com (626) 302-2043 Beth.M.Foley@edisonintl.com (626) 302-2809 Jendy.Burchfield@sce.com (626) 302-1389 Donald.Daigler@sce.com	• Customer Education and Engagement – Community Meetings (DEP-1.2) • Customer Education and Engagement – Marketing Campaign (DEP-1.3) • Customer Research & Education (DEP-4) • Aerial Suppression (DEP-5)
Section 8: Public Safety Power Shut Off	Erik Takayesu, VP (Asset Strategy & Planning) Ranbir Sekhon, Director (PSPS Readiness) Thomas Brady, Principal Manager (Business Resiliency)	(909) 274-3482 Erik.Takayesu@sce.com (626) 302-1649 Ranbir.Sekhon@sce.com (626) 302-1263 Thomas.Brady@sce.com	Entire Section

Wildfire Mitigation Plan Section	Program Owner(s): Name and Title	Contact Information: Email and Phone Number	Component (if entire section, put "entire section"):
Section 9: Appendix	Gary Chen, Director (Safety & Infrastructure Policy) Rajdeep Roy, Director (Wildfire Safety)	(626) 302-7214 Gary.Chen@sce.com (626) 302-1636 Rajdeep.Roy@sce.com	• 9.1: Definitions of Initiatives by Category • 9.2: Citations for Statutes, Directives, Proceedings, etc. • 9.5: WMP Activity Map • 9.6: SCE External Engagements • 9.7: List of Acronyms • 9.3: Covered Conductor Installation Reporting • 9.4: Undergrounding Implementation Reporting • 9.8: 2021 WMP Progress Report Working Group Updates • 9.9: Data Tables (1-12)

1.1 VERIFICATION

Complete the following verification for the WMP submission:

Rule 1.11 Verification

(See Rule 1.11)

(Where Applicant is a Corporation)

I am an officer of the applicant corporation herein, and am authorized to make this verification on its behalf. The statements in the foregoing document are true of my own knowledge, except as to matters which are therein stated on information or belief, and as to those matters I believe them to be true.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on 18th of February, 2022 at Rosemead, California

DocuSigned by:

Jill C Anderson

ADCE1371F2C040D...

Jill Anderson
Executive Vice President of Operations
SOUTHERN CALIFORNIA EDISON COMPANY
2244 Walnut Grove Avenue, Rosemead, CA 91770

2 ADHERENCE TO STATUTORY REQUIREMENTS

Section 2 comprises a "check list" of the Pub. Util. Code § 8386(c) requirements and subparts. The utility is required to both affirm that the WMP addresses each requirement AND cite the section and page number where statutory compliance is demonstrated fully. Citations are required to use cross-referencing with hyperlinks. Note: Energy Safety reserves the right to automatically reject a WMP that does not provide substantiation for statutory compliance or does not provide citations to appropriate sections of the WMP.

Table 2-1 provides the full list of statutory requirements. A table similar to Table 2-1 is required with the appropriate citation for each requirement. If multiple WMP sections address a specific requirement, then references to all relevant sections with a brief indication of information provided in each section must be provided. The table must include each section reference separated by semi-colon (e.g., Section 5, pg. 30-32 (workforce); Section 7, pg. 43 (mutual assistance)) where appropriate, and associated hyperlinks to the referenced section.

Table 2-1

Statutory Compliance Matrix

Requirement	Description	WMP Section & Page Number
1	An accounting of the responsibilities of persons responsible for executing the plan	Chapter 1, pg. 13
2	The objectives of the plan	Section 5.2 (overall objectives), pg. 124 Section 7.1.3 (Category Objectives), pg. 223
3	A description of the preventive strategies and programs to be adopted by the electrical corporation to minimize the risk of its electrical lines and equipment causing catastrophic wildfires, including consideration of dynamic climate change risks	Section 7.1.2.1 (Integrated Grid Hardening Strategy), pg. 207 Section 7.3 (Activity Strategies), pg. 253
4	A description of the metrics the electrical corporation plans to use to evaluate the plan's performance and the assumptions that underlie the use of those metrics	Section 5.3 (Plan Program Targets), pg. 126 Section 6.3 (Additional Metrics) pg. 177
5	A discussion of how the application of previously identified metrics to previous plan performances has informed the plan	Section 4.1, pg. 29

6	[A description of the electric corporation's protocols][10] for disabling reclosers and deenergizing portions of the electrical distribution system that consider the associated impacts on public safety. As part of these protocols, each electrical corporation shall include protocols related to mitigating the public safety impacts of disabling reclosers and deenergizing portions of the electrical distribution system that consider the impacts on all of the aspects listed in PU Code 8386[(c)(6)(A)-(D)].	Section 7.3.6.1 (Automatic Recloser Operations), pg. 437 Section 8.2 (Protocols on PSPS), pg. 539
7	[A description of the appropriate] and feasible procedures for notifying a customer who may be impacted by the deenergizing of electrical lines, including procedures for those customers receiving a medical baseline allowance as described in paragraph (6). The procedures shall direct notification to all public safety offices, critical first responders, health care facilities, and operators of telecommunications infrastructure with premises within the footprint of potential de-energization for a given event. [The procedures shall comply with any orders of the commission regarding notifications of de-energization events.]	Section 7.3.10 (Community Engagement), pg. 491 Section 8.2.4(Communication Standards), pg. 551 Section 8.1.5 (Mitigating Impacts), pg. 537 Section 8.4 (Vulnerable Communities), pg. 559
8	Identification of circuits that have frequently been deenergized pursuant to a de-energization event to mitigate the risk of wildfire and the measures taken, or planned to be taken, by the electrical corporation to reduce the need for, and impact of, future de-energization of those circuits, including, but not limited to, the estimated annual decline in circuit de-energization and de-energization impact on customers, and replacing, hardening, or undergrounding any portion of the circuit or of upstream transmission or distribution lines	Section 8.1.4 (Projected PSPS Reductions), pg. 531 Section 8.6 (Identification of Frequently Impacted Circuits), pg.572
9	Plans for vegetation management	Section 5.3 (Plan Program Targets), pg. 126 Section 7.1.3 (Category Objectives), pg. 223 Section 7.3.5 (Activity Strategies), pg. 392
10	Plans for inspections of the electrical corporation's electrical infrastructure	Section 5.3 (Plan Program Targets), pg. 126 Section 7.1.3 (Category Objectives), pg. 223 Section 7.3.4 (Activity Strategies), pg. 344

[10] Bracketed material incorporates additional statutory language from PUC Section 8386(c).

11	[A description of the electrical corporation's protocols] for the de-energization of the electrical corporation's transmission infrastructure, for instances when the de-energization may impact customers who, or entities that, are dependent upon the infrastructure. [The protocols shall comply with any order of the commission regarding de-energization events.]	Section 8.2.3, pg. 530
12	A list that identifies, describes, and prioritizes all wildfire risks, and drivers for those risks, throughout the electrical corporation's service territory, including all relevant wildfire risk and risk mitigation information that is part of the Safety Model Assessment Proceeding [(A.15-05-002, et al.)] and the Risk Assessment Mitigation Phase filings. [The list shall include, but not be limited to, both of the following: (A) Risk and risk drivers associated with design, construction, operations, and maintenance of the electrical corporation's equipment and facilities and (B) Particular risks and risk drivers associated with topographic and climatological risk factors throughout the different parts of the electrical corporation's service territory.]	Section 4.3.2, pg. 51
13	A description of how the plan accounts for the wildfire risk identified in the electrical corporation's Risk Assessment Mitigation Phase filing	Section 4.3.2 (Risk-Informed Decision-Making), pg. 51 Section 4.3.7 (Multi-Attribute Risk Score), pg. 63 Section 7.1.2 (How Risk Modeling Outcomes Inform Decision-Making Processes), pg. 193
14	A description of the actions the electrical corporation will take to ensure its system will achieve the highest level of safety, reliability, and resiliency, and to ensure that its system is prepared for a major event, including hardening and modernizing its infrastructure with improved engineering, system design, standards, equipment, and facilities, such as undergrounding, insulation of distribution wires, and pole replacement	Section 7.1.2.1 (Integrated Grid Hardening Strategy), pg. 207 Section 7.3.3 (Grid Design and System Hardening Strategy), pg. 290 Section 9.3 (Covered Conductor Reporting), pg. 600 Section 9.4 (Undergrounding Reporting), pg. 614

15	A description of where and how the electrical corporation considered undergrounding electrical distribution lines within those areas of its service territory identified to have the highest wildfire risk in a commission fire threat map	Section 7.1.7 (GIS for Grid Hardening), pg. 246 Section 7.1.2.1 (Integrated Grid Hardening Strategy), pg. 207 Section 7.3.3.16.1 (Undergrounding Overhead Conductor), pg. 334
16	A showing that the electrical corporation has an adequately sized and trained workforce to promptly restore service after a major event, taking into account employees of other utilities pursuant to mutual aid agreements and employees of entities that have entered into contracts with the electrical corporation	Section 5.4 (Workforce Planning), pg. 150 Section 7.3.6.6 (PSPS Incident Management Team), pg. 446 Section 7.3.9.1 (Emergency Response Training), pg. 477 Section 7.3.9.6 (Protocols in place to learn from wildfire events), pg. 488
17	Identification of any geographic area in the electrical corporation's service territory that is a higher wildfire threat than is currently identified in a commission fire threat map, and where the commission must consider expanding the high fire threat district based on new information or changes in the environment	Section 4.2.1, pg. 36
18	A methodology for identifying and presenting enterprise-wide safety risk and wildfire-related risk that is consistent with the methodology used by other electrical corporations unless the commission determines otherwise	Section 4.3.2 (Risk-Informed Decision-Making), pg. 51 Section 7.1.2 (How Risk Modeling Outcomes Inform Decision-Making Processes), pg. 193 Section 7.1.2.1 (Integrated Grid Hardening Strategy), pg. 207 Section 9.8 (Risk Model Working Group), pg. 634

19	A description of how the plan is consistent with the electrical corporation's disaster and emergency preparedness plan prepared pursuant to Section 768.6, including [both of the following: (A) Plans to prepare for, and to restore service after, a wildfire, including workforce mobilization and prepositioning equipment and employees and (B) Plans for community outreach and public awareness before, during, and after a wildfire, including language notification in English, Spanish, and the top three primary languages used in the state other than English or Spanish, as determined by the commission based on the United States Census data.]	Section 7.3.9.4 (Disaster and Emergency Preparedness Plan), pg. 485 Section 7.3.9.5 (Preparedness and Planning for Service Restorations), pg. 486 Section 8.2.3 (Strategy for Re-Energization), pg. 547 Section 8.2.4 (Communication Standards), pg. 551
20	A statement of how the electrical corporation will restore service after a wildfire	Section 7.3.9.5 (Preparedness and Planning for Service Restorations), pg. 486 Section 8.2.3 (Strategy for Re-Energization), pg. 547
21	Protocols for compliance with requirements adopted by the commission regarding activities to support customers during and after a wildfire, outage reporting, support for low-income customers, billing adjustments, deposit waivers, extended payment plans, suspension of disconnection and nonpayment fees, repair processing and timing, access to electrical corporation representatives, and emergency communications	Section 7.3.9.3, pg. 482
22	A description of the processes and procedures the electrical corporation will use to do the following: (A) Monitor and audit the implementation of the plan. (B) Identify any deficiencies in the plan or the plan's implementation and correct those deficiencies. (C) Monitor and audit the effectiveness of electrical line and equipmentinspections, including inspections performed by contractors, carried outunder the plan and other applicable statutes and commission rules.	Section 7.2 (Monitor and Audit Implementation of Plan), pg. 251 Section 7.3.4.14.1 (Quality Assurance of Inspections), pg. 387 Section 7.3.5.13 (Quality Assurance of Vegetation Management), pg. 416

Table SCE 2-1

2021 WMP Key Areas of Improvement and Other Issues

Requirement	Description	WMP Section & Page Number
1	Key Areas of Improvement and Remedies: Updates on status of Key Areas of Improvement SCE-21-01 to SCE-21-14	Section 4.6, pg. 109
2	2021 WMP Additional Issues to Address in 2022 WMP: Directory to where to find responses to the additional issues identified in the SCE 2021 Action Statement (OEIS WSD-020 Action Statement on SCE 2021 WMP Final)	Section 4.6, pg. 109

3 ACTUALS AND PLANNED SPENDING FOR MITIGATION PLAN

3.1 SUMMARY OF WMP INITIATIVE EXPENDITURES

Table 3-1 summarizes the projected costs (in thousands of US $) per year over the three-year WMP cycle, including actual expenditures for past years. In Table 3-2, break out projected costs per category of mitigations, over the three-year WMP plan cycle. In reporting "planned" expenditure, use data from the corresponding year's WMP or WMP Update (i.e., 2020 planned expenditure must use 2020 WMP data). The financials represented in the summary tables below equal the aggregate spending listed in the mitigations financial tables reported quarterly. Nothing in this document is required to be construed as a statement that costs listed are approved or deemed reasonable if the WMP is approved, denied, or otherwise acted upon.

SCE presents its 2020-2021 actual WMP expenditures along with its 2022 planned levels in Table 3-1 and Table 3-2 below. SCE's 2022 plan of ~$1.1 billion in capital (as compared to its GRC Authorized of ~$0.7B) and ~$0.8 billion in operations and maintenance (O&M) (as compared to its GRC Authorized of ~$0.3B) will be subject to reasonableness review for any amounts spent above authorized.

Table 3-1

Summary of WMP Expenditures[11] - Total (Nominal, $000)

	Capital	O&M	Total
2020 WMP Planned	$808.5	$499.8	$1,308.3
2020 Actual	$769.7	$587.1	$1,356.8
Difference	$38.7	($87.3)	($48.6)
2021 Planned	$1,109.4	$596.3	$1,705.7
2021 Actual	$1,106.2	$552.6	$1,658.8
Difference	$3.1	$43.8	$46.9
2022 Planned	$978.7	$641.6	$1,620.4
2020-22 Planned (w/2020 and 2021 actuals)	**$2,854.7**	**$1,781.3**	**$4,636.0**

[11] The summary of WMP Expenditures reflects direct capital and O&M costs, excluding corporate overheads and financing costs, for wildfire activities which correspond to the HFTD spend as shown in Table 12 (see Appendix 9.9)

Table 3-2

Summary of WMP Expenditures[12] by Category (Nominal, $000)

																		Spend in thousands $ of USD
WMP Category	**2020**							**2021**								**2022**		**2020-2022 Planned (w/2020 and 2021 actuals)**	
	Capital Planned	Capital Actual	Capital Δ	O&M Planned	O&M Actual	O&M Δ	**2020 Total Actual**	Capital Planned	Capital Actual	Capital Δ	O&M Planned	O&M Actual	O&M Δ	**2021 Total Actual**	Capital Planned	O&M Planned	Capital	O&M
Situational Awareness	$13.2	$11.9	$1.4	$10.4	$7.8	$2.6	$19.7	$21.4	$17.5	$3.9	$16.1	$10.9	$5.2	$28.4	$4.0	$13.7	$33.3	$32.4
Grid Design and System Hardening	$549.1	$581.4	($32.3)	$10.4	$4.0	$6.4	$585.4	$830.4	$933.8	($103.4)	$5.6	$1.7	$3.9	$935.5	$824.8	$12.2	$2,340.0	$17.9
Asset Management and Inspections	$244.1	$149.9	$94.3	$268.1	$173.9	$94.1	$323.8	$216.1	$114.4	$101.7	$136.5	$117.0	$19.5	$231.5	$99.5	$107.4	$363.8	$398.4
Vegetation Management and Inspections	-	$16.1	($16.1)	$137.2	$334.4	($197.2)	$350.6	$9.9	$11.0	($1.1)	$343.2	$335.2	$8.0	$346.2	$6.8	$402.7	$33.9	$1,072.4
Grid Operations and Protocols	$2.0	$6.8	($4.8)	$56.7	$20.1	$36.6	$27.0	$7.2	$14.5	($7.3)	$60.9	$52.2	$8.7	$66.7	$20.2	$53.8	$41.6	$126.1
Data Governance	-	$1.8	($1.8)	-	-	-	$1.8	$15.7	$9.3	$6.4	$1.1	-	$1.1	$9.3	$16.5	$4.1	$27.6	$4.1
Resource Allocation Methodology	-	-	-	-	$32.9	($32.9)	$32.9	-	-	-	$7.9	$11.4	($3.4)	$11.4	-	$10.4	-	$54.6
Emergency Planning and Preparedness	-	-	-	$12.2	$5.9	$6.3	$5.9	$0.2	-	$0.2	$1.7	$3.9	($2.2)	$3.9	-	$9.1	-	$19.0
Stakeholder Cooperation and Community Engagement	-	-	-	-	$7.8	($7.8)	$7.8	-	-	-	$23.4	$20.3	$3.1	$20.3	-	$28.2	-	$56.3
New Innovations and Technologies	-	$1.9	($1.9)	$4.7	$0.2	$4.6	$2.0	$8.4	$5.7	$2.7	-	$0.0	($0.0)	$5.7	$7.0	-	$14.5	$0.2
Total	**$808.5**	**$769.7**	**$38.7**	**$499.8**	**$587.1**	**($87.3)**	**$1,356.8**	**$1,109.4**	**$1,106.2**	**$3.1**	**$596.3**	**$552.6**	**$43.8**	**$1,658.8**	**$978.7**	**$641.6**	**$2,854.7**	**$1,781.3**

3.2 SUMMARY OF RATEPAYER IMPACT

For each of the years in Table 3-3, *report the actual and projected* cost *increases to ratepayers due to utility related ignitions and wildfire mitigation activities engaged. For past years, account for all expenditures incurred in that year due to utility related ignitions and wildfire mitigation activities. Below the table, describe the methodology behind the calculations.*

Table 3-3

WMP Electricity Cost Increase to Ratepayers

Outcome metric name	Annual performance						Unit(s)
	Actual					Projected	
	2017	2018	2019	2020	2021	2022	
Increase in electric costs to ratepayer due to utility related ignitions (total)	N/A	N/A	0.14 cents per kWh impact to System average rates (SAR). The monthly bill impact for a non-California Alternate Rates for Energy (CARE)	0.07 cents per kWh impact to SAR. The monthly bill impact for a non-CARE residential customer with average usage of 500 kWh is $0.47.	0.52 cents per kWh impact to SAR. The monthly bill impact for a non-CARE residential customer with average usage	-0.03 cents per kWh impact (reduction) to SAR. The monthly bill impact for a non-CARE residential customer with average usage of 500 kWh is a reduction of -$0.23.	*Dollar value of average monthly rate increase/decrease attributable to utility-ignited wildfires per year (e.g., $3/month on average across customers for utility related ignitions occurring in 20XX)*

[12] The summary of WMP Expenditures reflects direct capital and O&M costs, excluding corporate overheads and financing costs, for wildfire activities which correspond to the HFTD spend as shown in Table 12 (see Appendix 9.9); Table 3-2 incorporates Risk Assessment and Mapping spend into Situational Awareness

Outcome metric name	Annual performance						Unit(s)
	Actual					Projected	
	2017	2018	2019	2020	2021	2022	
			residential customer with average usage of 500 kWh is $0.99.		of 500 kWh is $3.62.		
Increase in electric costs to ratepayer due to wildfire mitigation activities (total)	N/A	N/A	N/A	0.21 cents per kWh impact to SAR. The monthly bill impact for a non-CARE residential customer with average usage of 500 kWh is $1.41.	0.25 cents per kWh impact to SAR. The monthly bill impact for a non-CARE residential customer with averageusage of 500 kWh is $1.60.	$1.02 cents per kWh impact to SAR. The monthly bill impact for a non-CARE residential customer with average usage of 500 kWh is $6.90.	*Dollar value of average monthly rate increase attributable to WMPs per year*

For both categories above, the annual increases/decreases reflect year over year changes.

SCE interprets the category of "increase in electric costs to ratepayers due to utility-ignited wildfires" to include: (1) wildfire liability insurance or Self-Insured Retention (SIR) costs; (2) Catastrophic Event Memorandum Account (CEMA) costs incurred for restoration and repair of utility infrastructure associated with wildfire events; (3) emergency customer protection costs for qualifying wildfire events as recorded and approved for recovery in the Emergency Customer Protections Memorandum Account (ECPMA); (4) costs in rates associated with the nonbypassable charge (NBC) related to the AB 1054 Wildfire Fund; and, (5) uninsured third-party damage claims for events associated with SCE's infrastructure that have been reviewed by the Commission and included in customer rates. For 2017-2021, the increases do not include costs that are either under review, that will be reviewed by the Commission for later cost recovery or are otherwise not included in customer rates. The increases also do not include costs associated with claims paid pursuant to any wildfire liability insurance policy SIR or costs approved by the Commission on a forecast basis as "claims reserve" in a GRC. For 2022, SCE included costs from the categories outlined above that were either included in rates on January 1, 2022 or that SCE expects to include in rates in 2022.

For 2017-2021, SCE interprets the category of "increase in electric costs to ratepayer due to wildfire mitigation activities" to include wildfire mitigation costs that have been reviewed by the Commission and included in rates. Beginning in 2021, SCE included all vegetation management costs in rates in this category since SCE's adopted vegetation management cost recovery mechanism does not require a wildfire versus non-wildfire designation. The increases do not include wildfire mitigation activity costs that are either still under review, that will be reviewed by the Commission for later cost recovery or are otherwise not currently included in customer rates. For 2022, SCE included wildfire mitigation costs that were either included in rates on January 1, 2022 or that SCE expects to include in rates in 2022.

4 LESSONS LEARNED AND RISK TRENDS

4.1 LESSONS LEARNED: HOW TRACKING METRICS ON THE 2020 AND 2021 PLANS HAS INFORMED THE 2022 PLAN UPDATE

Describe how the utility's plan has evolved since the 2020 WMP and 2021 WMP Update submissions. Outline any major themes and lessons learned from the 2020 and 2021 plans and subsequent implementation of the initiatives. In particular, focus on how utility performance against the metrics used has informed the 2022 WMP Update. Include an overview map of the utility's service territory. If any of the lessons learned are derived from data, include visual/graphical representations of this/these lesson(s) learned.

SCE's wildfire mitigation efforts have continued to grow and advance to mitigate the threat of wildfires in HFRA. SCE continuously evaluates its wildfire mitigation initiatives based on execution experience, internal analysis, stakeholder feedback, benchmarking, customer surveys and post-event PSPS reports. This evaluation process includes monitoring the implementation of WMP initiatives along with the effectiveness of those WMP initiatives. At a high level, SCE as applicable leverages a general lessons learned process as depicted in Figure SCE 4-1 below.

Table SCE 4-1 provides additional details on the lessons learned in 2020 and 2021 and the corresponding changes made to SCE's 2022 WMP Update.

Figure SCE 4-1

SCE's General Lessons Learned Process

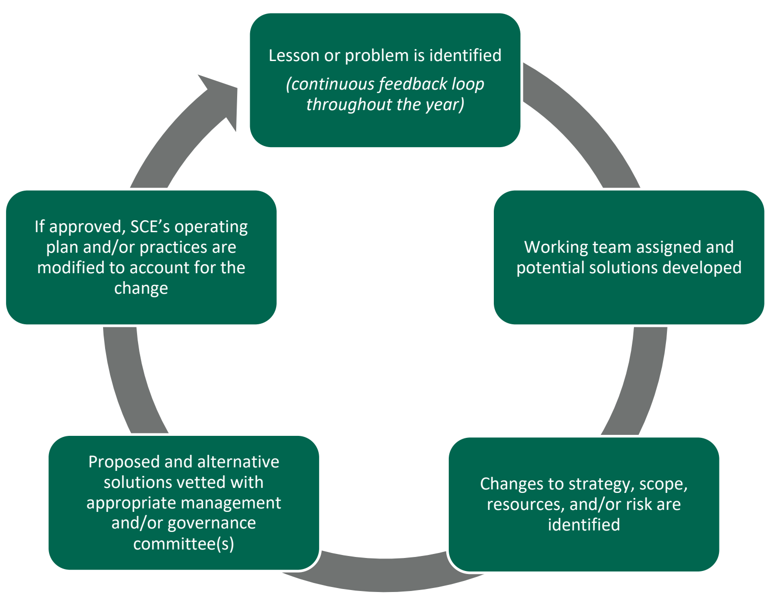

Table SCE 4-1

Summary of Lessons Learned

Category	Change	Lesson Learned in 2020 and 2021	Description of Change in 2022 WMP Update
Resource Allocation	Additional RSE Scores	In prior WMP submissions, SCE did not calculate an RSE for certain activities because there was not enough quantifiable data or experience to develop one with a high degree of certainty. However, an RSE that can be sensibly developed using reasonable assumptions – even qualitative – can provide insight into the potential relative effectiveness of a mitigation.	Where they could be meaningfully developed, RSEs were calculated for nearly all wildfire mitigation activities. Where an RSE was prohibitively difficult to define for a singular activity and where that activity truly enabled other activities, SCE included the costs for those enabling activities within (on a pro-rata basis) the primary activities they support.
Risk Assessment and Mapping	Additional weather scenarios and granular fuel data	In the prior version of the Technosylva Wildfire Risk Reduction Model (WRRM), SCE utilized 41 weather scenarios. Similarly, SCE used fuels data accounting for present fuel conditions. SCE determined that a wider range of both fuel and wind driven conditions was needed for its risk modeling.	In 2021, SCE added an additional 400+ weather scenarios to better represent a wider range of both fuel and wind driven fire conditions. Similarly, SCE incorporated a more granular fuel model to account for fuel regrowth in recently burned locations with fuel regrowth projected out to the year 2030.
Risk Assessment and Mapping	Mitigation Selection for High Consequence Segments	SCE has performed analysis indicating that segments with consequence risk of 300 acres or greater within the first eight hours (High Consequence Segments) necessitate mitigation of the majority of risk for all significant ignition risk drivers.	SCE is further refining its mitigation selection based on this analysis to identify which distribution HFRA segments will be best served by which mitigation or suite of mitigations.
Risk Assessment and Mapping	Severe Risk Area Framework	While the WRRM provides a foundational understanding of wildfire ignition risk, it does not fully capture other qualitative risk factors, such as egress.	SCE developed a new framework to identify locations in which the wildfire risk to those locations is not fully captured by ignition simulations alone. The Severe Risk Area framework allows SCE to consider qualitative risk factors, such as population egress, historical fire frequency, canopy cover and/or density, the deployment of existing mitigations, as well as locations likely to exceed PSPS thresholds even with covered conductor installed. This framework is being finalized in 2022 for use in development of future scope and could include undergrounding of some circuit segments.
Situational Awareness	Longer evaluation periods for weather modeling enhancements (SA-3)	PSPS customer notifications are based on weather modeling. More accurate weather modeling will improve the accuracy of customer notifications. However, enhancements to the models require time to properly test and evaluate before incorporating into operations. In 2020 and 2021, SCE made substantial improvements to the modeling, but needed more time to test before operationalizing the enhancements.	SCE will be deploying ML capabilities on 500 weather stations and is building earlier deadlines into its scope of work prior to the start of the 2022 fire season to provide for a longer evaluation period. The evaluation will include new verification statistics and more tailored output.
Situational Awareness	Refine and mature fire spread modeling applications (SA-8)	SCE encountered difficulties with assessing wildfire consequence information from new fire spread modeling applications (i.e., FireSim and FireCast), resulting in a need to refine and mature the applications.	SCE is working with the vendor to incorporate fire suppression and buildings lost metrics into fire spread modeling applications.

Category	Change	Lesson Learned in 2020 and 2021	Description of Change in 2022 WMP Update
Situational Awareness	Development of Data Manager (SA-8)	SCE experienced slow response to requests for data and the ability to perform proper data analysis, due to reliance upon vendor and manual pulls of weather and fuels data.	SCE is continuing to enhance the Data Manager developed by Atmospheric Data Solutions, which helps to efficiently retrieve and aggregate weather and fuels information.
Grid Design and System Hardening	Rapid Earth Fault Current Limiter (REFCL) (SH-17)	SCE studied three REFCL technologies: Ground Fault Neutralizer (GFN), Resonant Grounded Substation (RGS), and Isolation Transformer (IT), to mitigate ground faults. SCE received the GFN and RGS equipment in 2020 and began construction in late 2021. SCE expected significant reduction in ignitions associated with phase-to-ground faults where GFN was deployed as compared to historical averages. Effectiveness was confirmed by staged fault tests showing voltage on the faulted conductor is reduced quickly enough to prevent the ignitions that the technology is designed to prevent.	SCE will begin developing GFN for more locations in 2022 and will continue to evaluate RGS and Information Technology (IT) in the pilot phase.
Grid Design and System Hardening	Vibration Damper Retrofit (SH-16)	A study was conducted to determine the susceptibility of the 2018 to 2020 covered conductor installations to Aeolian vibration.	SCE included a new activity in the 2022 WMP for Vibration Damper Retrofit to retrofit prior covered conductor installations with dampers designed to stop wind-driven Aeolian vibration that may lead to conductor abrasion or fatigue over time.
Grid Design and System Hardening	Secondaries	Between 2019 and 2021 there have been 99 California Public Utilities Commission (CPUC)-reportable ignitions where Secondary conductor is listed as the “Root Cause Equipment.” Approximately 30% of CPUC-reportable ignitions in 2021 involved secondary conductors across SCE’s service territory, with approximately 25% of these ignitions occurring in HFRA.	SCE is mitigating high risk secondary conductor locations, including remediating connectors and inspecting and trimming vegetation. SCE is also developing a long-term secondary connection covering to replace taping and is evaluating a breakaway that disconnects and de-energizes service and secondary connector at a predetermined mechanical load, which prevents ignitions if the wires fall due to fallen trees or excessive winds.
Grid Design and System Hardening	Microgrids (SH-12)	SCE is currently attempting to acquire the land needed for the microgrid pilot and agree to terms with the landowners. Since negotiations are ongoing with the potential partner, SCE did not complete the design package in 2021, as discussed in the 2021 WMP Update. SCE needed more time than it estimated for the necessary deliberations and negotiations necessary to reach an agreement.	SCE has forecast a greater amount of time for community outreach and community group deliberation and will negotiate with multiple landowners in parallel, so we are better able to reach agreements relatively quickly.
Asset Management and Inspections	Decrease in Distribution / Transmission HFRI inspections find rates (IN-1.1 and IN-1.2)	SCE relied on historical find rates (i.e., the percentage of inspections that identify the need for a remediation) to forecast the remediation portion of HFRI inspections for the 2021 WMP. Notably, the assumed find rate for Distribution HFRI ground inspections in the 2021 WMP Update was 7.0%, based on inspections as of mid-year 2020. The actual find rate in 2021 has since come down to 5.7%.	SCE is assuming the lower find rate for planning purposes. This can reduce the number of contractors required to perform the work and allow for deployment of resources to other risk mitigation activities. SCE balances these opportunities with the potential for additional work that may result from changes or additions to the inspection form resulting from lessons learned throughout the year.

Category	Change	Lesson Learned in 2020 and 2021	Description of Change in 2022 WMP Update
Asset Management and Inspections	New 360-degree Approach for Distribution Ground and Aerial Inspections	SCE identified ways to reduce customer and environmental impacts, and improve notification identification, employee safety, and inspection efficiency.	SCE will test a new approach to performing overhead distribution (33 kV and below) inspections in HFRA by performing both a ground and an aerial inspection at the same time, instead of deploying two separate resources at different times of the year.
Asset Management and Inspections	Transmission Conductor and Splice (IN-9)	Anomalies and underlying equipment issues associated with transmission conductor and splices may not be identifiable using existing inspection methods.	SCE included a new activity in the 2022 WMP Update for Transmission Conductor and Splice (IN-9) to identify additional anomalies not captured with existing methods.
Vegetation Management and Inspections	Decrease in Scale of Expanded Pole Brushing (VM-2)	In 2020 and 2021, SCE's expanded pole brushing program was based on the quantity of poles in HFRA without examining the risks and consequences specific to each structure. In 2022, SCE has incorporated vegetation management risk-based prioritization consistent with OEIS feedback.	SCE's 2022 updated pole brushing strategy has refined scope to include the following risk-based prioritization (subject to resource constraints): (1) Compliance Requirement (PRC 4292)[E1] - All State Responsibility Area (SRA) non-exempt already existing poles in Pole Brushing inventory (2) Areas of Concern (AOCs) (additional exempt poles) - Incremental poles added from AOCs (3) HFRA High Risk (Tier 2 & 3) - All other poles with the type of equipment subject to PRC 4292 [E1] and which have a Technosylva Consequence score of ≥ 300 Acres
Vegetation Management and Inspections	Decrease in Scale of Dead and Dying Tree Removal Program (VM-4)	The decrease in scale of the Dead and Dying Tree Removal Program is primarily due to a lower than anticipated find rate of dead, dying, and diseased trees, resulting in less work needing to be completed. Circuit patrols continue to be performed as planned for the year, however, the volume of trees in need of removal is lower than anticipated.	SCE reduced its 2021 WMP Forecast to align with actual dead and dying tree find rate and will take its findings from 2021 into account in its 2022 WMP.
Grid Operations & Protocols	Modification of backup battery and rebate programs	SCE was looking to methods to expand the pool of customers eligible to receive financial assistance and help improve customer resiliency during PSPS events. As such, SCE made modifications to the Critical Care Backup Battery (CCBB) program and rebate programs (e.g., Residential Battery Station and Well Water and Water Pumping Backup Generation programs) to encourage and allow for more participation. For more information please see Section 7.3.6.6.2.3.	SCE's program changes will continue into 2022, and SCE will explore methods to increase participation further.
Grid Operations & Protocols	Increasing focus on internal SCE field resources to conduct Unmanned Aerial Systems (UAS) patrols for PSPS	During some simulated UAS PSPS patrols in 2021 conducting line-of-sight missions, the team learned that SCE field resources had made significant strides in flight automation using company-issued UAS. SCE believes that increasing internal UAS capabilities in the near-term will produce better results (more efficient patrols) sooner and potentially for a lower cost than using outside vendors.	SCE will continue to train and equip additional internal field resources with UAS, investigate next-generation UAS platforms, and continue field testing flight automation techniques in an effort to make aerial UAS patrols more safe, secure, and efficient.

Category	Change	Lesson Learned in 2020 and 2021	Description of Change in 2022 WMP Update
Grid Operations & Protocols	Fast Curve (FC) Settings Refinement Strategy	SCE found that the existing FC philosophy, set to four times the existing circuit minimum trip, does not always provide adequate fast tripping on all portions of circuitry within HFRA.	This led to a refinement to SCE's strategy to provide a lower multiple of circuit minimum trip, which will provide more fast-curve protection coverage across the entirety of the circuit on a higher percentage of circuits within HFRA. The revised FC setting strategy will reduce fault energy which may reduce wildfire risk while maintaining reliability by providing coordination with downstream protective devices.
Data Governance	Centralized Data Repository Data Sharing	Due to PSPS Corrective Action Plan submitted in Q1, SCE had to re-direct its design team and solution approach to re-evaluate the technical solution for wildfire centralized data repository and analytics capabilities. Changes in OEIS data specifications and new data requests results in changes/updates to business logic for data reporting.	SCE will centralize the wildfire data platform for analytics/reporting. SCE will proactively track the OEIS changes and business process, streamline data sources and accommodate the high-level changes requested by OEIS. SCE will also finalize data reporting design and implement foundation for data portal.
Resource Allocation Methodology	Third-Party Safety Observers	The program focuses on identifying and supporting the management of conditions and behaviors that can lead or contribute to serious injuries and fatalities.	The program is active in 2022 and is continually being evaluated.
Emergency Planning and Preparedness	UAS Training	SCE continuously reviews its UAS training and looks for ways to enhance it. In doing so, SCE determined there were opportunities for its vendor to standardize the UAS training.	For Q1 2022, SCE is publishing its Unmanned Aircraft Flight Operations Manual (developed during 2021). This is being incorporated into all unmanned operations. This manual standardizes UAS operations overall, but also standardizes the UAS training by addressing and correcting minor training deltas previously experienced.
Stakeholder Cooperation and Community Engagement	Community Meetings (DEP-1.2)	There was strong interest and positive feedback from customers in learning more about the details of the grid hardening work being conducted on PSPS FICs. SCE will continue to provide this information in future wildfire safety community meetings.	In 2022, SCE will keep its goal of holding least nine community meetings and will continue to provide details about community-specific grid hardening work and impacts.
Stakeholder Cooperation and Community Engagement	Marketing Campaign (DEP 1.3)	SCE has identified that while more than three quarters of SCE account holders in HFRA already participate in the PSPS alert program, more can be done with regard to master-metered customers to ensure they are receiving relevant information.	SCE will continue to improve campaign efficiency, monitor performance and adjust media channels and messaging as needed for master-meter customers to sign up for address level PSPS alerts.
Stakeholder Cooperation and Community Engagement	Customer Research and Education (DEP-4)	There is a lack of reliable data on AFN customers and ways to identify the specific demographics within the AFN population. SCE has been working with other utilities to develop an effective solution.	SCE plans to conduct additional customer surveys in 2022 compared to 2021, increasing the goal to six surveys, which will gather feedback and understand the needs of our customers and stakeholders.

Category	Change	Lesson Learned in 2020 and 2021	Description of Change in 2022 WMP Update
Stakeholder Cooperationand Community Engagement	Aerial Suppression (DEP-5)	In 2021, the quick reaction force (QRF) of aerial resources was effective at suppressing fire activity, based on helitanker performance reports and feedback from the fire agencies, as further described in Chapter 7.3.9.3. We also saw the additional benefits and effectiveness of the Coulson-Unical CH-47 helitanker, which has the capacity to carry three times more water or retardant compared to the smaller Sikorsky-61 helitanker.	In 2022, SCE plans to continue with the 2021 configuration of the QRF of aerial resources, which included two CH-47 helitankers, one Sikorsky-61 helitanker, one Sikorsky-76 intelligence and recon helicopter and a mobile retardant base.
PSPS	PSPS Lessons Learned	See Section 8.2.1 for detail on PSPS lessons learned from 2020 and 2021.	

4.2 UNDERSTANDING MAJOR TRENDS IMPACTING IGNITION PROBABILITY AND WILDFIRE CONSEQUENCE

Describe how the utility assesses wildfire risk in terms of ignition probability and estimated wildfire consequence, including use of Multi-Attribute Risk Score (MARS) and Multi-Attribute Value Function (MAVF) as in the Safety Model and Assessment Proceeding (S-MAP)[13] and Risk Assessment Mitigation Phase (RAMP), highlighting changes since the 2020 WMP and 2021 Update. Include description of how the utility distinguishes between these risks and the risks to safety and reliability. List and describe each "known local condition" that the utility monitors per GO 95, Rule 31.1, including how the condition is monitored and evaluated. List and describe each "known local condition" that the utility monitors per GO 95, Rule 31.1, including how the condition is monitored and evaluated.

In addition:

A. *Describe how the utility monitors and accounts for the contribution of weather to ignitionprobability and estimated wildfire consequence in its decision-making, including describing any utility-generated Fire Potential Index or other measure (including input variables, equations, the scale or rating system, an explanation of how uncertainties are accounted for, an explanation of how this index is used to inform operational decisions, and an explanation of how trends in indexratings impact medium-term decisions such as maintenance and longer-term decisions such as capital investments, etc.).*
B. *Describe how the utility monitors and accounts for the contribution of fuel conditions to ignition probability and estimated wildfire consequence in its decision-making, including describing any proprietary fuel condition index (or other measures tracked), the outputs of said index or other measures, and the methodology used for projecting future fuel conditions. Include discussion of measurements and units for live fuel moisture content, dead fuel moisture content, density of each fuel type, and any other variables tracked. Describe the measures and thresholds the utility uses to determine extreme fuel conditions, including what fuel moisture measurements and threshold values the utility considers "extreme" and its strategy for how fuel conditions inform operational decision-making.*

For ease of review and to minimize duplicative information, SCE has organized this section to first explain known local conditions it monitors to assess wildfire risk (part of 4.2 requirements). Next, SCE explains its service area fire-threat evaluation and ignition risk trends (part of 4.2.1 requirements). Sequentially, SCE

[13] Updates to S-MAP are currently in deliberation under proceeding R.20-07-013 – Order Instituting Rulemaking to Further Develop a Risk-based Decision-making Framework for Electric and Gas Utilities.

then describes the major trends impacting ignition probability and wildfire consequence (4.2.A, 4.2.B, and part of 4.2.1 requirements). For information regarding ignition probability and estimated wildfire consequence, MARS, MAVF and how this information is used in SCE's decision-making, please see Section 4.3 (4.3 and part of 4.2 requirements) which includes a comprehensive description of SCE's overall risk mitigation framework.

Known Local Conditions

SCE accounts for known local conditions in its service area in designing, engineering, constructing, inspecting, maintaining, and operating its electrical facilities. These include wind, fuel, and other environmental conditions. For example, in 2013, SCE completed a service area-wide wind study, which was used to define high-wind areas (above the eight pounds per square foot specified in General Order (GO) 95[E3]) for usein pole loading calculations for pole replacements and installations. SCE implemented the results of this wind study in 2014. Known local conditions that SCE monitors related to its wildfire mitigation programs are described in the following sections.

The Commission, in D.17-12-024[E2], adopted regulations to enhance fire-safety in the High Fire Threat District (HFTD). These fire-safety regulations aim to reduce the fire hazards associated with overhead power-line facilities in elevated and extreme areas throughout the state and are contained in the Commission's GOs 95, 165 and 166 Rule 11 of each of the electric Investor Owned Utilities' (IOU) electric tariff rules.[E3] The HFTD tiers were determined based on elevated hazards for the ignition and rapid spread of power-line fires due to strong winds, abundant dry vegetation, and other environmental conditions. Since adoption of the HFTD maps in 2018, SCE began setting new construction standards, enhanced vegetation trimming, increased asset inspections, and shortened remediation timelines, consistent with the GOs, to reduce fire risk in its HFRA. At the time, SCE's HFRA included areas outside of the California Public Utilities Commission (CPUC)'s HFTD. In 2019, SCE conducted a detailed analysis of its historical non-CPUC designated HFRA and determined that a small portion of this area has similar wildfire risk profile as the Commission's HFTD. The Commission, in collaboration with CAL FIRE, reviewed SCE's Petition for Modification (PFM) of Decision D.17-12-024[E2] and approved its request for a modest expansion of the Commission's HFTD with modifications.[14] SCE has historically treated its non-CPUC HFRA as a Tier 2 HFTD and its wildfire mitigation activities are conducted across its HFRA including these additional areas. SCE will continue to monitor and assess areas outside of SCE's HFRA for potential inclusion in the HFTD. See Section 4.2.1. for further details on SCE's HFRA.

Fuel and weather conditions play a significant role in the initiation, spread, and intensity of wildfires. Fuel conditions such as the age of fuels, condition and health of the fuels, volume and type of fuel, is very localized and dynamically impacts wildfire risk. Similarly, weather conditions such as wind speed and dryness of the air play a significant role in the initiation, spread, and intensity of wildfires, and can be local to a particular area. Historically, SCE used the Santa Ana Winds Threat Index (SAWTi) issued by United States Forest Service (USFS) to assess fuel and weather conditions, which categorizes Santa Ana wind severity with respect to the potential for large fires to occur. The SAWTi assesses fuel and weather conditions to generate a threat level associated with Santa Ana wind events and extends out six days showing four threat levels that range from Marginal to Extreme. The SAWTi covers much of the southern

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[14] *See* D.20-12-030[E4]

portion of SCE's service area. SCE used it to gauge the overall severity of forecasted or ongoing Santa Ana wind events across affected SCE districts and as additional validation of the Fire Weather Watches and Red Flag Warning (RFW) provided by the National Weather Service (NWS). SCE still monitors these services. However, SCE has since developed improved fuel and weather modeling and tools which, along with its FPI, have replaced use of the SAWTi product to gauge and forecast the overall severity of fire-weather conditions. Known fuel and weather conditions that SCE monitors for wildfire risk are further described below.

As noted above, fuel conditions play a critical role in the initiation, spread, and intensity of wildfires. Currently, SCE has several methods and tools to monitor moisture amounts in the vegetation that contributes most to significant wildfire activity. Fuel moisture (dead and live vegetation) is expressed as a percentage of the water amount compared to the dry weight of the vegetation. For dead vegetation, less than 10% moisture represents fuels that will burn actively whereas moisture for live vegetation that is less prone to burning is generally 80% or more. In 2019, SCE launched a fuels sampling program to fill in known gaps in live fuel moisture observational data. Physical samples of native living plants are collected bi-weekly to determine the dryness and ultimately the combustibility of the vegetation. This data is monitored to determine moistening/drying trends that affect wildfire activity. In addition, SCE has several models that project moisture amounts in dead vegetation. This information is combined with the bi-weekly live fuel sampling to provide a holistic understanding of the fuels environment and serve as inputs into the FPI. Monitoring fuel data is also used to detect high-flammability fuel conditions. For example, beginning in 2020, SCE has used its fuel data to help determine several AOCs for wildfire potential that resulted in targeted inspections in these areas. For more information about SCE's AOCs, please see Section 7.3.4.9.1. SCE will continue to monitor fuels by conducting bi-weekly (weather permitting) live fuel sampling to inform its FPI and help detect high- flammability fuel conditions. For detailed information regarding SCE's current FPI thresholds see Section 8.2.3.

As noted above, weather conditions such as wind speed and dryness of the air play a significant role in the initiation, spread, and intensity of wildfires and can be local to a particular area. Therefore, monitoring weather data is a key function. SCE monitors location-specific, real-time weather conditions through its network of weather stations. SCE currently has 1,460 weather stations deployed across its HFRA and will continue to expand its weather station network through this WMP period as further described in Section 7.3.2. Weather data serve as key inputs into fire spread modeling to calculate probability and consequence of ignitions. See Section 4.3.5 and Section 4.3.6 for more details. In addition, the weather data is an input to SCE's FPI that helps assess the likelihood of significant fire activity occurring within the service area.

4.2.1 Service territory fire-threat evaluation and ignition risk trends

Present a map of the highest risk areas identified within the current High Fire Threat District (HFTD) tiers of the utility's service territory as a figure in the WMP. Discuss fire threat evaluation of the service territory to determine whether a modification to the HFTD is warranted (i.e., expansion beyond existing Tier 2 and Tier 3 areas). If the utility believes there are areas in its service territory that are not currently included in the HFTD but require prioritization for mitigation efforts, then the utility is required to provide a process outlining the formal steps necessary to have those areas considered for recognition in the CPUC-defined

HFTD.[15] Include a discussion of any fire threat assessment of its service territory performed by the electrical corporation, highlighting any changes since prior WMP submissions. In the event that the utility's assessment determines the fire threat rating for any part of its service territory is insufficient (i.e., the actual fire threat is greater than what is indicated by the CPUC's Fire Threat Map and High Fire Threat District designations), the utility is required to identify those areas for potential HFTD modification, based on the new information or environmental changes, showing the differences on a map in the WMP. To the extent this identification relies upon a meteorological or climatological study, a thorough explanation and copy of the study must be included as an Appendix to the WMP.

List, describe, and map geospatially (where geospatial mapping is applicable) any macro trends impacting ignition probability and estimated wildfire consequence within utility service territory, highlighting any changes since the 2021 WMP Update:

In 2018, SCE adopted the CPUC HFTD map but continued to retain pre-existing HFRAs until they could be evaluated and dispositioned. On December 17, 2020, the Commission approved SCE's request for a modest expansion of the Commission's HFTD, with modifications, to include areas in SCE's service area that pose an elevated wildfire risk to customers and communities. The modifications included removing six areas from SCE's non-CPUC HFRA, classifying one area as Tier 3 (versus Tier 2 in the original submittal), and incorporating various polygons, with slight adjustments to better align with the HFTD boundary, into Tier 2.[16] On January 20, 2021, SCE filed Advice Letter 4397-E requesting Commission staff approval of the final modification of the boundaries of the CPUC HFTD pursuant to Ordering Paragraph (OP) 2 of D.20-12-030.[E4] Commission staff reviewed and then updated the CPUC's Statewide HFTD maps and relevant links on the Commission's webpage.[17] See

Figure SCE 4-2 that includes the updated HFTD in and near SCE's service area. In June 2021, as required per Commission decision D.17-12-024,[E2] SCE completed the implementation of these boundary modifications within their internal mapping systems and processes.[6] SCE's HFRA is thus now synonymous with the CPUC HFTD in its service territory.

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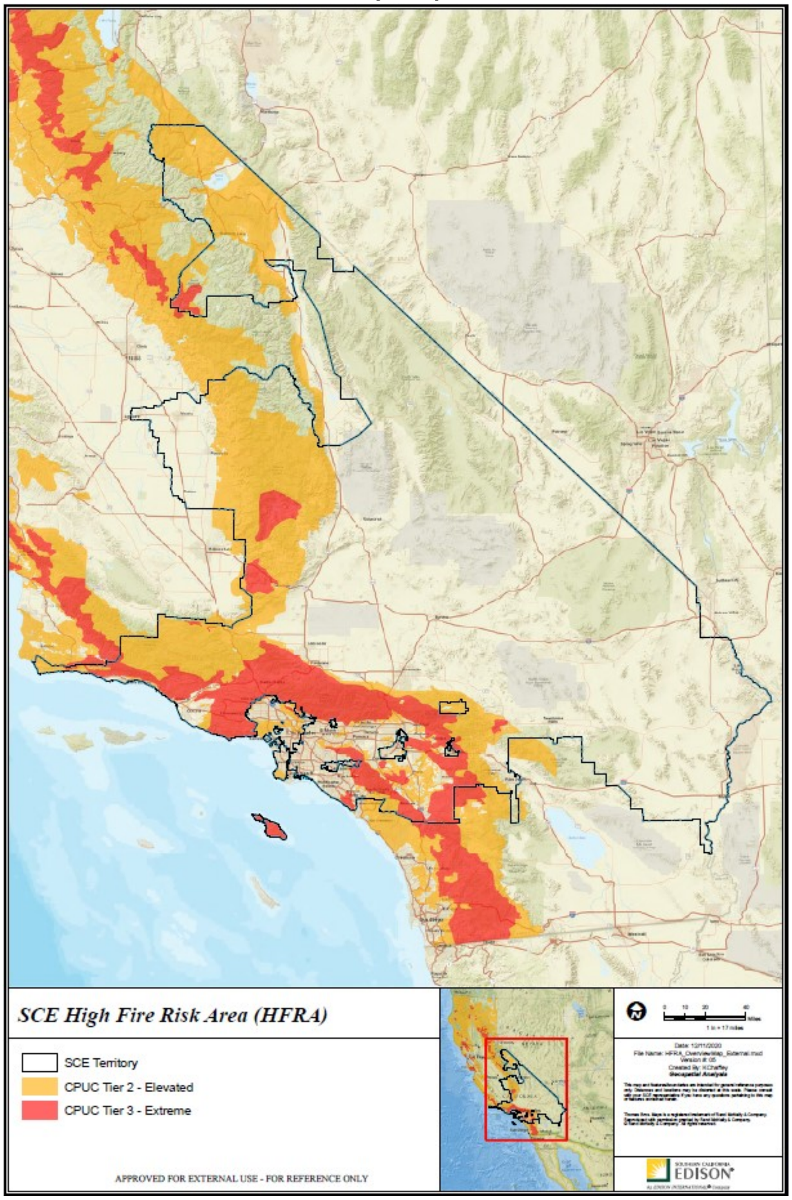
[15] As there is no formal or standard process for modifying the HFTD maps defined by the CPUC, Utilities may utilize a similar approach adopted by SCE during the 2019 WMP review process described in D.19-05-038, p. 53. For this process, in August 2019 SCE submitted a petition to modify D.17-12-024 to recognize SCE-identified HFRA as HFTD Tier 2 areas.

[16] *See* D.20-12-030.[E4]

[17] Further information about and Internet access to the CPUC HFTD Map is available at: Https://www.cpuc.ca.gov/FireThreatMaps/.

Figure SCE 4-2

Current Boundary Map of SCE's HFRA



In 2021, SCE enhanced its capabilities to perform an HFRA-wide analysis of wildfire risk using its Wildfire Risk Reduction Model (WRRM). Recent updates to the WRRM incorporated more advanced analytical technologies, such as satellite image change detection, for analyzing changes in fuels or land uses and informing consequence modeling. These advances enabled SCE to develop a more data-driven and risk-informed methodology to conduct fire-threat assessments across its HFRA. See Section 4.3.3 for further info regarding the specific updates to SCE's WRRM.

The HFRA Boundary Assessment process currently in development is expected to produce a net analysis, meaning it is likely to result in recommendations to add *and* remove areas from HFRA designation. The assessment process will review areas adjacent to and within SCE's current HFRA. The potential additions and removals will then be vetted by various subject matter experts (SME) in fire science, enterprise risk management, grid operations, vegetation management, and fire management. SCE believes this process will produce a more efficient, objective, and repeatable approach to analyze areas that represent an elevated or extreme utility ignition risk. In Q4 2021, SCE began a limited scale project utilizing this proposed HFRA boundary assessment methodology in a few selected regions in order to fine tune the methodology and better understand the impacts of the change should we decide to formally move forward with the recommendations. While SCE does not believe any boundary changes to HFRA are warranted at the time of this WMP filing, SCE will continue to develop its HFRA Boundary Assessment process and work with CPUC and CAL FIRE to process these changes.

At a high level, SCE's HFRA Boundary Assessment process consists of the following inputs and steps:

Primary Inputs:

(1) LandFire 2016 update with additional classifiers from Technosylva to better represent urban fuel, as well as a projection of fuel growth in major fire scars from the 2020 fire season
(2) Wildland-Urban Interface (WUI) information from Silvis Labs, which may be further augmented with information from CAL FIRE
(3) Historical wildfires from CAL FIRE's Fire Resource Assessment Program (FRAP)

Steps:

(1) Condense fuel information to identify locations with moderate to highly burnable fuels based on fuel loading conditions (e.g., grass, grass-shrubs, timber, and slash-blowdown)
(2) Select locations with highly urbanized landcover with the assistance of WUI information from Silvis Labs and identify a new WUI to represent the boundary where highly combustible landcover meets urban landcover
(3) Where overhead assets are present along this WUI boundary, create/add a 600-ft buffer from that interface into urbanized landcover. The 600-foot buffer is used as a conservative measure to address possible ignition fusing and facility failure which may occur along the immediate WUI boundary and could result in a small fire that may, under the right conditions, ignite more abundant and contiguous fuels nearby. As part of this new boundary assessment methodology, SCE would not prescribe a buffer along the wildland urban interface boundary when only underground assets are present.
(4) Additionally, SCE uses historical wildfire information from CAL FIRE's FRAP map, as well as wildfire ignition simulations from WRRM to further analyze locations for manual inclusion/exclusion
(5) Finally, SCE pressure tests all recommended locations with SMEs across the organization including specialists in fire science, emergency and grid operations, risk management, vegetation management, and others

Although SCE is not proposing to modify its HFRA boundaries at this time, it will continue to develop its HFRA boundary assessment process and work with OEIS, CPUC, and CAL FIRE to propose and process changes to the HFTD when needed. Additionally, SCE plans to further collaborate with neighboring Investor Owned Utilities (IOUs) and CAL FIRE on the boundary assessment methodology and will also discuss recommendations for the cadence of future HFTD map changes given the developments in wildfire risk modeling and availability of more granular and accurate data. When and where applicable, SCE intends to propose meaningful changes to the boundary that balance the need to appropriately adjust for changes in wildfire risk and the need to minimize change impacts on utility operations.

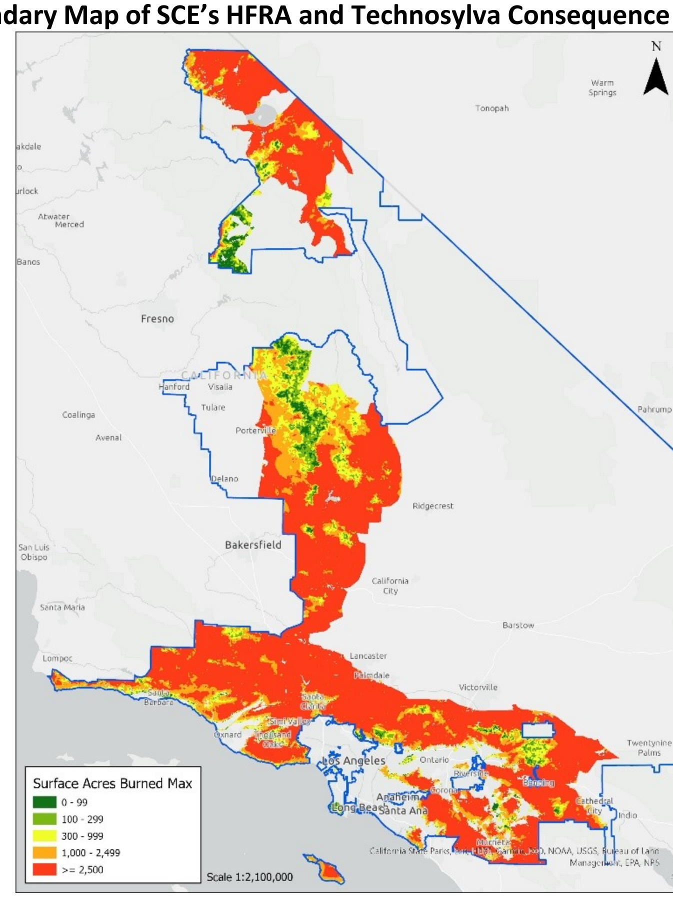
Highest Risk Areas within the Current HFRA

In terms of the highest risk areas within current HFRA boundaries, SCE has performed recent analysis in which it has categorized those highest risk areas as High Consequence Segments, defined as segments where an ignition can become a 300-acre-or-greater sized fire within the first eight hours, signaling a high probability of eventually becoming a very large fire.

Figure SCE 4-3 below shows SCE's HFRA areas and the Technosylva consequence values in terms of acres burned. Areas in yellow, orange, and red are those which SCE has identified as High Consequence Segments. See Section 7.1.2.1 for additional discussion on this analysis.

Figure SCE 4-3

Boundary Map of SCE's HFRA and Technosylva Consequence Scores



1. Change in ignition probability and estimated wildfire consequence due to climate change

Climate change is the primary driver of a range of underlying factors that affect wildfire initiation, spread, and intensity and, in turn, wildfire consequences. At a high-level, climate change-driven droughts are tightly coupled with wildfire activity, more so than fuel density and invasive species (e.g., mountain and bark beetles) alone. Climate/weather-related factors (e.g., extreme temperatures, high evapotranspiration, dry winds, etc.) have produced environments for extreme fire conditions where the vegetation is often dry enough to fuel extensive fires independent of the presence of secondary factors such as invasive species. Extreme multiyear drought (i.e., increased temperatures and decreased precipitation may lead to an increase in dead vegetation, increased bark beetle infestations, and more fuel for wildfire, if left unmanaged. Increases in the frequency and/or magnitude of wind events can compound these impacts.

Projections by Westerling (2018) point to a future defined by intensifying and, at times, expanding areas of elevated wildfire risk, that are strongly driven by changes to underlying climate conditions used in the statistical modeling. [18]Other research, notably Williams, et al. (2019) further strengthens the primary link between climate change and wildfire activity in California.[19] Additionally, while the impact of climate change on utility equipment failure (e.g., lines-down) may not be overly significant as a wildfire driver, the consequences of resulting ignitions could increase as climate change makes the underlying and surrounding landscape more receptive to ignitions.

To account for a wide range of historical climate scenarios, SCE uses 444 weather scenarios across a 20-year historical climatology in its WRRM consequence model. By using a wide range of models, SCE can determine the relative risk of wildfire consequence for each location under the maximum likely weather conditions, based on a historic climatology for any given location. The result is a relative ranking of locations by ignition consequence across SCE's service area. In 2022, SCE is developing a probabilistic view of future weather and fuel conditions to better understand how the climate change may exacerbate existing wildfire risk both spatially as well as consequentially for integration into its WRRM.

2. Change in ignition probability and estimated wildfire consequence due to relevant invasive species, such as bark beetles.

In recent years, mountain pine beetle outbreaks and fire activity have both increased independently and simultaneous to recent climate warming. SCE initiated its Dead and Dying Tree initiative in response to this threat. In 2020, SCE began to see the impact of the introduction of new invasive species in its HFRA. The Gold Spotted Oak Borer is a species that SCE's service area had limited exposure to until recently. The species is beginning to have a broad impact causing decline and even death in the oak tree communities

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[18] Westerling, Anthony Leroy. (University of California, Merced). 2018. Wildfire Simulations for California's Fourth Climate Change Assessment: Projecting Changes in Extreme Wildfire Events with a Warming Climate. California's Fourth Climate Change Assessment, California Energy Commission. Publication Number: CCCA4-CEC-2018- 014.

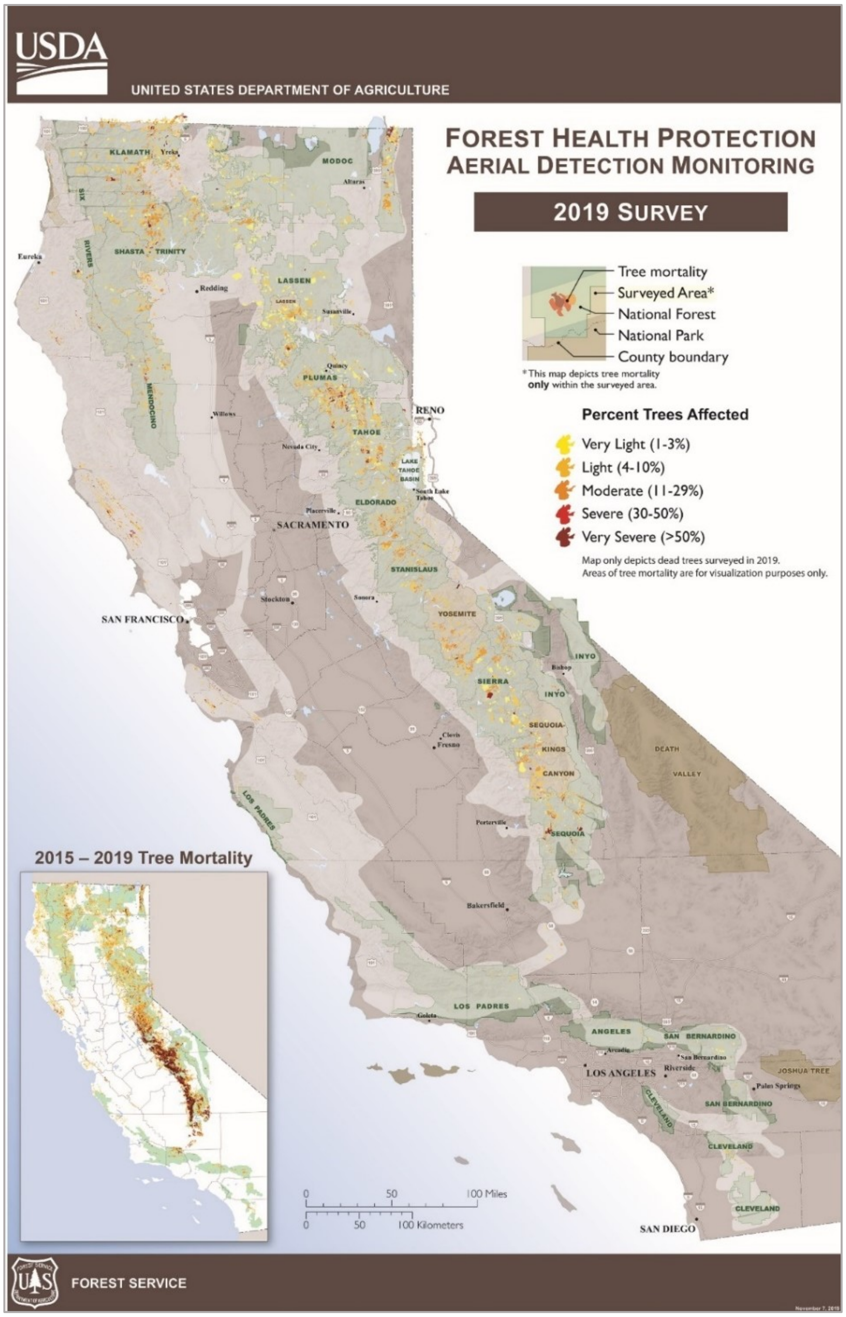
[19] Williams, A. P., Abatzoglou, J. T., Gershunov, A., Guzman-Morales, J., Bishop, D. A., Balch, J. K., & Lettenmaier, D. P. (2019). Observed impacts of anthropogenic climate change on wildfire in California. Earth's Future, 7, 892–910. https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2019EF001210

to which it spreads. The other emerging challenge is the Invasive Shot Hole Borer, which targets numerous tree species in addition to oak trees in the WUI areas. While these insects have not caused widespread devastation of oak and other mountainous tree species to date, the threat of their impact is a growing concern as they spread across the HFRA. The arrival of these insects has the same impact on oaks and other tree species as the bark beetle has had on pines. SCE's Dead and Dying Tree initiative effectively mitigates this risk by inspecting its HFRA multiple times a year for dead and dying trees (often due to invasive species) within striking distance of its facilities and removing any such trees. As such, SCE has not yet seen an overall increase in the probability of wildfire ignition due to invasive species.

SCE continues to monitor USFS insect and disease Aerial Detection Surveys (ADS), which are conducted annually using a variety of light fixed and rotor wing aircraft. USFS, state and other federal agencies work together to complete overview surveys in order to map current year forest injury. See map of the most recent published survey, below (Figure SCE 4-4).

Figure SCE 4-4[20]

2019 Forest Health Projection



Change in ignition probability and estimated wildfire consequence due to other drivers of change in fuel density and moisture

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[20] https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd700810.pdf

As noted above, climate change is a main driver of fuel density and moisture. Vegetation is an existing condition and its contribution to ignition likelihood and wildfire consequence is predicated on its interaction with weather conditions. Westerling (2018) uses vegetation fraction as a logistic model variable to determine wildfire presence, but the regression analysis also considers a range of underlying climate variables (e.g., temperature, water deficit, etc.) to help determine how vegetation may convert to wildfire fuel. Applying these studies with SCE's experience, we consider fuel density and moisture as secondary to (though influenced by) climate change trends. Fuel density may also be reduced by active forest management.

For example, Westerling's simulation of fuel treatment scenarios indicate a significant reduction of area burned relative to the baseline scenario. Based on SCE's forestry management team's experience protecting the Shaver Lake area's forests for more than three decades, fuel breaks (created in partnership with CAL FIRE), tree removal, and prescribed burning has reduced wildfire impacts to customers. For example, when the Creek Fire occurred in 2020, the largest fire in SCE's service territory at more than 379,000 acres, most of the region was spared from this devastating wildfire. SCE's actions played a critical role in slowing the spread of the Creek Fire, reducing damage, and providing more time for residents in this area to evacuate.[19]

Additionally, SCE conducts a full, HFRA-wide mapping of its surface fuel conditions (see SCE's HFRA Boundary Assessment process at the start of Section 4.2.1). For wildfire ignition simulation modeling, SCE uses an enhanced version of the LandFire 2016 with updated urban fuel types from Technosylva. These fuel layers were updated to reflect surface fuels data to accommodate the recent 2017- 2020 fires (prior to October 2020) within the SCE service territory. The most recent update focused on incorporating changes to the fuels within 2020 fire scars (perimeters). Burn severity mapping used a standard USFS Normalized Burn Ratio (NBR) method to update fuels in these locations based on fuel model class to reflect a 10-year growth from the current date within those burn scars. This methodology allows SCE to accommodate for changes in fuels (and risk) in these recently burned locations, yet account for short-term regrowth in the area.

Figure SCE 4-5 below shows the SCE domain final surface fuels data with the pre-October 2020 burn scar updates. Figure SCE 4-6 below shows a detailed map of the Bobcat Fire (left) and the El Dorado Fire (right).

Figure SCE 4-5

SCE Domain Surface Fuels with 2020 Burn Scar Updates

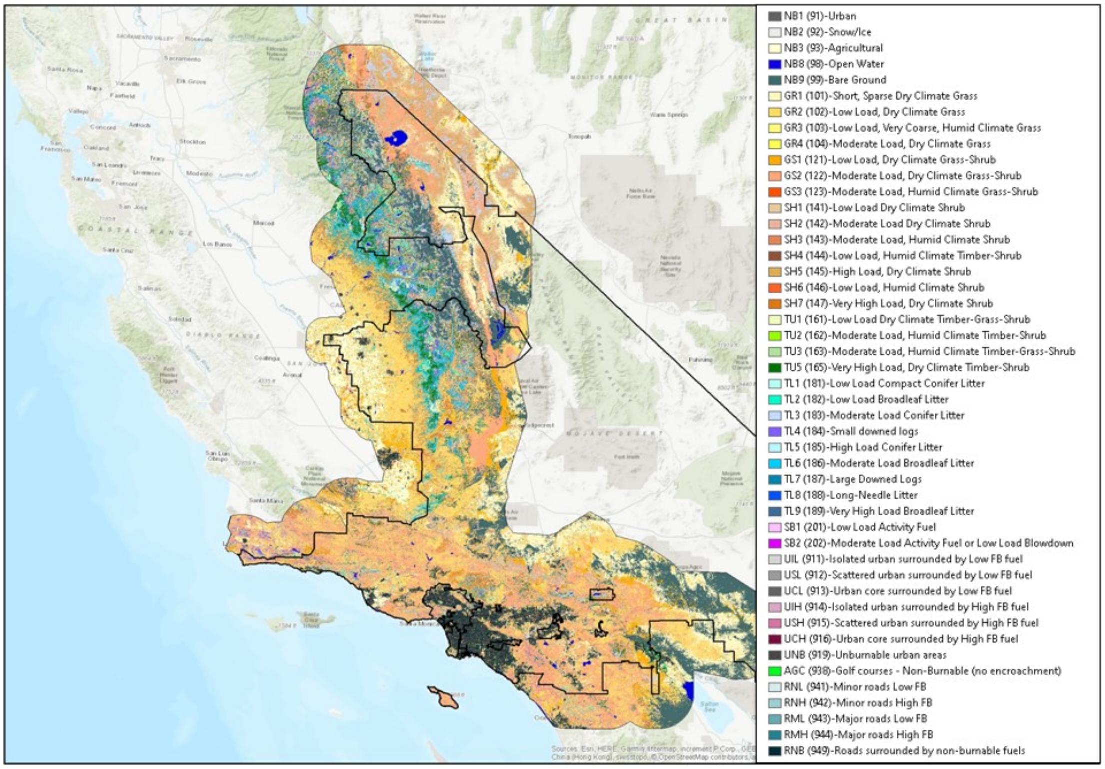
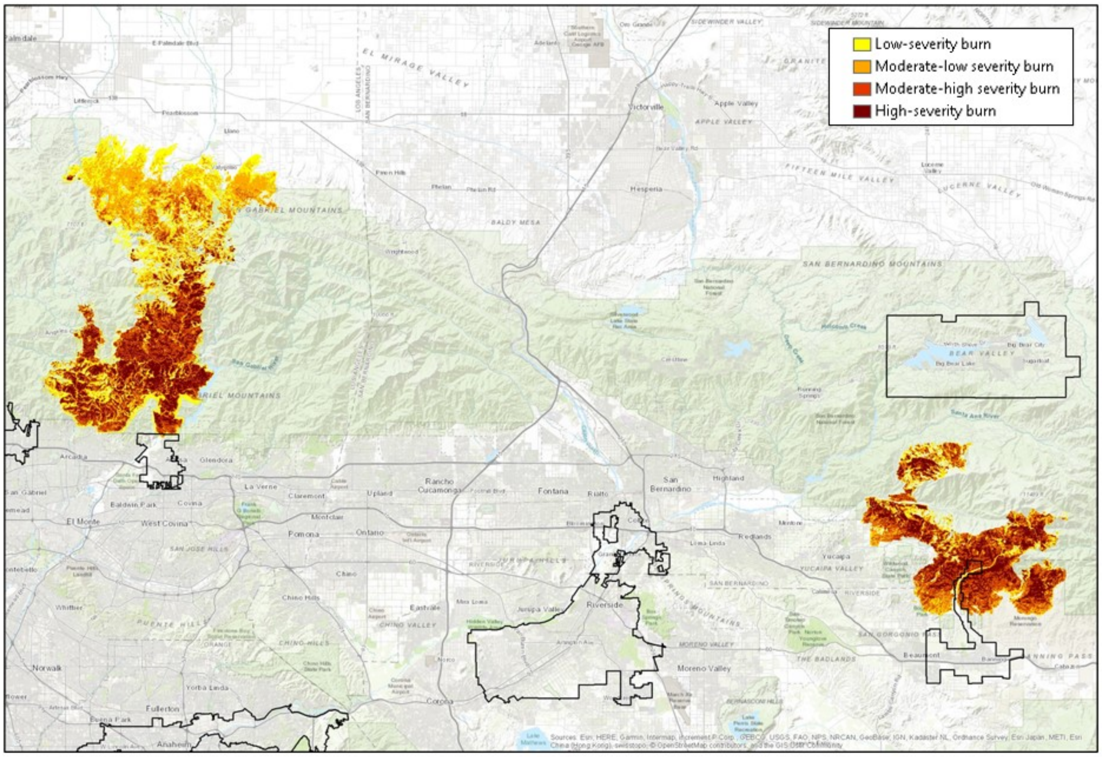


Figure SCE 4-6

Detailed Map Showing Burn Severity Data for Bobcat and El Dorado Fires

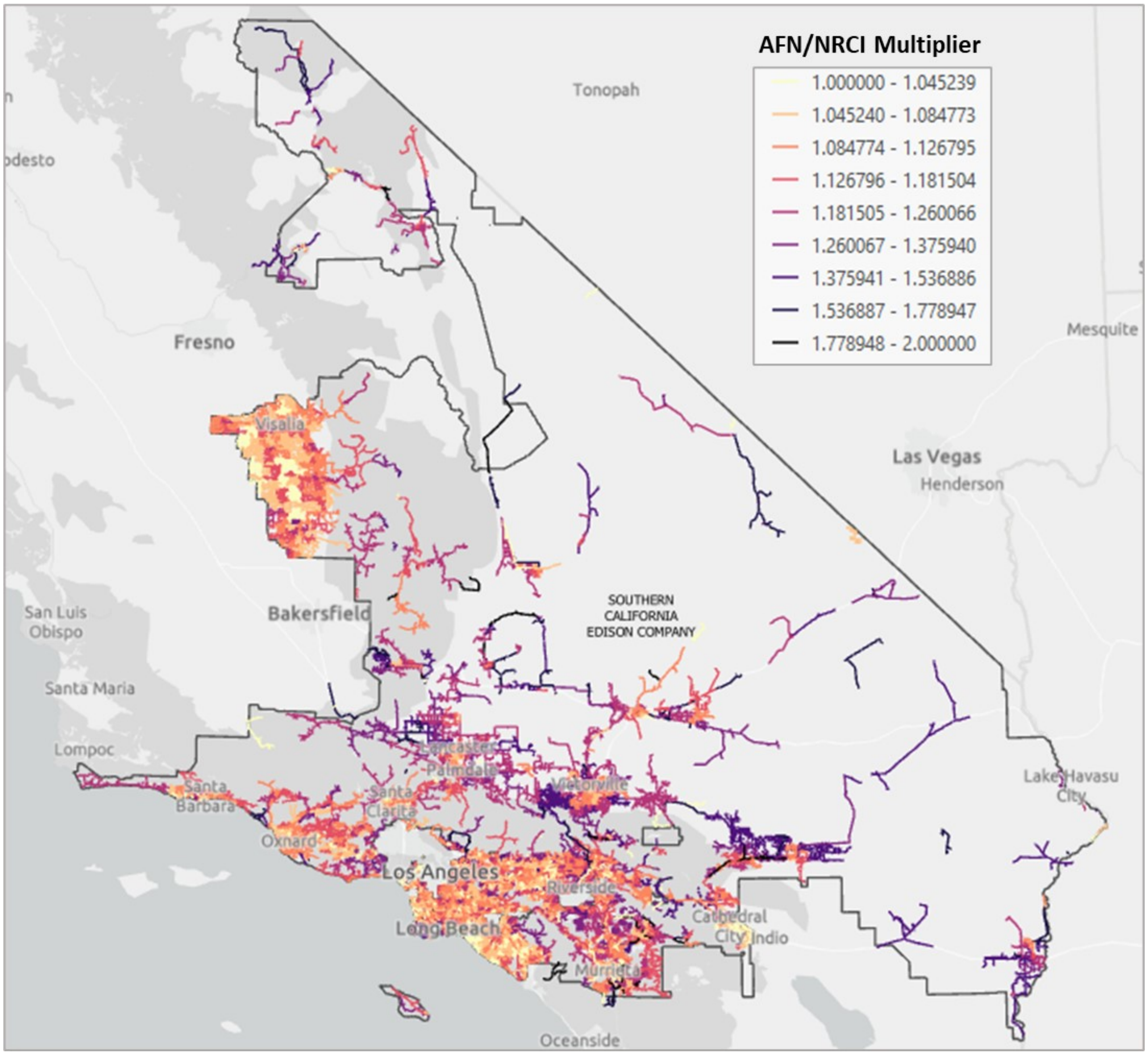


4. Population changes (including AFN population) that could be impacted by utility ignition

SCE performed a Geographical Information System (GIS) analysis (see Figure SCE 4-7 below) with locations of AFN/ Non-Residential Critical Infrastructure (NRCI) customers across SCE's service territory. The AFN/NRCI multiplier represents a relative ranking of the social vulnerability of circuits within SCE's service territory. The darker purple lines represent circuits with relatively higher proportion of AFN/NRCI customers, while the lightly shaded areas have a lower portion of AFN/NRCI customers.

Figure SCE 4-7

Relative Ranking of Circuits by AFN/NRCI Multiplier



Additionally, SCE has developed a Customer Care Dashboard that is used during PSPS events by the Customer Care Team. This dashboard maps MBL and AFN customers by circuit, which is used to help inform decisions, such as locations to deploy CRCs and CCVs. Additionally, this tool will also help us identify geographic areas that may benefit from increasing MBL awareness campaigns.

There are higher concentrations of MBL customers in larger counties such as Ventura, Los Angeles, San Bernardino, and Riverside. SCE also flags profiles of customers that self-certify as having a condition that could become life-threatening if electrical service is disconnected. The self-certified vulnerable customers are a smaller group than those enrolled in MBL, which also includes Critical Care customers.

The Joint IOUs, In-Home Supportive Services (IHSS) and Regional Centers have engaged in efforts to identify electrically dependent customers/consumers that we serve. In May 2021, these entities gathered this data at a ZIP code level aggregation. Based on this data, there are approximately 100,000 electrically dependent customers (as defined by these entities) in the areas of Southern and Central California based on California Department of Social Services regional centers, IHSS, and Medicare databases. Note that some of the areas serviced by the California Department of Social Services may be located in municipalities that are not serviced by SCE.

The exact number of customers is difficult to determine as the services provided by each are not exclusive, meaning that a customer from SCE may receive services from the regional center, IHSS and Medicare, so there may be overlap in customer count. Table SCE 4-2 below provides a summary of accounts identified as electrically dependent by County and entity.

Table SCE 4-2

Summary of Electrically Dependent Accounts

County	SCE MBL[21]	Regional Center	IHSS	Medicare
Fresno	26	0	0	22
Imperial	Less than 20	0	0	11
Inyo	116	0	2	139
Kern	2,542	99	279	1,854
Kings	1,038	31	160	564
Los Angeles	33,561	2,347	6,598	28,900
Mono	94	0	20	335
Orange	17,882	1,449	1,761	11,425
Riverside	22,474	1,587	2,626	14,086
San Bernardino	22,874	1,396	1,996	12,222
Santa Barbara	658	11	36	576
Tulare	4,871	252	561	3,093
Ventura	6,256	230	387	4,094
Total	**112,398**	**7,402**	**14,426**	**77,321**

5. Population changes in HFTD that could be impacted by utility ignition

SCE uses current population figures from LandScan 2018, developed by Oak Ridge National Laboratory, to estimate potential consequence; SCE has not used population projections in the current HFTD to assess possible future consequence. The WRRM is a static model. As such, it does not account for population growth. Population increases over time will increase the potential consequence of a wildfire but not necessarily contribute to an ignition risk related to the electrical system. Population increases in the highest risk areas of SCE's service area directly increase the consequences for where wildfires are most prone to initiate. SCE will refresh population data, along other inputs, as it updates the model.

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[21] Number of accounts as of September 2021.

6. Population changes in WUI that could be impacted by utility ignition

Similar to population changes in HFTD, SCE uses current population projections from LandScan 2018 and has not used population projections in the WUI to assess possible future consequence. SCE will refresh population data, along other inputs, as it updates the model.

7. Utility infrastructure location in HFTD vs non-HFTD

SCE has not modeled ignition probability or estimated consequence under future scenarios. Given this, SCE assumed normal load growth to conceptually assess this macro trend. SCE ranked this macro trend higher than the other utility infrastructure macro trends because the HFTD includes areas in SCE's service area most prone to wildfires. SCE's utility infrastructure located in the HFTD will be hardened, i.e., all new additions will include, at a minimum, covered conductor, fire-resistant poles, etc. SCE's hardened infrastructure will reduce the likelihood of ignitions associated with SCE's facilities.

Pursuant to the 2022 WMP Update Guidelines (Attachment 1, pp. 24-25), SCE is providing this information in GIS (see Section 7.1.7).

8. Utility infrastructure location in urban vs rural vs highly rural areas

SCE has not modeled ignition probability or estimated consequence under future scenarios. Given this, SCE assumes normal load growth to conceptually assess this macro trend. SCE's utility infrastructure located in urban, rural and highly rural areas do not necessarily align with HFTD areas. However, those areas that also traverse the HFTD will be hardened, i.e., all new additions will include, at a minimum, covered conductor, fire-resistant poles, etc. SCE's hardened infrastructure will reduce the likelihood of ignitions associated with SCE's facilities. SCE ranked this macro trend lower than the other utility infrastructure macro trend because it does not align with the HFTD.

Pursuant to the 2022 WMP Update Guidelines (Attachment 1, pp. 24-25), SCE is providing this information in GIS (see Section 7.1.7).

4.3 CHANGE IN IGNITION PROBABILITY DRIVERS

Based on the implementation of the above wildfire mitigation initiatives, explain how the utility sees its ignition probability drivers evolving over the 3-year term of the WMP, highlighting any changes since the 2021 WMP Update. Focus on ignition probability and estimated wildfire consequence reduction by ignition probability driver, detailed risk driver, and include a description of how the utility expects to see incidents evolve over the same period, both in total number (of occurrence of a given incident type, whether resulting in an ignition or not) and in likelihood of causing an ignition by type. Outline methodology for determining ignition probability from events, including data used to determine likelihood of ignition probability, such as past ignition events, number of risk events, and description of events (including vegetation and equipment condition).

4.3.1 Ignition Reduction Estimates

For the 2020 WMP, SCE assessed wildfire risks, risk mitigation alternatives, and risk mitigation scope based on system averages for probability and consequence of ignition. In 2019 and 2020, SCE created WRRM to model and quantify the Probability of Ignition (POI) and Consequence of fire at the asset level, which allows SCE to prioritize programs using asset and circuit-segment level risk rankings by targeting the assets and/or circuit- segments with the highest wildfire risks, e.g., SCE's Wildfire Covered Conductor Program (WCCP) is informed by segment- level wildfire risk rankings. Risk data at the asset-level now enables SCE to quantify wildfire risks, risk mitigation alternatives, and risk mitigation scope and perform asset- or location-specific analyses. This led to different results between the system level and asset- or location-specific risk analyses.

Beginning in 2021, the WRRM includes a method to translate the expected values produced by the model into unitless MARS values at the asset and location level. This enables SCE to both calculate risk and risk reduction at the asset and location level as well as aggregated as needed for circuit, or system level analysis.

Based on the transition to asset-level risk analysis, SCE's ignition forecast is dependent on using a risk buy down curve, where priority is based on mitigating the total overall risk. SCE illustrates this concept in Table SCE 4-3:

Table SCE 4-3

Risk Illustrative Example

Asset ID	Probability of Ignition (%)	Consequence (risk points)	Total Risk
Asset A	50%	100	50
Asset B	10%	10,000	1,000

As shown in Table SCE 4-4 below, SCE estimates a nearly 20% ignition reduction in HFRA for 2022 compared to 2020 recorded ignitions, assuming the same weather conditions as experienced in 2020. SCE also provides a two-year ignition forecast in Table 7.2 by risk driver (see Table 7.2 in Appendix 9.9).

This reduction is driven by the methodology described in the RSE section (see Section 4.3.8), whereby SCE estimated the mitigation effectiveness of programs by risk drivers and determined the risk reduction given the exposure and scope of the program.

Table SCE 4-4

Baseline Forecast (with no 2021-2022 Mitigations) and Forecast (with 2021-2022 Mitigations) in HFRA for Ignitions, Outages, and Primary Wire Downs

Risk Event	Recorded (2020)	Recorded (2021)	Baseline Forecast[22] (2022, Without Mitigations)	Forecast (2022, With Mitigations)
Ignitions	50	48	46	41
Outages	2,824	2,356	2,655	2,332
Primary Wire Downs	186	188	179	167

SCE has developed ML models to quantify the POI caused by Equipment and Facility Failure (EFF) and Contact From Object (CFO). The models utilize historical outages and faults caused by EFF and CFO, SCE asset data including circuit connectivity, historical weather data, tree inventory data, etc., to identify patterns that lead to faults then sparks.

The baseline forecast of ignitions is based on time-series forecasting. Time-series forecasting uses patterns in history to create a forecast of what the future may look like. A time-series forecast methodology was chosen because it can capture variation over smaller periods compared to other forecasting methods. For example, a five-year average forecast method cannot capture quarterly variation, such as a short fire season, or trends taking place over those five years. By capturing quarterly ignition data, our time-series approach predicts a seasonal pattern based on history. Should a sub-driver begin trending, either up or down, the time-series method can detect and forecast the implications to the system-wide ignition rate.

In Sections 4.3.2 to 4.3.9 below, SCE describes its wildfire risk analysis and how it informs SCE's decision-making process, including how it distinguishes this risk from other safety and reliability risks.

4.3.2 SCE's Risk-Informed Decision-Making Approach for WMP

SCE's Enterprise Risk Management (ERM) process annually identifies and evaluates the key risks that the enterprise and its customers face, with a focus on safety, such as wildfire risk. SCE uses a multi-step process that includes both a top-down and bottoms-up approach, as described below and discussed in further detail in Section 7.1.2:

- Top-down review of enterprise-level risks: This effort is aimed at assessing the breadth of activities ongoing at SCE, in the state, and in the utility industry to identify key risks. It includes a review of utility benchmarking, industry trends and research, public policy efforts, legislative activities, CPUC and other regulatory proceedings, major SCE initiatives, and critical business functions. The team also compiles and

[22] Baseline forecast relies on time series model which incorporates data from 2015-2021

assesses feedback on current and emerging enterprise level risks through company-wide surveys and direct discussions with SCE leadership.

- Bottom-up review of SCE Enterprise Risk Register: SCE's ERM function maintains an enterprise risk register that captures and assesses risks from across the enterprise, based on interviews and feedback from working groups throughout the organization, including from engineering analyses and field observations. New risks are also identified based on emerging trends in the industry.

- Consolidation and aggregation: SCE aggregates the risks identified through the above processes to evaluate which risks have potential major safety consequences, including consolidation of duplicate and similar risks.

- Review and refinement with senior leadership: Through leadership review and assessment, further refinements are made as appropriate.

Risk modeling and analysis has been a cornerstone in the development and execution of our WMPs and has matured over time. In 2018, we used this multi-step process to develop our RAMP report, which contained nine top safety risks, including wildfire.[23] SCE developed a RAMP risk model and MARS framework (SCE's version of a Multi Attribute Value Function (MAVF) to quantify our enterprise level risks and evaluate mitigation options). SCE's MARS model aligns with the methodology approved in the Safety Model and Assessment Proceeding (S-MAP). This analysis informed SCE's Grid Safety and Resiliency Plan (GSRP) and 2019 WMP. In parallel, we developed the Wildfire Risk Model (WRM) which was used to determine probability and consequence of ignitions at the asset level.

In 2019, SCE continued to use the RAMP model and MARS framework to assess system- or HFRA-level wildfire risks and risk mitigation using HFRA-level "top down" averages for probability and consequence of ignitions. Once the appropriate mitigation was selected for overall implementation (e.g., covered conductor) SCE used the segment level POI and Reax-based consequence model (together referred to as the WRM) to risk rank conductor segments. This "top down" RAMP model, along with the "bottoms -up" circuit segment prioritization, was used to determine the prioritization of covered conductor installation in the field, in conjunction with other operational considerations. The results of these analyses were included in SCE's Test Year 2021 GRC and 2020 WMP.

In 2020, SCE achieved several key milestones in enhancing our wildfire risk analytics. We developed asset-specific POI models for transmission and sub-transmission assets to add to our previously built distribution asset models. SCE also transitioned to a new fire consequence modeling tool developed by Technosylva. We developed a method to translate the risk scores produced by our POI and consequence models into

[23] The other eight 2018 RAMP safety risks included: 1) Building Safety, 2) Contact with Energized Equipment, 3) Cyberattack, 4) Employee, Contractor & Public Safety, 5) Hydro Asset Safety, 6) Physical Security, 7) Underground Equipment Failure, 8) Climate Change.

unitless values consistent with RAMP using the MARS framework at the structure (pole or tower) level. Finally, SCE developed a PSPS risk calculation to more comprehensively account for risk reduction benefits, as well as risks associated with use of PSPS for individual circuit segments. All of these improvements and additions are integrated into the overarching model referred to as the WRRM.

In 2021, SCE updated its existing asset-specific WRRM POI models by using the latest asset data, weather data and most suitable algorithms. At the same time, SCE updated the Technosylva fire consequence models by including additional historical weather scenarios and most up-to-date fuel including the recent burn scars to better capture the potential fire consequences. Furthermore, SCE improved its methods, processes and documentation to better estimate the mitigation effectiveness values associated with the wildfire mitigation programs to better estimate the RSE values through a data driven approach using historical fault and ignition data to quantify mitigation effectiveness values to the corresponding WF mitigation programs. SCE presents a multi-year comparison in Table SCE 4-5 below.

In 2021, SCE also participated in a number of Energy Safety-led joint utility workshops to further inform how individual utilities perform risk modeling and formulate RSEs.

Table SCE 4-5

Comparison of SCE's WRM (2019) and WRRM (2020+)

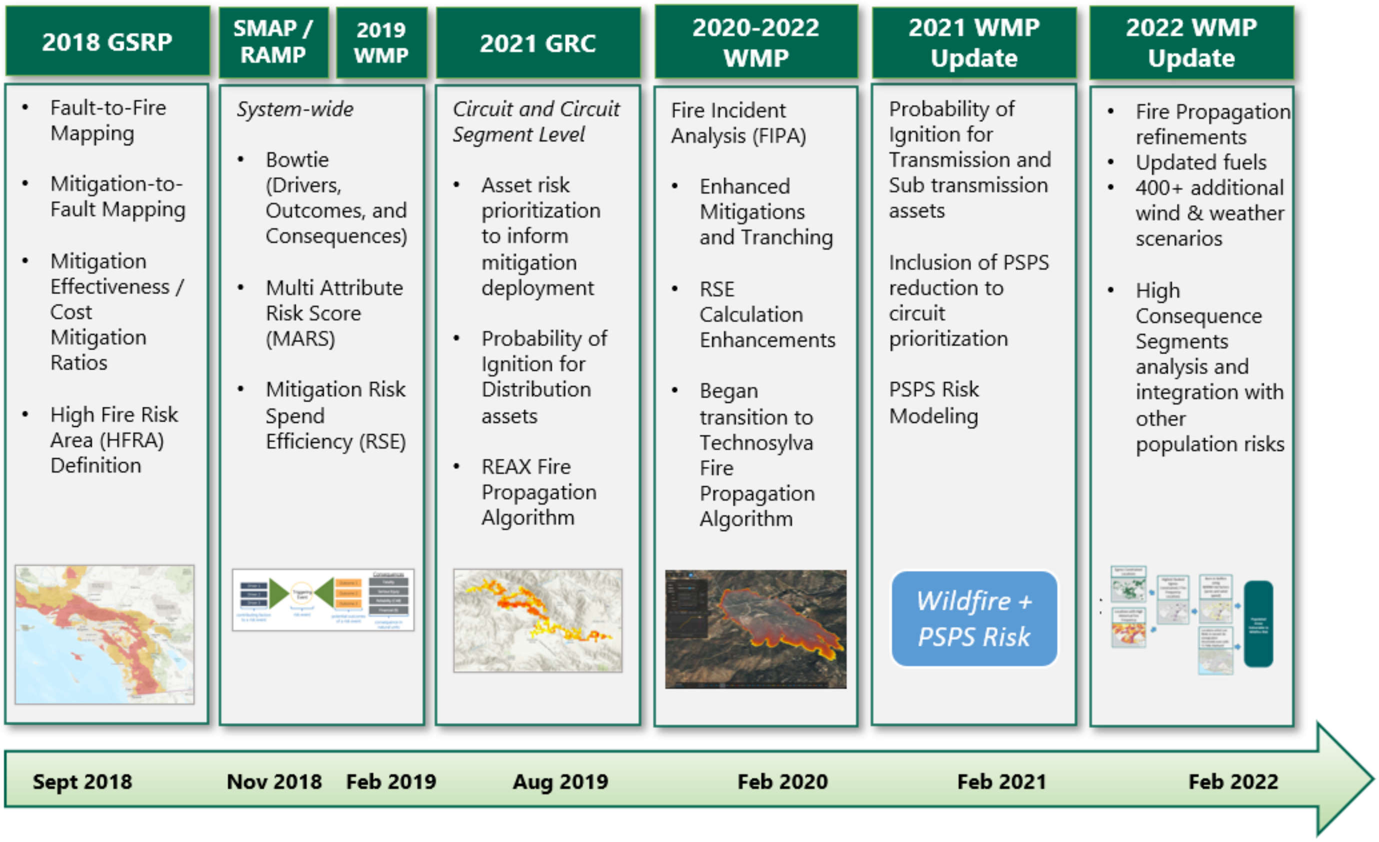
Year	Model Name	WF Probability Component	WF Consequence Component	PSPS Probability Component	PSPS Consequence Component
2019	WRM	SCE Machine Learning	Reax Consequence	Not Captured	Not Captured
2020	WRRM	SCE ML	Technosylva Consequence	Prob of PSPS De-energization	Consequence of PSPS De-energization
2021	WRRM	SCE ML (Updated with latest available data)	Technosylva Consequence (Updated with latest fuel data and more weather scenarios)	Prob of PSPS De-energization (Updated with latest PSPS operation protocols)	Consequence of PSPS De-energization (Updated with latest customer and circuit connectivity data)

These improvements enable SCE to calculate risk and risk reduction at the asset and location level for both wildfire and PSPS risk in a consistent risk-informed decision-making framework. This approach benefits the customers and communities we serve by providing a quantitative assessment of both wildfire and PSPS risk, as well as the risk reduction benefits of mitigation activities that are intended to the probability and/or consequences of wildfire and PSPS events. SCE also uses the outputs of the WRRM to perform RSE calculations using this granular approach, focusing on risk-informed decision making and validation of key WMP activities.

Figure SCE 4-8 describe the evolution of SCE's wildfire and PSPS risk modeling.

Figure SCE 4-8

Evolution of SCE's Wildfire (and PSPS) Risk Modeling



4.3.2.1 Response to SCE Action Statement, 2021 WMP Additional Issue to Address in 2022 WMP

The following is one of the Additional Issues as provided by OEIS in the Final Action Statement on SCE's 2021 WMP.

> *"Issue: (Requirement 11) According to the WMP Guidelines, SCE must provide a "list that identifies, describes, and prioritizes all wildfire risks, and drivers for those risks." SCE did not provide this list and instead included a footnote that referenced a list. This list was later provided via a data request (see Appendix 10.2).*
> *Remedy: Provide a table with a prioritized list of wildfire risks and drivers and the rationale for prioritization."*

SCE's response to this Issue/Remedy is described below:

Table SCE 4-6 below provides the list of ignition drivers and their rankings based on the adjusted risk. The table contains the following information:

- Category is the major category – EFF or CFO for Transmission (T) or Distribution (D)
- Sub-cause category is the reason for the outage
- Average Outage is the average number of outages per year from 2019 through 2021
- Ignition Rate is the rate of ignitions per outage calculated from 2019 through 2021
- Adjusted Risk is the product of Average Outage * Ignition Rate
- Ignition Rank is the ranking of adjusted risk

The drivers are ranked from highest to lowest ignition ranks. Drivers without ignitions have been left out for clarity. This analysis does not consider consequences of ignitions.

Further, as noted in its 2021 WMP Update Progress Report, SCE "quantifies each initiative's effectiveness at mitigating those same ignition drivers. Initiatives that are more effective against historical ignition drivers result in greater risk reduction in SCE's modeling...risk reduction is a key consideration in the evaluation and selection of mitigations. Absent other considerations, then, ignition drivers responsible for higher historical ignition counts will effectively be prioritized via the deployment of initiatives which are most effective at mitigating those drivers."[24]

Table SCE 4-6

List of SCE Wildfire Risk Drivers and Rankings

Cause Category	Sub-cause category	Average Outage 2019-2021	Ignition Rate 2019-2021	Adjusted Risk	Ignition Rank
D-EFF	Conductor damage or failure — Distribution	922	2.02%	18.67	1
D-CFO	Animal contact- Distribution	612	2.72%	16.67	2
D-CFO	Balloon contact- Distribution	953	1.75%	16.67	3
D-CFO	Veg. contact- Distribution	386	3.63%	14.00	4
D-CFO	Vehicle contact- Distribution	530	1.82%	9.67	5
D-EFF	Connection device damage or failure - Distribution	467	1.86%	8.67	6
D-CFO	Other contact from object - Distribution[25]	328	2.24%	7.33	7
D-EFF	Transformer damage or failure - Distribution	2688	0.27%	7.33	8
D-EFF	All Other- Distribution[26]	2563	0.26%	6.67	9
D-EFF	Wire-to-wire contact / contamination- Distribution	25	23.68%	6.00	10
D-EFF	Vandalism / Theft - Distribution	82	7.32%	6.00	11
D-EFF	Other - Distribution[27]	254	2.23%	5.67	12

[24] *See* "SCE 2021 WMP Update Progress Report," p. 36

[25] D-CFO Other contact from object-Distribution (and similarly, T-CFO Other contact from object-Transmission) includes sub-drivers such as ice/snow and lightning

[26] D-EFF All Other-Distribution (and similarly, T-EFF All Other-Transmission) includes other sub-drivers typically not associated with overhead lines and equipment, such as underground and substation equipment

[27] D-EFF Other-Distribution (and similarly, T-EFF Other-Transmission) includes other sub-drivers typically associated with overhead lines and equipment, such as pole top substation and tower damage or failure

Cause Category	Sub-cause category	Average Outage 2019-2021	Ignition Rate 2019-2021	Adjusted Risk	Ignition Rank
D-EFF	Switch damage or failure- Distribution	68	5.37%	3.67	13
D-EFF	Insulator and brushing damage or failure - Distribution	109	3.06%	3.33	14
T-CFO	Animal contact- Transmission	38	7.02%	2.67	15
D-EFF	Lightning arrestor damage or failure- Distribution	129	1.55%	2.00	16
D-EFF	Fuse damage or failure - Distribution	923	0.18%	1.67	17
D-EFF	Unknown - Distribution	1970	0.08%	1.67	18
D-EFF	Pole damage or failure - Distribution	280	0.48%	1.33	19
T-CFO	Balloon contact- Transmission	31	3.26%	1.00	20
T-CFO	Other contact from object - Transmission	21	3.17%	0.67	21
T-EFF	Capacitor bank damage or failure- Transmission	1	66.67%	0.67	22
D-EFF	Capacitor bank damage or failure- Distribution	414	0.08%	0.33	23
D-EFF	Crossarm damage or failure - Distribution	395	0.08%	0.33	24
T-CFO	Veg. contact- Transmission	6	5.56%	0.33	25
T-CFO	Vehicle contact- Transmission	19	1.72%	0.33	26
T-EFF	Lightning arrestor damage or failure- Transmission	1	33.33%	0.33	27
T-EFF	Unknown - Transmission	231	0.14%	0.33	28
T-EFF	Crossarm damage or failure - Transmission	6	0.00%	0.00	29
T-EFF	Connection device damage or failure - Transmission	1	0.00%	0.00	30
T-EFF	Other - Transmission	32	0.00%	0.00	31
T-EFF	Vandalism / Theft - Transmission	2	0.00%	0.00	32
T-EFF	All Other- Transmission	197	0.00%	0.00	33

4.3.3 Wildfire Risk Reduction Modeling (WRRM) Framework

SCE's wildfire risk models are used to analyze and quantify wildfire risk. The outputs are used to estimate risk reduction and calculate RSEs to help make decisions about wildfire mitigation activities, and to inform the prioritization of mitigation deployment.

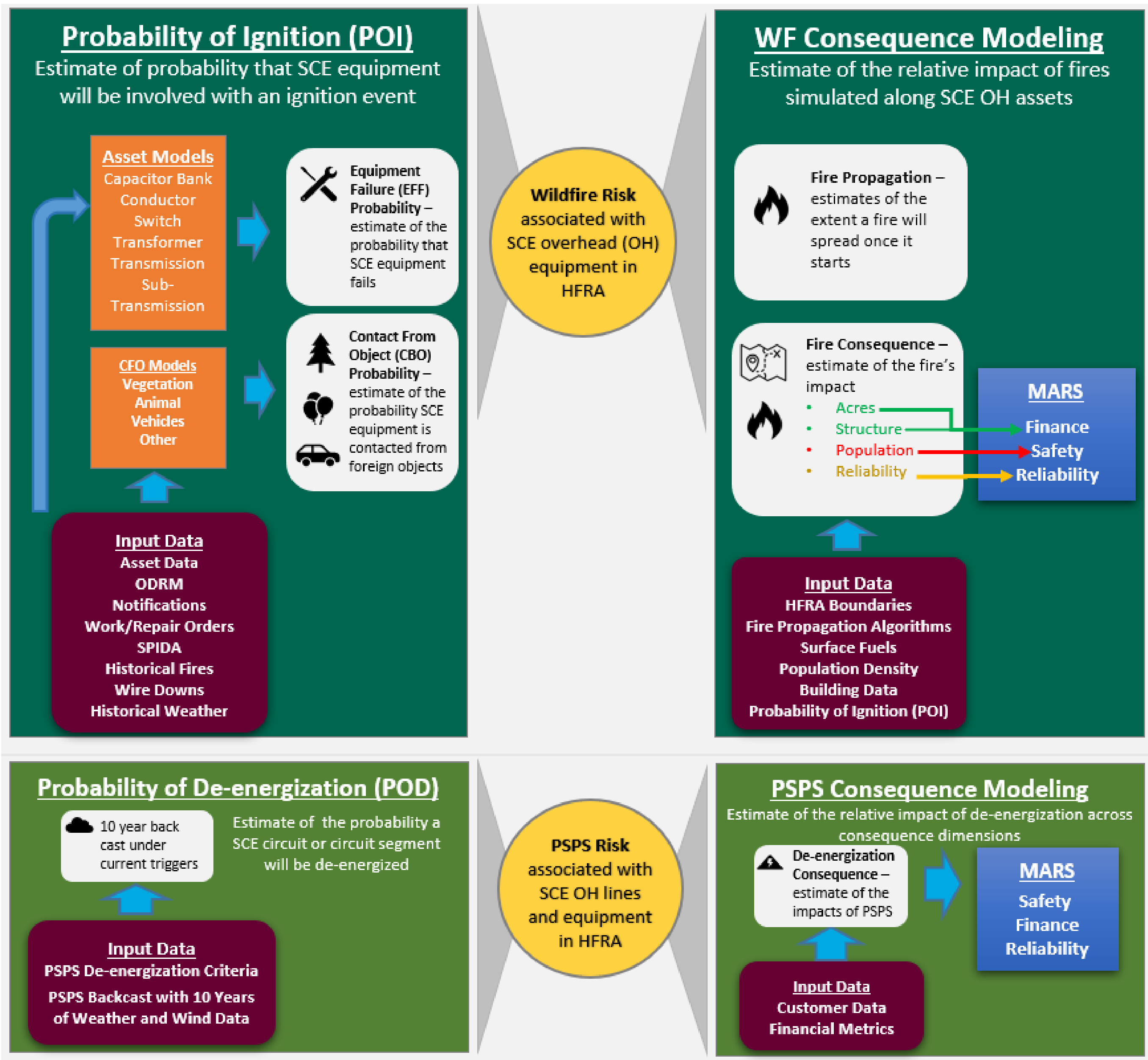
The WRRM framework leverages the risk bowtie to organize drivers, triggering events, and consequences (see

Figure SCE 4-9 below). The triggering event at the center of the wildfire bowtie is an ignition, associated with SCE's assets, in SCE's HFRA. On the left-hand side, asset and contact from object models, are used to develop an estimate of the POI for a given set of assets. For example, potential ignitions from conductors are primarily driven by equipment failure, CFO (such as trees or balloons), and wire-to-wire contact (such as during high winds). The consequences of these ignition events are estimated on the right-hand side using the Technosylva consequence model. The model estimates the potential spread of a fire over a given time, as well as the corresponding impact of this fire in natural units - structures, acres, and

population. These consequences are then translated into MARS units to calculate RSEs of mitigation activities and compare the relative risk of wildfire ignitions to that of other risk events. The outputs of the various models are aggregated into a unified WRRM output. The output of individual models and/or the entirety of the model output can be used for risk-informed decision-making.

Figure SCE 4-9

Wildfire Risk Reduction Modeling (WRRM) Framework



4.3.4 PSPS Risk Model

In the 2021 WMP, SCE developed a PSPS risk component for the WRRM.[28] Similar to the wildfire risk component of the WRRM, SCE's PSPS risk component leverages the risk bowtie to assess the relative risk of PSPS impacts to customers at each circuit or circuit segment. On the left side of the bowtie, SCE estimates the Probability of De-energization (POD) based on a 10-year back-cast of historical wind and weather conditions to estimate the annual frequency and duration of de-energization events, based on current PSPS de-energization protocols. On the right side of the bowtie, SCE estimates the safety, reliability, and financial consequences resulting from a PSPS event by counting the number of customers potentially impacted. The consequences are estimated based on the number of customers on a potentially de-energized circuit, along with a multiplier for the potential safety, reliability, and financial impacts associated with those de-energizations.

4.3.5 Probability of Ignition Models

Within the wildfire component of the WRRM, there are two classes of POI models: EFF and CFO. Each of the individual models are developed using ML algorithms for each asset or contact type as the drivers vary by asset/contact type.

Each asset-specific model uses historical outage data, available asset attributes and condition data (i.e., age, voltage, inspection results, etc.) and other asset and environmental attributes (i.e., historical wind, number of customers, etc.) to predict the probability of the asset creating a spark. Similarly, each CFO model uses outage data along with other variables to predict a spark caused by the particular type of contact (e.g., vegetation, animal, balloon, vehicle).

The POI models within the wildfire component of the WRRM calculate probabilities at the structure level, and thus total ignition probability at a structure (i.e., pole or tower) is calculated as the sum of the probabilities of ignition across the assets at that location. Similarly, risk values can be aggregated to the circuit level, district, etc. Currently, for the purpose of prioritizing mitigations, all sparks are assumed to potentially create ignitions.

Developing and maintaining these models is a resource-intensive and complex task. Significant data synthesis and quality checks are needed prior to analysis and building models to estimate probabilitiesof ignition. Once the models are built, they need to be continuously tested and updated using new outage data for observed failures or "near misses," and new inspection, remediation, or replacement data for latest available asset condition.

In 2019, SCE developed POI models for distribution overhead conductors, distribution switches, distribution capacitors, and distribution transformers. In 2020, SCE further developed POI models for sub-

[28] SCE's PSPS risk modeling aligns with SDG&E's Wildfire Next Generation System approach.

transmission and transmission wires and towers. In 2021, SCE refreshed the existing POI models with up-to-date data.

Further, as noted in SCE's Progress Report response to SCE-21-10[29] on how ignition sources factor into its risk modeling and mitigation selection, SCE incorporates the location-specific conditions described above into its POI models, which are in turn used to help select the mitigation, or mitigations, that are most effective at addressing site-specific CFO and EFF ignition sources. Moreover, as addressed in SCE's Progress Report response to SCE-21-11[30] and alluded to above, SCE's POI models use historical weather data, including wind speed, as important input components to capture their impact on potential faults and ignitions.

4.3.6 Ignition Consequence Models

To estimate the consequence of an ignition, WRRM leverages the Rothermel fire propagation algorithm within the Technosylva consequence module to estimate the natural unit consequences (e.g., structure burned, acres burned, and population impacted) from individual ignition simulations along SCE's overhead assets within HFRA. These natural units are translated into MARS units to incorporate safety, financial and reliability impacts due to wildfire. This consequence module replaces the broader "outcome" scenarios presented in GSRP and RAMP by estimating a fire's characteristics once it starts (e.g., fuel conditions and wind speed), where the fire will move (wind direction and terrain impacts), and the potential structures, population and acres impacted by a fire based on scenario-based fire sheds. The 2022 WMP Update differs from SCE's 2021 WMP, in that SCE updated the fuel and weather scenarios in the previous version of the WRRM. A more detailed discussion of the evolution of our ignition consequence model enhancements is below.

In early 2019, SCE engaged Reax Engineering (Reax), an experienced fire science consulting firm, to develop a fire-propagation model for areas surrounding SCE's overhead facilities within the HFRA, and to identify relative consequence areas based on fire-weather climatology and Census data. Fire propagation characteristics were estimated using a twenty-year fire weather climatology model. Based on ignition simulations in SCE's HFRA where overhead facilities are located, fire volume – the spatial integration of fire area and flame length – was estimated to develop sample fire scars. This process was repeated across SCE's service area for hundreds of thousands of combinations of ignition location and duration. The outputs of these simulations were used to quantify the consequence as the product of fire volume and the number of impacted structures within the weighted average overlay of simulated fire scars localized to 300-meter by 300-meter Reax grid squares. SCE later enhanced the Reax consequence output via the MARS framework to consider not only the number of structures impacted, but also impacts to safety, such as serious injuries and fatalities, acres of property burned, as well as suppression and restoration costs.

[29] *See* SCE 2021 WMP Update Progress Report Item SCE-21-10, pgs. 35-37.
[30] SCE 2021 WMP Update Progress Report, pgs. 38-41. 2021 WMP Progress Report Item SCE 21-11.

In 2020, SCE transitioned to a Technosylva-based consequence model, which included improvement over the Reax-based consequence model. Key improvements include updated and more granular model inputs (e.g., buildings, assets, fuels, population), more advanced fire propagation techniques (e.g., urban encroachment), and direct mapping of consequence scores to individual assets. Technosylva fire spread model uses individual building footprints, population count, SCE asset data, and a 20-year climatology and surface fuel data specifically calibrated to SCE's service area. This will enable SCE to re-run this simulation on an annual, or semi-annual, basis based on updated and calibrated information from previous fire weather seasons which is a significant improvement from the Reax models in targeting mitigations to HFRAs.

In 2021, SCE significantly enhanced the underlying fuel data to developed forward projections of fuels in recent fire scars in the Technosylva consequence model. Additionally, SCE added 403 additional weather scenarios for a total of 444 weather scenarios to provide broader geographic representation of both fuel and different types of wind driven fires. Please see Table SCE 4-7 below for a list of model inputs, outputs, and algorithms.

In addition to asset-specific consequence values, SCE has enhanced its geospatial viewer tool to display aggregated and disaggregated risk scores geospatially across SCE's service area, as well as the associated wind and weather variables associated with each of those weather scenarios for all assets in HFRA with an additional 20-mile buffer outside of HFRA (see Figure SCE 4-10 and Figure SCE 4-11, below). Finally, SCE has integrated the WRRM data with a new Severe Risk Area framework developed jointly by Technosylva and SCE to better represent risk in locations with egress concerns, as well as high wind conditions not fully captured by ignition propagation models. SCE intends to leverage this framework to guide the evaluation and deployment of enhanced mitigations supplementing covered conductor, including alternative grid hardening measures, or targeted undergrounding where feasible (see Section 7.1.2.1 for additional information). In 2022 SCE will enhance the egress and general wildfire consequence modeling to better support its integrated grid hardening strategy.

Figure SCE 4-10

Illustrative Wildfire Risk Map from WRRM along Distribution Lines - Ignition Consequence

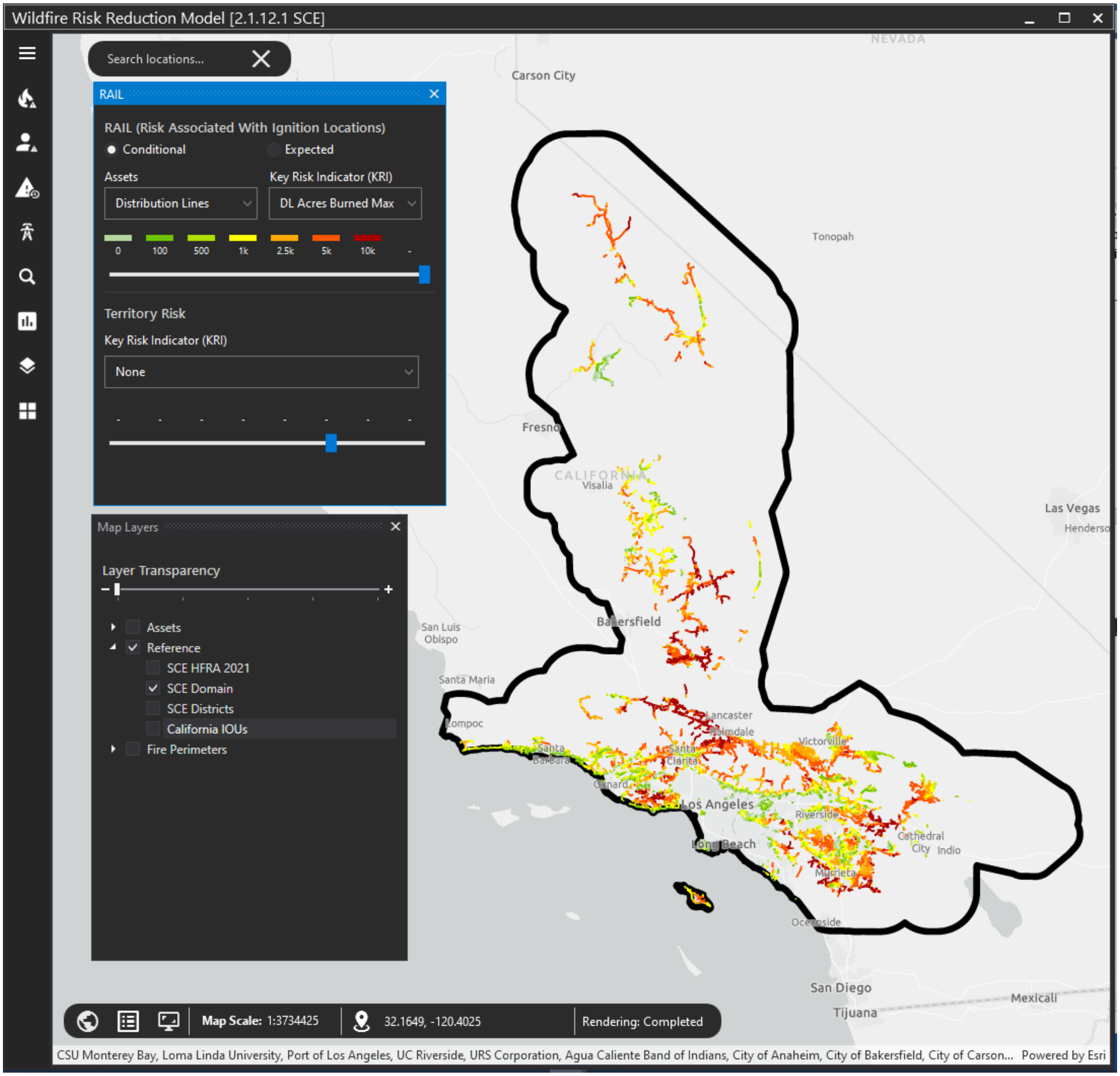


Figure SCE 4-11

Illustrative Wildfire Risk Map from WRRM HFRA-Wide Raster – Ignition Consequence

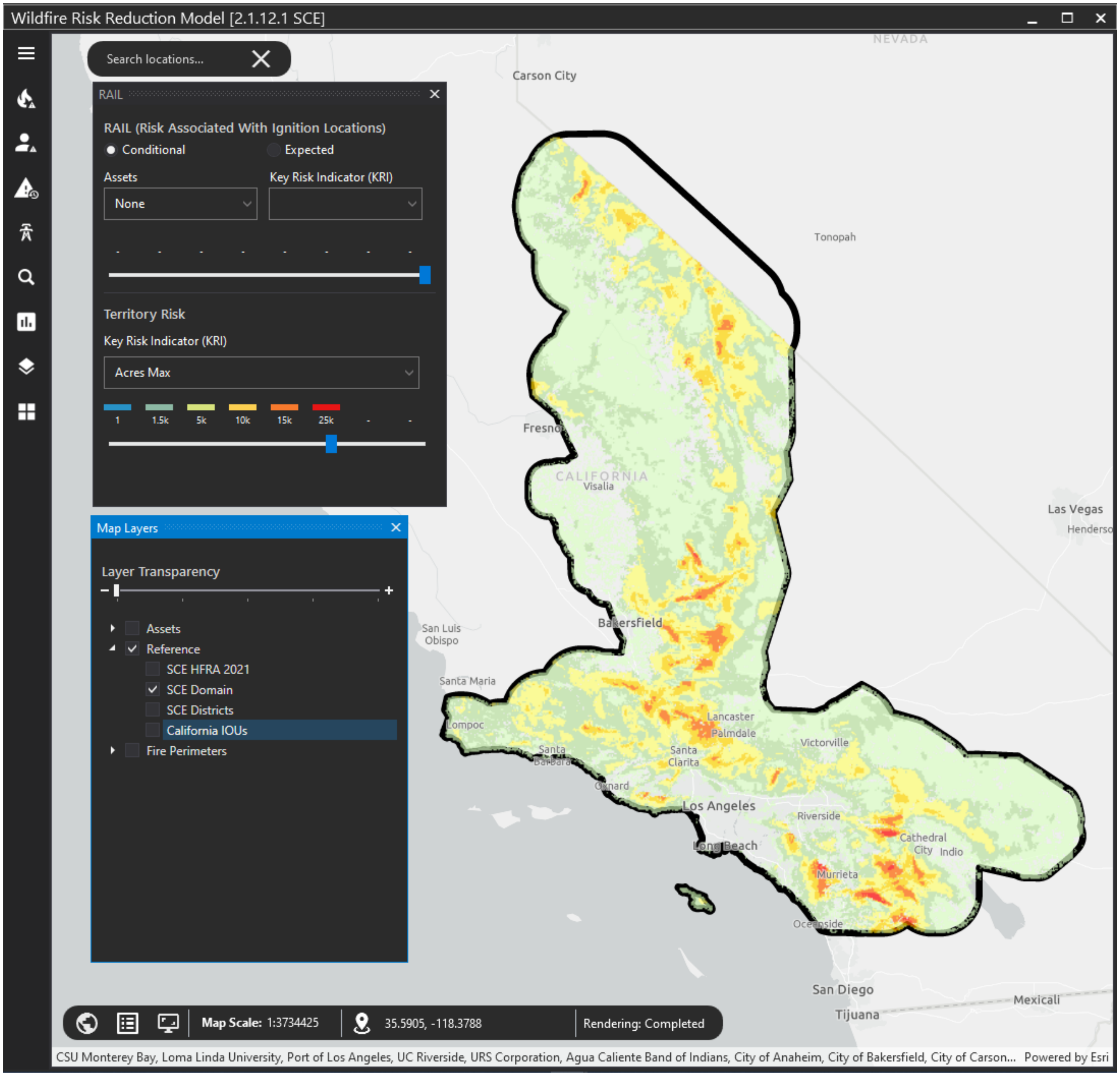


Table SCE 4-7

General Summary of WRRM Inputs, Outputs and Fire Propagation Algorithms

General Summary of Key Product Elements	
Category	**Technosylva WRRM**
Input Data	• LandFire 2016 surface fuels, with burn scar update as of October 2020 • Microsoft building footprints • LandScan 2018 population count • Updated SCE asset information, including poles/functional locations (FLOC)[31] • Incorporates SCE POI for distribution and FLOC ignition assets, POI for transmission and sub-transmission • Uses SCE specific 20-year climatology
Output Data	• Asset-level conditional risk (consequence only) and expected risk (POI xConsequence) assigned to individual assets • Service area-wide asset-level Hybrid Raster Consequence provided for entire service area in addition to a 20-mile buffer into adjacent service territories • Outputs are aggregated for all 444 weather scenarios as – mean, median,maximum and 90th percentile
Fire Modeling Methods	• Uses published and endorsed models with a proprietary implementation • 20+ models used to enhance core fire modeling • Advanced urban encroachment model ensures a more accurate identification ofbuildings and population impacts • Uses all weather scenarios for each asset simulation(s) resulting in multiplesimulations per asset • Integrates SCE ignition probability data to provide expected risk outputs in additionto conditional risk • Model and software recently adopted by State of California CAL FIRE as the onlyauthoritative fire risk model in the state • Modeling methodology also adopted by Pacific Gas and Electric Company (PG&E) and San Diego Gas and Electric Company (SDG&E)

4.3.7 Multi-Attribute Risk Score

The MAVF was developed as part of the S-MAP proceeding and is used in the utilities' RAMP filings to compare risks and mitigation alternatives. The MAVF is also used to calculate RSEs. SCE's version of the MAVF is called MARS.

[31] FLOC is a physical location, not an asset

As described in the previous sections, SCE modeled wildfire and PSPS risks independently from one another. In order to use this information to assess combined risk (wildfire and PSPS), as well as assess the relative effectiveness of mitigations, SCE converted WRRM natural unit consequence outputs (acres, structures, population) to MARS units. Converting these consequences to MARS units allows SCE to assess the benefit of deploying mitigations to address wildfire risk, PSPS risk, or both. Corresponding RSEs were calculated using the estimated wildfire risk reduction, PSPS risk reduction, or both as applicable.

- **Wildfire Component of WRRM** – Applicable to programs that only mitigate wildfire risk driversand/or consequences. Example: Expanded pole brushing.
- **PSPS Component of WRRM** – Applicable to programs that only mitigate the probability of a PSPS de-energization and/or consequence caused by a de-energization. Example: Critical Care Backup Battery Program.
- **Wildfire and PSPS Components Together** – Applicable to programs that mitigate both Wildfire andPSPS risks. Example: Covered Conductor (reduces wildfire ignition drivers and raises wind speed thresholds for PSPS de-energization).
- The PSPS risk is added or "stacked" along with the wildfire risk for a total combined risk for purposes of RSE calculations.

Table SCE 4-8 below summarizes the probability and consequence modeling inputs for the wildfire and PSPS risk components of the WRRM.

Table SCE 4-8

Overview of Probability and Consequence Modeling Inputs for Wildfire and PSPS Components of the WRRM

	Wildfire Component	PSPS Component
Probability (normalized to an annual frequency)	POI based on internally developed ML algorithms at segment or asset level	Probability of de-energization based on a 10 year back-cast based on wind and FPI data using SCE's current PSPS de-energization protocols
MARS Consequence		
Safety	Population impacted based on Technosylva consequence simulation which in turn is translated into the Safety index.	From the number of customers impacted from reliability, gross-up to the number of impacted population. Use a conversion ratio [32] to convert impacted population to a Safety index.
Reliability	Eight hours of interruption per customer on the circuit. This duration was used in order to maintain consistency with Technosylva fire propagation simulation, which also uses eight hours.	Number of customers based on the downstream impact of a de-energization on a circuit. Duration is based on a historical back-cast as described above.
Financial	Buildings and acres impacted based on values from Technosylva WRRM which is then translated to financial dollars.	Per customer, per de-energization event to quantify potential financial losses for the purpose of comparing PSPS risk to wildfire risk. The figure represents potential customer losses, such as lost revenue/income, food spoilage, cost of alternative accommodations, and equipment/property damage. This value is based on a Value of Lost Load (VoLL), which is a widely accepted industry methodology to estimate a customer's willingness to

[32] Given the limited information directly linking fatalities to a PSPS event, SCE used the 2003 Northeast Blackout event as a data point to determine safety impacts from an outage. That blackout lasted for 48 hours, impacted 50 million people, and was recorded to have 100 fatalities, which converts to 4.2×10^{-8} fatalities / people-hrs. Other data points include the 2011 Southwest blackout and the 2019 PSPS outages in SCE service area, though no fatalities were attributed to those events.

		accept compensation for service interruption. VoLL is dependent on many factors, including the type of customer, the duration of the outage, the time of year, the number of interruptions a customer has experienced. SCE's VoLL estimate is consistent with academic and internal studies to estimate VoLL for a single-family residential customer for a 24-hour period.[33]

MARS uses natural units[34] of safety, reliability, and financial consequences and converts them into a combined unit-less consequence score. SCE continues to use the MARS 2.0 framework as previously described in the 2021 WMP and shown below in Table SCE 4-9**.**

Table SCE 4-9

MARS 2.0 Framework

Attribute	Unit	Weight	Range	Scaling
Safety	Index	50%	0 - 100	Linear
Reliability	CMI	25%	0 – 2 Billion	Linear
Financial	Dollars	25%	0 – 5 Billion	Linear

MARS 2.0 Consequence Attributes

$$Safety\ Index = 1.0 * \#\ of\ Fatalities + 14 * (\#\ of\ Serious\ Injuries) * AFNMultiplier * NRCIMultiplier$$

Vulnerable / At-Risk communities - SCE has incorporated a targeting multiplier to its Safety index which amplifies the score based on an internal analysis of two population sets, AFN[35] and

[33] SCE utilizes $250 per customer, per de-energization event to approximate potential financial losses on average, recognizing that some customers may experience no financial impact, while other customers' losses may exceed $250. It is not an acknowledgment that any given customer has or will incur losses in this amount, and SCE reserves the right to argue otherwise in litigation and other claim resolution contexts, as well as in CPUC regulatory proceedings.

[34] Natural units are the number of Fatalities or Serious Injuries for safety, CMI for Reliability, and dollars for Financial.

[35] AFN customers include but not limited to Critical Care, Disabled, Medical Baseline, Low Income, Limited English, Pregnant, Children.

NRCI[36]. At the circuit level, SCE developed both an AFN and NRCI score to incorporate the level of support that an individual or entity would need in an emergency event or PSPS event, in the case of an AFN customer.

AFN_Score$_{MAX}$ is the maximum score from all the circuits. The lowest AFN multiplier would be 1 in the case where the AFN score on that circuit was zero. The highest AFN multiplier would be 2 in the situation where a circuit had the highest AFN score.

$$AFNMultiplier = 1 + AFN\_ScorecircuitAFN\_ScoreMAX$$

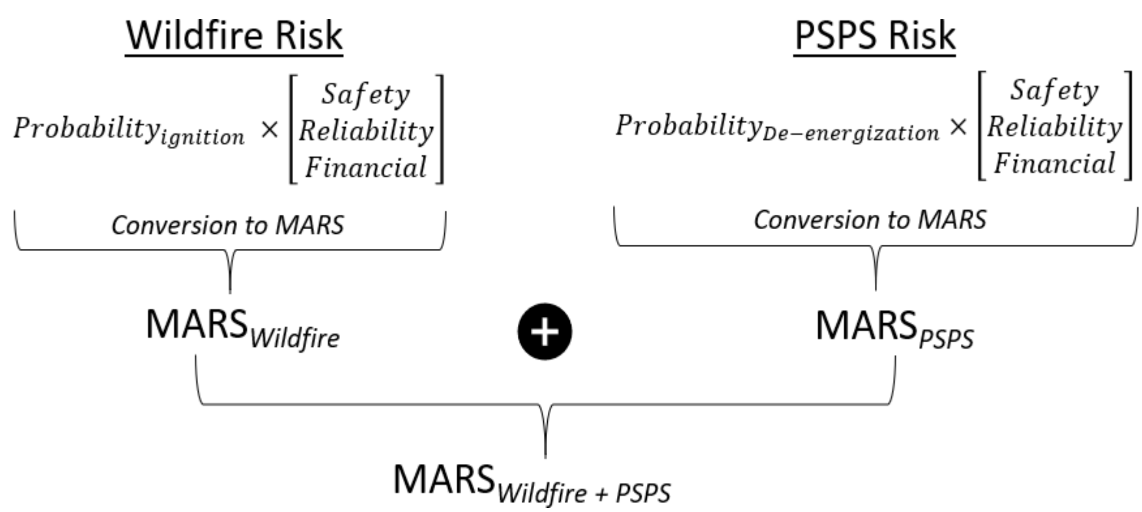
NRCI_Score$_{MAX}$ is the maximum score from all the circuits. The lowest NRCI multiplier would be 1 inthe case where the NRCI score on that circuit was zero. The highest NRCI multiplier would be 2 in the situation where a circuit had the highest NRCI score.

$$NCRCIMultiplier = 1 + \ NRCI\_ScorecircuitNRCI\_ScoreMAX$$

Since the MARS framework is used to estimate both wildfire and PSPS unit-less consequence scores, they can be combined into a Wildfire + PSPS Stacked risk as shown in Figure SCE 4-12 below.

Figure SCE 4-12

Wildfire + PSPS Stacked Risk



While PSPS is an effective mitigation against ignitions under extreme fire conditions, we recognize there are broader impacts, hardship, and risks that are introduced by proactive de-energization. This is why we have accounted for these broader PSPS impacts in our overall risk model. The combined MARS$_{wildfire}$ and MARS$_{psps}$ model shows that wildfire risk is substantially greater than PSPS risk across the safety, reliability, and financial dimensions. Nevertheless, by combining the PSPS risk with the wildfire risk to calculate a

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[36] NRCI sectors include but not limited to Healthcare and Public Health, Water and Wastewater systems, Emergency Services, Communication, Transportation, Government Facilities, Energy.

total MARS, SCE has the means to target mitigations to areas that have the highest combined risk in addition to targeting wildfire and PSPS impacts separately.

4.3.8 RSE Analysis

The RSE calculation provides an indicator of the risk reduction accomplished through an activity compared to the costs for that activity. The RSE is calculated for those activities that have a direct impact on risk or consequence of wildfire and/or PSPS de-energizations. The remainder of this section provides an overview of the benefits and limitations of using RSEs in decision-making, an overview of the RSE calculation methodology, and a summary of RSE results.

RSEs are a useful tool to inform the decision-making process when evaluating alternative mitigations, selecting new programs for widespread deployment, or making changes to the scope of deployed programs. For recently concluded pilot activities, the RSE value can serve as one threshold indicator to determine whether the pilot (or program deployed elsewhere, but not yet deployed in SCE's service area) should move into full deployment.

It should be noted that RSE values may not be identical among the California utilities. Given that RSE values are derived from calculated risk scores which include the estimated effectiveness of the mitigation (which can be based on a utility's unique data and experience in their respective service territory) and POI along with consequence (which are unique for each asset), they will vary based on historical data (such as faults and ignitions by sub-driver), equipment conditions, potential for CFO, and the size of potential fires inherent in each utility's service area. In addition, each utility, while following RAMP guidelines for translation to unitless values for RSE calculation, may use assumptions and values for their MAVF components that are unique to their environment which will result in differences in RSE. Notwithstanding these potential differences, SCE is collaborating with OEIS, PG&E and SDG&E in an RSE working group to improve understanding and consistency of RSEs across the three large IOUs. In addition, the topic of comparable risk scores will be taken up in the Phase II of the Risk Order Instituting Rulemaking (OIR). See Appendix 9.8 that describes the status of this RSE working group's efforts. In addition, SCE engaged a team of independent internal data, modeling and engineering personnel to review a variety of inputs and coding used to develop the RSEs for the 2022 WMP Update.

RSEs, though an important and valuable input to help understand the relative value of various activities in economic terms, are not, and should not, be the only factor used to develop or execute a risk mitigation plan. The RSE metric does not account for certain operational realities, including planning and execution lead times, resource constraints, work management efficiencies, regulatory compliance requirements, environmental and permitting requirements, and other risks and conditions that are not captured within the WRRM. These additional factors are considered by SCE while determining the type, volume, and sequence of workundertaken to reduce wildfire and PSPS risks in a timely manner.

RSE Calculation Method

SCE's RSE calculation method follows the steps below.

1. Use historical counts to forecast baseline (in the absence of mitigations) wire-down, outage, andCPUC ignition levels.
2. For each program, obtain
    a. cost forecast,
    b. mitigation effectiveness – a percentage between 0 and 100% denoting the effectivenessof reducing various risk driver frequencies and or consequences of events,
    c. prospective units to be installed/performed, and
    d. years of useful life (mean time to failure)

3. For each year, calibrate the WRRM to the forecast baseline wire-down, outage, and CPUCignition levels to convert probabilities to frequencies.
4. Where available, use location data, mitigation effectiveness, and the WRRM to estimate riskbuydown associated with the program.
    a. If location data are not available, or if the scope is not determined yet, use the risk buydown curve from the WRRM. Use the units to be installed/performed in that year to determine how far down the risk buydown curve theprogram may mitigate risk.
    b. Apply the mitigation effectiveness to the particular asset's risk drivers and or consequences and compare the resulting risk with the baseline risk. The difference is the risk reduction.
5. Calculate the net present value (NPV) of the risk reduction applying the years of useful life as thetime horizon.
6. Calculate the RSE by dividing the NPV of risk by the cost forecast.
7. The risk reduction data is then further leveraged to calculate the buydown of risk events using the calibrated WRRM.
8. Calculate the forecast of net events by subtracting the estimated count of mitigated events fromthe baseline forecast.

The methodology to calculate RSEs for wildfire mitigations, as described above, is identical to that for calculating RSEs for PSPS mitigations, but instead of incorporating wildfire ignitions and its associated consequences, the model uses the PSPS probability and consequences as described in Section 4.3.2. The Covered Conductor, Undergrounding, RARs, and High Definition (HD) Camera programs mitigate both Wildfire and PSPS risks. In these cases, SCE added both wildfire and PSPS risk benefits together and divided by the forecasts of the program to arrive at an RSE.

Summary of RSE Results

The WMP requirements seek RSE calculations for all WMP initiatives. As in its 2021 WMP Update, SCE again provides RSEs for all activities that directly mitigate wildfire or PSPS risks. SCE has also incorporated 22 additional activities into its RSE portfolio for this 2022 WMP Update, consistent with OEIS direction in its 2021 WMP Revision Notice (Critical Issue SCE-01)[37] and Final Action Statement (Progress Report Key Area for Improvement SCE-21-01)[38] and SCE's 2021 WMP Update Progress Report commitment to its Key Area for Improvement SCE-21-14.[39] These new RSEs include PSPS-related initiatives and enabling activities, among others. As a result, SCE has incorporated nearly all of its wildfire activities into its 2022 WMP RSE portfolio, either directly or as enabling mitigations, with limited exceptions as described below. Table SCE 4-10 lists the PSPS mitigations for which RSE methodologies were assessed as part of the 2022 WMP update. Table SCE 4-11 summarizes RSE results for each wildfire initiative.

Table SCE 4-10

RSE Scores Developed for PSPS Mitigations

WMP Mitigation Activity	2021 WMP Identifier	RSE Calculated in 2021 WMP?	RSE Calculated in 2022 WMP?	RSE Methodology
CRCs and CCVs	PSPS-2	Yes	Yes	PSPS Consequence Reduction
Critical Care Back-up Battery		Yes	Yes	PSPS Consequence Reduction
Resiliency Zones		No	No	No RSE (No expected 2022 installs)
Microgrid Islanding (CREI)		No	No	No RSE (No expected 2022 installs)
Well Water and Residential Battery Enrollment (Rebates)		No	Yes	PSPS Consequence Reduction
Community Meetings	DEP-1.2	No	Yes- Costs allocated to PSPS-2	Enabling Activity for PSPS-2
PSPS Marketing Campaign	DEP-1.3	No	Yes- Costs allocated to PSPS-2	Enabling Activity for PSPS-2
Customer Research and Education	DEP-4	No	No- Supports Enabling Activities	Enabling Activity for PSPS-2
High-Performing Computer Cluster (HPCC) Weather Modeling System	SA-3	No	Yes	PSPS Consequence Reduction
Fire Spread Modeling	SA-4	No	Yes- Aggregated into SA-8	PSPS Consequence Reduction
Fuel Sampling Program	SA-5	No	Yes- Aggregated into SA-8	PSPS Consequence Reduction
Remote Sensing/Satellite Fuel Moisture	SA-7	No	Yes- Aggregated into SA-8	PSPS Consequence Reduction

[37] SCE 2021 WMP Revision Notice, p. 5.

[38] Final Action Statement on 2021 Wildfire Mitigation Plan Update – Southern California Edison, p. 9.

[39] SCE 2021 WMP Update Progress Report, p. 54. 2021 WMP Progress Report Item SCE-21-14.

WMP Mitigation Activity	2021 WMP Identifier	RSE Calculated in 2021 WMP?	RSE Calculated in 2022 WMP?	RSE Methodology
Fire Science	SA-8	No	Yes	PSPS Consequence Reduction
FPI Phase II	SA-2	No	Yes- Aggregated into SA-8	PSPS Consequence Reduction
Weather Stations	SA-1	Yes	Yes	PSPS Consequence Reduction
PSPS IMT Training	DEP-2	No	Yes	PSPS Consequence Reduction
Unmanned Aircraft Systems (UAS) Operators Training		No	Yes	PSPS Consequence Reduction
Microgrid Assessment	SH-12	No	No	No RSE (No expected 2022 installs)
Circuit Evaluation for PSPS Driven Grid Hardening Work	SH-7	No	No- Supports Enabling Activities	Enabling Activity for SH-5

SCE has enhanced its RSE modeling practices with regard to scoring activities that either indirectly support risk reduction through modeling and decision-making support (e.g., Weather and Fuels Modeling SA-3, Fire Science SA-8) or enabling activities that do not directly reduce either wildfire or PSPS risk by themselves but rather enable more effective deployment of other WMP activities. Previously, SCE did not include either these types of activities when calculating RSEs. In order to develop RSE scores for these previously unscored activities, SCE engaged in intensive working sessions with subject matter experts across a variety of disciplines (e.g., operations, risk, and regulatory personnel) and work categories (e.g., situational awareness, grid operations and protocols, stakeholder cooperation, and community engagement).

For the added activities which indirectly support risk reduction through modeling and decision-making, SCE's risk and regulatory teams led operations-based subject matter experts through a series of informational, brainstorming, development, and challenge sessions to help ensure an informed and consistent approach. For the added enabling activities, the teams worked to map them to the activities they enable. The teams then included a portion of the enabling activities' costs within the RSE calculations for each of the enabled activities. Thus, while these enabling activities do not have RSEs of their own, their costs do factor into SCE's overall RSE portfolio and associated decision-making processes. These enabling activities are noted in Table SCE 4-11 below, along with a reference to the activities they enable.

Generally speaking, SCE still believes that the development of RSEs for pilot activities is too speculative, given that they are conducted to *assess* technologies that can potentially reduce risks to determine operational impacts, costs, and risk reduction benefits. It is more meaningful to calculate RSEs once the *results* of the pilots are available to inform decision-making prior to potential broad scale deployment. Accordingly, while SCE still does not score most of its pilots, it has developed new RSEs for some pilots or nascent activities which are further along in terms of development (i.e., Early Fault Detection (EFD) and REFCL)).

Other than pilots, SCE included RSEs for almost all of the wildfire activities found in its 2022 WMP Update. The reasons underpinning the few exceptions are as follows:

- No installations planned in 2022
- Distribution Fault Anticipation (DFA) (SA-9)
- Microgrid Assessment (SH-12)
- Installations are incorporated within other activities
- PSPS-Driven Grid Hardening Work – installations are incorporated within Weather Stations (SA-1), WCCP (SH-1), and RARs/ RCSs (SH-5)
- Activities which enable other enabling activities
- Customer Research and Education (DEP-4)

Table SCE 4-11

Summary Table of RSE Results

Category	ID	Initiative / Activity	RSE Calculated (Rationale)	RSE[40]	Quantified Risk Reduction Benefits
Situational Awareness	SA-1	Weather Stations	Yes	1	Reduces PSPS risk
	SA-3	Weather and Fuels Modeling System	Yes	115	Reduces PSPS risk
	SA-8	Fire Science	Yes	105	Reduces PSPS risk
	SA-10	HD Cameras	Yes	586	Reduces ignition risk and PSPS risk
Grid Design & System Hardening	SH-1	Covered Conductor	Yes	7,884	Reduces ignition risk and PSPS risk
		Fire Resistant Poles	Yes	3,725	Reduces ignition risk
	SH-2	Undergrounding Overhead Conductor	Yes	1,421	Reduces ignition risk and PSPS risk
	SH-4	Branch Line Protection Strategy	Yes	3,767	Reduces ignition risk
	SH-5	Installation of System Automation Equipment – RAR	Yes	4,946	Reduces ignition risk and PSPS risk
		Installation of System	Yes	2,981	Reduces PSPS risk

[40] RSEs provided are for total activity, please see Table 12 in Appendix 9.9 for activity RSEs by tier.

Category	ID	Initiative / Activity	RSE Calculated (Rationale)	RSE[40]	Quantified Risk Reduction Benefits
		Automation Equipment – RCS			
	SH-6	Circuit Breaker Relay Hardware for Fast Curve	Yes	17,873	Reduces ignition risk
	SH-7	Circuit Evaluation for PSPS-Driven Grid Hardening Work	No - Supports Enabling Activities	N/A	N/A
	SH-8	Transmission Open Phase Detection	Yes	532	Reduces ignition risk
	SH-10	Tree Attachment Remediation	Incorporated into covered conductor	12,847	Reduces ignition risk
	SH-11	Legacy Facilities	Yes	203	Reduces ignition risk
	SH-12	Microgrid Assessment	No - Pilot Activity	N/A	N/A
	SH-13	C-Hooks	Yes	41	Reduces ignition risk
	SH-14	Long Span Initiative (LSI)	Yes	3,496	Reduces ignition risk
	SH-15	Vertical Switches	Yes	5	Reduces ignition risk
	SH-16	Vibration Damper	Yes	538	Reduces ignition risk
	SH-17	Rapid Earth Fault Current Limiter	Yes	28,789	Reduces ignition risk
	IN-1.1	Distribution Ground Inspections and remediations	Yes	2,668	Reduces ignition risk
		Distribution Aerial Inspections and remediations	Yes	856	Reduces ignition risk
	IN-1.2	Transmission Ground Inspections and remediations	Yes	1,076	Reduces ignition risk
		Transmission Aerial Inspectionsand remediations	Yes	579	Reduces ignition risk

Category	ID	Initiative / Activity	RSE Calculated (Rationale)	RSE[40]	Quantified Risk Reduction Benefits
Asset Management & Inspections	IN-3	Infrared Inspection of energized overhead distribution facilities and equipment	Yes	560	Reduces ignition risk
	IN-4	Infrared Inspection, Corona Scanning, and HD imagery of energized overhead Transmission facilities and equipment	Yes	0	Reduces ignition risk (though no ignitions in historical dataset used to model RSE)
	IN-5	Generation Inspections and Remediations	See IN-1.1	See IN-1.1	See IN-1.1
	IN-8	Inspection Work Management Tools	Yes-Enabling Activity	Enabling	Costs allocated to IN-1.1 and 1.2
	IN-9	Transmission Conductor & Splice	Yes	0	Reduces ignition risk *(though no ignitions in historical dataset used to model RSE)*
Vegetation Management	VM-1	Hazard Tree Management Program	Yes	2,818	Reduces ignition risk
	VM-2	Expanded Pole Brushing	Yes	6,166	Reduces ignition risk
	VM-3	Expanded Clearances for Legacy Facilities	Yes	< 1	Reduces ignition risk
	VM-4	Dead and Dying Tree Removal	Yes	8,915	Reduces ignition risk
	VM-6	Vegetation Management Work Management Tool (Arbora)	Yes-Enabling Activity	Enabling	Costs allocated to VM-1, VM-4, and Expanded Line Clearing (N/A)
		CRCs and CCVs	Yes	1	Reduces PSPS risk
		Battery Backup for low-income			

Category	ID	Initiative / Activity	RSE Calculated (Rationale)	RSE[40]	Quantified Risk Reduction Benefits
Grid Operations & Protocols	PSPS-2	critical care / MBL customers	Yes	2	Reduces PSPS risk
		Rebates	Yes	4	Reduces PSPS risk
		211 Partnership	Yes	35	Reduces PSPS risk
Data Governance	DG-1	Wildfire Safety Data Mart (WiSDM)	Yes-Enabling Activity	Enabling	Costs allocated to SA-1, SA-10, SH-1, SH-2, SH-4, SH-5, SH-6, SH-8, SH-10, SH-13, SH-14, SH-15, SH-16, SH-17, IN-1.1, IN-1.2, IN-3, IN-4, VM-1, VM-2, VM-4, and Expanded Line Clearing (N/A)
		Data Management (Ezy)	Yes-Enabling Activity	Enabling	Costs allocated to SH-14, IN-1.1, IN-1.2, and IN-4
Emergency Planning & Preparedness	DEP-2	SCE Emergency ResponderTraining (IMT/ Field Training)	Yes	24	Reduces PSPS risk
		SCE Emergency ResponderTraining (UAS)	Yes	15	Reduces PSPS risk
Stakeholder Cooperation & Community Engagement	DEP-1.2	Customer Education and Engagement - Community Meetings	Yes-Enabling Activity	Enabling	Costs allocated to PSPS-2
	DEP-1.3	Customer Education and Engagement - Marketing Campaign	Yes-Enabling Activity	Enabling	Costs allocated to PSPS-2
	DEP-4	Customer Research and Education	No - Supports Enabling Activities	N/A	N/A
	DEP-5	Aerial Suppression	Yes	8,478	Reduces ignition risk

Category	ID	Initiative / Activity	RSE Calculated (Rationale)	RSE[40]	Quantified Risk Reduction Benefits
Alternative Technology	N/A	Asset Defect Detection Using Machine Learning Object Detection	No - Pilot Activity	N/A	N/A
		Alt Tech Evaluations – Distribution Open Phase Detection	No - Pilot Activity	N/A	N/A
		High Impedance (Hi-Z) Relay Evaluations	No - Pilot Activity	N/A	N/A
		Early Fault Detection (EFD) Evaluation	Yes	9,169	Reduces ignition risk
		Satellite and Other Imaging Technology for Fire Spotting	No - Pilot Activity	N/A	N/A
Other (Activities that are not enumerated initiatives)	N/A	Expanded Line Clearing	Yes	270	Reduces ignition risk

4.3.8.1 Response to SCE Action Statement, 2021 WMP Additional Issue to Address in 2022 WMP

The following is one of the Additional Issues as provided by OEIS in the Final Action Statement on SCE's 2021 WMP.[41]

> *"**Issue**: For Capability 41c of the 2021 maturity survey, SCE selected "RSE estimates are verified by historical or experimental pilot data and confirmed by independent experts or other utilities in CA" starting 2023. However, SCE does not detail who the independent experts or other utilities in CA are to verify the RSE estimations.*
> ***Remedy**: "SCE shall: 1) detail its RSE verification methodology, 2) specify who the independent experts and other utilities in California are, and 3) their roles in the RSE verification process."*

SCE's response to this Issue/Remedy is described below:

RSE estimates are a function of multiple components, including cost, useful life and mitigation effectiveness. As discussed in the OEIS RSE workshop on December 9, 2021, each component has a different level of data fidelity. For example, the cost component has the highest level of certainty followed by a mitigation's useful life, which can be informed by a manufacturer's claim, depreciation schedule, contractual terms or SME judgment. A mitigation's effectiveness has the highest level of uncertainty compared with the other two component and thus SCE interprets this action statement as focusing on a

[41] OEIS Report SCE WSD-020 Action Statement on SCE 2021 WMP Final, p. 91.

mitigation's effectiveness, which can be influenced by internal data where possible supplemented by external data/benchmarks and informed by SME judgment.

1) Detail its RSE verification methodology

Since mitigation effectiveness has the greatest level of uncertainty, SCE has identified ways and processes to minimize this uncertainty:

A) Conducting workshops with SMEs to assess and document mitigation effectiveness including reviewing historical data, testing and benchmarking studies. Ultimately, SCE will use the most comprehensive and data-informed methodology to calculate mitigation effectiveness, but also acknowledges that there are mitigation programs nascent in their maturity and may take time to collect historical data.

B) Calibrating the mitigation effectiveness values, at the risk driver or consequence level, among the different mitigations to drive towards a relative comparison

C) Conducting challenge sessions with SMEs and program managers to review inputs and assumptions and internal management to review RSE estimates and assumptions

D) Collaboration with other utilities to refine mitigation effectiveness assumptions (such as the Joint IOU Covered Conductor Effectiveness Working Group)

2) Specify who the independent experts and other utilities in California are and 3) roles in the verification process.

SCE is participating in two OEIS specific workshops which will help inform the mitigation effectiveness of two programs, Covered Conductor and Vegetation line clearing. Although the final product of these workshops is expected to be after the 2022 WMP, SCE will leverage the findings, if available, in the 2023 WMP. Please see Appendix 9.8 for the status of Working Group updates.

4.3.9 Resource Allocation and Prioritization Methodology

SCE has advanced its ability to make data-driven, risk-informed decisions for prioritizing wildfire mitigation activities since the 2021 WMP that aligns with our RAMP methodology. SCE described above how both POI and consequence calculations improved. These continued refinements to the WRRM are being used to make risk- informed decisions for both existing in-flight WMP activities as well as for new entrants and emergent issues.

At the portfolio level, the model is used by comparing the RSE across the programs to understand the relative amount of risk buy down per dollar. This information is considered along with operational feasibilities and other factors to set the program levels. This also allows us to plan for resource needs as the model can forecast risk reduction after planned mitigations are completed thereby changing the future risk profile across programs.

At the program level, the WRRM is very flexible in that it can be used to calculate the risk (e.g., Wildfire or PSPS risk) that is most applicable to the individual WMP activity. For example, an activity such as the installation of covered conductor that mitigates both wildfire and PSPS risks can use the full WRRM risk score for prioritizations. Whereas an activity such as the replacement of C-Hooks, which mitigates wildfire only and does not affect PSPS thresholds, can use the wildfire component of the risk score to prioritize C-Hook replacement.

The WRRM can also be used to prioritize activities at the individual driver level. For example, vegetation activities like hazard tree removals can be prioritized using only the POI of a vegetation contact which can be isolated in the WRRM's CFO models within the wildfire component. As the WRRM is now SCE's corporate standard model for calculating wildfire risk, all new programs will be evaluated and prioritized using this model where applicable.

SCE is considering methods to optimize across multiple mitigations at a specific location (i.e., structure level). However, executing wildfire mitigation work in that manner is not practical for certain mitigations as many are complimentary (e.g., vegetation management is required regardless of most system hardening for compliance, and installation of covered conductor includes replacement of other equipment such as poles, insulators, cross-arms, and fuses). Furthermore, it is not clear if the benefits of such granularity outweigh the costs of planning and executing wildfire mitigation in this manner. Thus, as SCE continues to develop its risk modeling optimization capabilities, it may be more constructive to optimize deployment of mitigations in different ways. For example, for a tree removal crew to remove the "riskiest" hazard tree in one region and then travel to another region to remove the next "riskiest" tree sharply reduces the pace of risk reduction for SCE and also increases the cost from the tree removal contractor due to the time elapsed between tree removals. However, determining the risk of each hazard tree in SCE's inventory, then prioritizing larger areas (i.e., region/district) with the highest hazard tree risk on average, and using that prioritization to remediate all identified hazard trees area by area may be more beneficial from a pace of risk-reduction and execution efficiency perspective (See Section 7.3.5 for more information on SCE's Tree Risk Index (TRI)).

In addition, SCE is exploring ways of reevaluating need and prioritization criteria for one mitigation activity once another mitigation has been implemented (e.g., need for expanded trims once covered conductor has been installed or changes to PSPS de-energization thresholds as more system hardening is completed). This type of sequential evaluation of mitigation deployment inherently provides optimization across multiple mitigations while still helping ensure the most effective mitigations are being deployed to reduce the greatest amount of risk in the shortest amount of time. SCE is planning to implement PSPS cross-mitigation changes in the near-term, and broader cross-mitigation by 2023. As SCE's asset management capability progresses, we hope to assess tradeoffs not just among wildfire mitigation activities, but also across all risks (e.g., reliability or public safety in addition to wildfire ignition).
For additional information on how SCE uses risk analysis to inform its risk-informed decision-making process, please see Section 7.1.2.

4.3.10 Future improvements to the WRRM

In addition to a full refresh the inputs into its ML and fire propagation models with the latest available data, SCE intends to focus its WRRM improvements to a few key areas in 2022. These include:

Updated Mitigation Effectiveness Values – SCE intends to conduct additional studies to reduce uncertainty and improve fidelity of values used to quantify mitigation effectiveness and improve confidence in RSE calculations. SCE ultimately intends to build a more statistically robust mitigation effectiveness quantification that allows for a more sophisticated statistical understanding of the various mitigations' interaction with risk values in order to combine subject matter expertise with observed effectiveness. SCE also looks forward to additional workshops as part of Energy Safety's RSE working group (see Section 9.8) in pursuit of cross-utility collaboration, expert input, and transparency.

Research and develop continuous improvement opportunities to enrich SCE's asset management predictive models. This includes but is not limited to the exploratory analysis and data engineering of new data sets such as SCE's planned vegetation remote sensing initiatives (see Section 7.3.5) and inspection data from HFRI. Opportunities to improve temporal granularity will also be explored.

Integration with the new Severe Risk Area framework – The Severe Risk Area framework developed jointly by Technosylva and SCE to better represent a risk not fully captured by ignition propagation models, such as those with egress concerns, and/or subject to frequently high wind and dry fuel conditions. SCE intends to leverage this framework to guide the evaluation and deployment of enhanced mitigations supplementing covered conductor, including alternative grid hardening measures, or targeted undergrounding where feasible (See Section 7.1.2.1 for additional information).

Addition of Forward-Looking Climate Change Scenarios – Climate change represents is a primary driver of a range of underlying factors that affect wildfire initiation, spread, and intensity; these, in turn, affect wildfire consequences. To account for a wide range of historical weather scenarios, SCE currently incorporates 444 weather scenarios across a 20-year historical climatology.

By using a wide range of models, SCE can determine the relative risk of wildfire consequence for each location under the maximum likely weather conditions, based on a historic climatology for any given location. By using a wide range of models, SCE can determine the relative risk of wildfire consequence for each location under the maximum likely weather conditions, based on a historic climatology for any given location. In 2022, SCE is developing a probabilistic view of future weather and fuel conditions to better understand how the climate change may exacerbate existing wildfire risk both spatially as well as consequentially.

4.4 RESEARCH PROPOSALS AND FINDINGS

Report all utility-sponsored research proposals, findings from ongoing studies and findings from studies completed in 2020 and 2021 relevant to wildfire and PSPS mitigations.

SCE's Research Strategy

SCE actively pursues and collaborates on various research topics for different issues related to wildfire mitigation including root weather causes, ignition sources, emergency responders, consequence of wildfires, customer impacts, etc. The goals of the research include integrating industry into partnership-based research programs, designing specific measurement tools in-house, identifying innovative solutions and resolving critical industry problems.

Additionally, SCE directly supports the research community by providing in-kind services, financial commitments, and letters of recommendation. SCE's parent company also supports the research community through its philanthropic efforts and grant funding. Specifically, philanthropic grants support nonprofits that facilitate convenings among a diverse range of partners and develop networks for an open exchange of information regarding the current science on climate change, fire recovery and vegetation management practices.

The research work SCE conducts and supports, can be divided into four research areas:

1. **Discovery** – SCE supports innovative research by accepting proposals (grants, letters of support requests), collaborating with universities on wildfire mitigation/fire safety, and on occasion requesting research studies on these topics.
2. **Capacity building** – SCE's parent company invests in developing researchers by providing philanthropic grants, providing scholarships to students in Science, Technology, Engineering & Math (STEM) field and fire technology/fire academies, funding resilience challenges and providing data, information, tools and resources to local government agencies and CBOs. SCE also promotes interdisciplinary collaboration and research in disadvantaged communities.
3. **Knowledge Transfer** – SCE actively disseminates findings from its research projects and policy recommendations through industry conferences and publishing the work in technical journals. This includes support for its funded researchers and the dissemination of their work through thesame channels.
4. **Partnerships** – SCE partners with universities, national labs, and research institutes to expand its reach across the industry. This includes providing matching funds or cost-sharing to support the partnership projects.

SCE evaluates its research opportunities to ensure they reflect both ongoing and emerging questions of priority around clean energy, wildfire mitigation and wildfire safety. The research areas listed above ensure the work we support is innovative, essential, and relevant to the industry.

The list below includes active and ongoing utility-sponsored research proposals and initiatives supported, external collaborations, and completed internal studies. The list below does not include SCE's AFN research study that was performed in 2021 and aims to gather qualitative feedback on the AFN customer experience. Details of this planned AFN study can be found in Section 8.4. Engaging Vulnerable Communities.

4.4.1 Research Proposals

Report proposals for future utility-sponsored studies relevant to wildfire and PSPS mitigation. Organize proposals under the following structure:

1. *Purpose of research – brief summary of context and goals of research*
2. *Relevant terms - Definitions of relevant terms (e.g., defining "enhanced vegetation management"for research on enhanced vegetation management)*

3. *Data elements - Details of data elements used for analysis, including scope and granularity of data in time and location (i.e., date range, reporting frequency and spatial granularity for each data element, see example table below)*
4. *Methodology - Methodology for analysis, including list of analyses to perform; section must include statistical models, equations, etc. behind analyses*
5. *Timeline - Project timeline and reporting frequency to the Office of Energy Infrastructure Safety*

Example table reporting data elements

Data Element	*Collection period*	*Collection frequency*	*Spatial granularity*	*Temporal granularity*	*Comments*
Ignitions from contact with vegetation in non- enhanced vegetation areas	*2014 – 2021+ (ongoing)*	*Per ignition*	*Lat/long per ignition*	*Date, hour of ignition (estimated)*	
Ignitions from contact with vegetation in enhanced vegetation areas	*2019 – 2021+ (ongoing)*	*Per ignition*	*Lat/long per ignition*	*Date, hour of ignition (estimated)*	

<u>Utility-Sponsored Studies</u>

Effectiveness of Enhanced Vegetation Clearances Study

1) Purpose of research: SCE continues to conduct a study to evaluate the effectiveness of implementing the recommended clearances between vegetation and live conductor provided for in GO 95 Rule 35, Appendix.[E5] The objectives of this study are to establish uniform data collection standards, create a cross-utility database of tree-caused risk events (e.g., outages and ignitions caused by vegetation contact), incorporate biotic and abiotic factors into the determination of outage and ignition risk caused by vegetation contact, and assess the effectiveness of enhanced clearances.
2) Relevant terms:

   Enhanced Clearances: Trees in Distribution HFRA that are trimmed to an enhanced clearance distance of at least 12 feet as recommended by GO 95, Rule 35, Appendix.[E5]

   Tree-Caused Circuit Interruptions (TCCIs): events during which trees, or portions of trees, have contacted electrical equipment and caused circuit interruptions. TCCIs can result from vegetation that has fallen-in, blown-in, or grown-in.

3) Vegetation-Caused Ignition Events: events where a determination was made that the ignition was caused by vegetation. Data elements: (see
4) Table SCE 4-12)

Table SCE 4-12

TCCI Reporting Data Elements

Data Element	Collection period	Collection frequency	Spatial granularity	Temporal granularity	Comments
Global Positioning System (GPS) coordinates of TCCI's and Vegetation Caused Ignition Events	2014 - ongoing	Monthly	Specific latitude-longitude	Date of TCCI or ignition Event	Where data is available

5) Methodology: Data collection and comparison. For more details, see SCE's response to Action SCE-16 in response to Remedial Compliance Plan (RCP) SCE-12.
6) Timeline: December 2019 – approximately fourth quarter 2024; updates provided in SCE's annual report, as applicable.

University of California, Los Angeles (UCLA) Luskin Center for Innovation's Microgrid Study

1) Purpose of research: SCE is sponsoring and serving as a technical lead for microgrid study with the UCLA Luskin Center for Innovation to produce a report that develops a performance evaluation for microgrids to be used to inform microgrid siting decisions that maximize resiliency, equity, and grid service benefits for California communities. Insights may include how we should design and deploy microgrids to support PSPS events, with an emphasis on focusing the benefits of microgrids to customers where resiliency improvements are most critically needed.
2) Relevant terms:

   Microgrid: In this report, UCLA uses the definition detailed in Senate Bill (SB 1339[E6]) and used in the related CPUC proceedings: "an interconnected system of loads and energy resources, including, but not limited to, distributed energy resources (DER), energy storage, demand response tools, or other management, forecasting, and analytical tools, appropriately sized to meet customer needs, within a clearly defined electrical boundary that can act as a single, controllable entity, and can connect to, disconnect from, or run in parallel with, larger portions of the electrical grid, or can be managed and isolated to withstand larger disturbances and maintain electrical supply to connected critical infrastructure."

   Resiliency: The potential to serve uninterrupted loads, or minimize interruptions, to their customers during unplanned outages

   Equity: The equitable distribution of the costs and benefits of microgrids including improved reliability of electrical service, reduced pollution, reduced relative costs of service, and improved workforce participation for priority customers.

   Grid services: A set of products that ensure the electrical grid's reliability in order to continually provide electricity to customers at all times of day, traditionally, the resources and products that serve to maintain critical grid reliability and stability.

3) Data elements (see Table SCE 4-13): 1) data on existing microgrids - UCLA is gathering data on existing microgrids to measure the extent to which they currently provide resiliency, equity, and grid service benefits to California communities – specific data elements will be shared in the final report and 2) literature - UCLA is examining existing literature to inform the development of a microgrid performance evaluation.

Table SCE 4-13

Microgrid Reporting Data Elements

Data Element	Collection period	Collection frequency	Spatial granularity	Temporal granularity	Comments
Existing Microgrids in California	2020	Once	City	Date of installation	Data on existing microgrids was gathered to evaluate their resiliency, equity, and grid service benefits to date and to identify gaps in available data
Relevant literature	2014 through 2021+ (ongoing)	Throughout study	Varies by study	Varies by study	Existing academic journal articles, state agency reports, and other relevant literature were gathered to inform the development of a microgrid performance evaluation framework

4) Methodology: Literature review, supplemented by data on existing microgrids
5) Timeline: December 2019 – January 2023; previously April 2021, however research team is still collecting data and securing industry feedback before publishing; updates provided in SCE's annual report, as applicable.

Electric Power Research Institute (EPRI) study on "Fuel Removal Assessment for Wildfire Management"

1) Purpose of research: SCE is sponsoring this study to establish a baseline for SCE fuel removal practices in our service area within the jurisdiction of the USFS, with a target review of new research and technologies that provide promise in reducing wildfire impacts, risks, and associated costs. The learnings from the study can inform both near-term and long-term opportunities such as guidance for forestry methods for removal, and long-term goals for rights-of-way (ROWs) in consideration of the CA/USFS Shared Stewardship Memo of Understanding.
2) Relevant terms:
Fuel reduction; Fuel removal; wildfire risk; climate adaptation and resilience; integrated vegetation management (IVM); fuel removal costs and benefits; current practices; ecosystem support; fire risk reduction; right-of-way vegetation management; risk management; other terms as determined necessary.
3) Data elements:
GIS data layers of interest include: SCE service area; SCE facilities, transmission lines; SCE wildfire risk model/data; U.S. Energy Information Administration (EIA) data on location of other electric company infrastructure; USFS Forest boundaries; Protected areas data

layer; California HFRA; Data on dead/dying trees; beetle infestation data; Costs of fuel removal; Labor and Capital costs of fuel management; other data sources as determined necessary.

4) Methodology: The approach of this project is intended to examine current SCE (and USFS) fuel removal activities (e.g. encompassing SCE or USFS policy or strategy, management practices, priority areas, data and models used) and new technologies and methodologies identified in the literature. Thus, the research is intended to undertake both a desk review of SCE and USFS documents and sources related to fuel removal as well as a targeted review of new technologies and methodologies. Establishing a “baseline” of current practice may also include a high-level review of the data and models (GIS and other) used by SCE and USFS. Expertise and best practices of key wildfire stakeholders is expected to also be tapped through outreach to USFS and other key stakeholders identified by SCE. The literature review is intended to identify opportunities and best practices for reducing risk, damages, and costs with new technologies and methodologies, and is expected to highlight utility-relevant examples. An opportunity analysis is intended to lay out opportunities, best practices, and practical considerations as options for SCE management to consider. Practical considerations from the regulated utility perspective may include: debris management options, herbicide treatments, IVM practices, and technical modeling recommendations.
5) Timeline: Started December 2020, with an anticipated completion date first quarter 2022.

San Jose State University’s (SJSU) Wind Profiler Project

1) Purpose of research: SCE continues to support a pilot project to help understand the nature and behavior of wind speeds above ground level in areas where weather modeling efforts are challenged due to complex terrain issues. The main goal is to develop a state-of-art vertical wind profiling monitoring program in critical wind corridors where strong downslope winds can have large impacts on utility operations and fire danger risk.
2) Relevant terms:
   Wind Profiling: Vertical view of wind speeds and direction
   Light Detection and Ranging Technology (LiDAR): A remote sensing method that uses light in the form of a pulsed laser to measure ranges to the Earth.
3) Data elements: See Table SCE 4-14

Table SCE 4-14

Wind Profiler Project Data Elements

Data Element	Collection Period	Collection Frequency	Spatial granularity	Temporal granularity	Comments
Wind speeds directly above LiDAR unit or at set angle (e.g., 45 degrees)	24-48 hours	After each event	3m resolution between 30 m and 3,000 m above ground level	Instantaneous	

4) Methodology: When deployments end, all data will be uploaded to SJSU servers for storage and data processing which will take place at SJSU. Data processing includes time-height wind vector analysis to show evolution of vertical wind profiles. Vertical velocities will be analyzed as well as backscatter intensity to determine performance of LiDAR system
5) Timeline: Multiple deployment on an ad-hoc bases over the period of one year; updates provided in SCE's annual report, as applicable.

See Section 7.3.2 for additional information on this project.

University of Colorado Boulder Vegetation Build-Up Index

1) Purpose of research: Previously called the University of Colorado Boulder Vegetation Regrowth Model, this study is now referred to as the Vegetation Build-Up Index, which is a heat map showing the approximate areas where the dynamic combustibility of fuels is greatest, through the consideration of vegetation moisture, type, and amount as well as taking into account the long-term climatological affects upon the vegetation. This product will use remote sensing data that is publicly available to allow for an objective, quantifiable process to inform where and when to perform inspections and if any potential remediations should be accelerated. This product will provide SCE with the ability to see changes in the service area on a quarterly basis, by processing frequently updated imagery into vegetation indexes specifically designed for SCE service area to monitor the health of the environment, which assists with restoration efforts in areas affected by fires/natural events.

2) Relevant terms:

   Vegetation Moisture: The amount of moisture (expressed as a percentage) that is in both living and dead vegetation.

   Fuel Continuity: The degree of continuous vegetation over a given surface.

   Fuel Loading: The amount of vegetation across a given area expressed in tons/acre.

   LiDAR: A remote sensing method that uses light in the form of a pulsed laser to measure ranges to the Earth.

3) Data elements: See Table SCE 4-15.

Table SCE 4-15

Vegetation Build-Up Index Data Elements

Data Element	Collection Period	Collection Frequency	Spatial granularity	Temporal granularity	Comments
Fuels Regrowth	Various	Various	1 kilometer	Quarterly	In the 2021 WMP we noted that data collected, and frequency has not been determined. We have since decided to review data sets quarterly. There will be different datasets whichwill be updated at different intervals.

4) Methodology: Extensive research will be performed by Earth Lab at the University of Colorado in Boulder to determine best practices and processes for developing such remote sensing applications. Methodology will incorporate variability and uncertainty in all applicable algorithms to provide probabilistic products.
5) Timeline: SCE anticipates it will take two years to develop and operationalize; updates provided in SCE'sannual report, as applicable.

Cal Poly San Luis Obispo's Wildland Urban Interface Fire Information Research and Education Institute (WUI FIRE Institute)

1) Purpose of research: SCE continues to co-fund and serve as a technical lead for the WUI FIRE Institute to address research needs in several wildfire risk areas that generally fall outside traditional utility business scope such as fuels sampling/management, forest/vegetation management, land policy, infrastructure hardening (property hardening, building codes etc.), fire suppression/long duration fire retardants, and early fire detection. This aligns with the WUI FIRE institute's five pillars in Climate and Forests, Resilient Buildings, Community Survivability, Land Use Planning and Policy, and Workforce Education.

   The WUI FIRE Institute held a remote symposium at the end of 2021 to introduce the on-going research at the university to a wide range of industry stakeholders. The institute continues to develop and launch an external advisory council, to include stakeholders beyond the IOUs, with an in-person symposia planned in 2022. As part of the newly formed external advisory council, the institute and IOUs have identified an initial research topic to understand the impacts of catastrophic wildfire events in terms of greenhouse gas emissions, loss of wildfire, habitat change, land use, and societal impacts. As WMP activities may require California Environmental Quality Act (CEQA) studies, that adds additional costs and risk to hardening activities, CEQA exemptions may be advisable in some scenarios such as access road expansions, vegetation, and fuel management. The impacts of wildfire risk would be compared against the impact of a CEQA exemption via a case study to provide justification of Statuary Emergency Exemption.

SCE continues to work with WUI FIRE Institute to identify additional risk reduction opportunities such as supporting new wildfire risk and vegetation management education and workforce opportunities.

2) Relevant terms:

California Environmental Quality Act (CEQA): A California law that requires public agencies and local governments to evaluate and disclose the environmental impacts of development projects or other major land use decisions, and to limit or avoid those impacts to the extent feasible

CEQA Categorical Exemptions (Cat Exes): Categorical exemptions are made up of classes of projects that generally are considered not to have potential impacts on the environment. Categorical exemptions are identified by the State Resources Agency and are defined in the CEQA Guidelines (14 California Code of Regulations (CCR) Section 15300-15331).

Statutory Emergency Exemption: The California Legislature has the power to create exemptions from the requirements of CEQA, and projects which fall under such exemptions can be made wholly or partially exempt, as determined by the Legislature.

3) Data elements: See Table SCE 4-16.

Table SCE 4-16

WUI Fire Institute Data Elements

Data Element	Collection Period	Collection Frequency	Spatial granularity	Temporal granularity	Comments
Relevant literature	2022 to 2023	Throughout the life of the study	Statewide	Based on study	Data collected and frequency is still being determined. There will likely be different data sets based on the relevant literature

4) Methodology: Cal Poly's WUI FIRE Institute goal is to be the Center of Excellence that uses a multi- discipline, systems-based approach that focuses on education and research factors influencing WUI fire.

5) Timeline: January 2021 – December 2023; updates provided in SCE's annual reports, as applicable.

SJSU's Wildfire Interdisciplinary Research Center

1) Purpose of research: SCE is partnering with SJSU's Wildfire Interdisciplinary Research Center (WIRC) toconduct high-impact wildfire research so that improved tools and policies can be provided to community and industry stakeholders. The WIRC mission is to develop new prediction and observational tools to better understand extreme fire behavior in a changing climate. These new tools will help industry particularly the energy sector, manage assets during high fire danger periods. The outcomes of WIRC will be new knowledge, improved prediction tools, and community resilience policies. The center will also develop an integrated approach to solving the nation's wildfire problem by providing interdisciplinary solutions that span the physical, social, and economical scientific fields.

2) Relevant terms:

   Fire Behavior: The way fires ignite, burn, and propagate as a function of the interaction between fuels, weather, and topography.

   WUI: An area where building and infrastructure are in or adjacent to areas that are subject to wildfire activity.

3) Data elements: To be determined once specific projects are identified.
4) Methodology: To be determined once specific projects are identified.
5) Timeline: Ongoing

University of California, Santa Barbara Gridded Situational Awareness

1) Purpose of research: During PSPS events, meteorologists, fire scientists, and operations specialists require real-time situational awareness of weather conditions ongoing across the electric grid to aid decisions on potential circuit de-energizations, re-energizations, and in some cases air patrol. Currently, SCE has over 1,400 weather stations installed as aids in such decisions. However, weather stations do not offer complete area coverage which would provide a more complete infrastructure risk profile. This work will create a real-time gridded (raster) observations dataset to fill in these observation gaps that will help meteorologists and operations specialists make more informed de-energization and re-energization decisions. Additionally, the work will evaluate a new "nowcasting" tool designed by the USFS (Wind Ninja) that may have skill in very short-term prediction of wind that will aid meteorologists in refining period of concern, if necessary.
2) Relevant terms:
   Wind Ninja: A dynamical weather model designed to predict winds around wildfire in complex terrain at high spatial resolution.
3) Data elements: To be determined based on the research.
4) Methodology: This project will leverage SCE's weather station network along with public weather stations to derive a gridded (raster) observations dataset at high resolution. The method to do

the aggregation is part of the underlying research, but the result will be able to derive the grid in real time. Part two of the project will leverage the USFS Wind Ninja software to be evaluated against other short-term prediction models currently available.

5) Timeline: One-year project, tentatively January 2022 – December 2022.

Letters of Support and Commitment

As mentioned above, SCE supports the research community through our Letter of Support process.While these are not utility-sponsored, SCE is actively collaborating with organizations to support their wildfire research.

Through cost-share and technical advisory services, SCE is supporting the Mountain Communities Fire Safe Council's (MCFSC) project entitled, "San Jac Fuels Reduction Project." MCFSC was awarded a grant through the California Fire Safe Council 21 USFS-SFA Grant Program. Through this project SCE provides MCFSC quarterly summary information regarding its tree removal efforts under Resolution E-3824 (dead tree removals).

Starting January 2022, SCE will serve as a technical lead to the University of Nevada, Reno's research project titled, "Fighting Wildfires under Climate Change: A Data-Informed Physics-Based Computational Framework for Probabilistic Risk Assessment and Mitigation, and Emergency Response Management." The University was awarded a grant through the National Science Foundation (NSF). This project features three distinct and novel components that will be developed and implemented into practice to fill the present knowledge gaps and technical capabilities.

Through cost-share and technical advisory services, SCE continues to support the Gas Technology Institute's project entitled, "Advanced Energy-Efficient and Fire-Resistive Envelope Systems Utilizing Vacuum Insulation for New Mobile Homes." Gas Technology Institute (GTI) was awarded a grant through the California Energy Commission (CEC)'s Electric Program Investment Charge Program (EPIC) program. This project will develop and demonstrate all-electric, new mobile homes that can reduce energy bills and increase fire resilience of homes. The energy efficient homes will contain vacuum insulation panel, double/triple-pane glazing, fluid applied air barrier, low capacity ultra-efficient mini-split heat pumps, heat pump water heaters and all-electric appliances. At least one prototype home is planned to be in Loma Linda, a disadvantaged and low-income community in SCE's service area.

Customer Research

SCE conducts customer research to understand customer experiences, needs and behaviors as they relate to wildfire and PSPS activities and events. In 2021, SCE's Customer Insights team conducted various customer research projects that were required (i.e., mandated by the CPUC or as part of the 2021 Action Plan), or based on need by a SCE product/service team. Please see a summary of 2021 research findings below in Section 7.3.9 for additional details. The insights gleaned from customer research and the recommendations shared across the organization enables SCE to make enhancements to PSPS programs and services offered to our customers.

4.4.2 Research findings

Report findings from ongoing and completed studies relevant to wildfire and PSPS mitigation. Organize findings reports under the following structure:

Purpose of research – Brief summary of context and goals of research

Relevant terms – Definitions of relevant terms (e.g., defining "enhanced vegetation management" for research on enhanced vegetation management)

Data elements – Details of data elements used for analysis, including scope and granularity of data in time and location (i.e., date range, reporting frequency and spatial granularity for each data element, see example table above)

Methodology – Methodology for analysis, including list of analyses to perform; section must include statistical models, equations, etc. behind analyses

Timeline – Project timeline and reporting frequency to the Office of Energy Infrastructure Safety. Include any changes to timeline since last update

Results and discussion – Findings and discussion based on findings, highlighting new results and changes to conclusions since last update

Follow-up planned – Follow up research or action planned as a result of the research

External Collaborations

1. Purpose of Research: As described in its 2021 WMP, SCE continues to collaborate with Texas A&M on its DFA deployment to evaluate the technology performance on fault anticipation technology for potential future deployment. SCE will also continue to work closely with Texas A&M to provide information about SCE's system configuration/networks and to provide an on-going exchange of the field validations to optimize the DFA software algorithms – which will continue to improve through the 2020-2022 plan term as additional grid event data is collected.
2. Relevant Terms:

   Incipient Event – Pre-cursor event that may lead or develop into a fault or failure.CYME – Circuit modelling analysis software.

3. Data elements: See Table SCE 4-17

Table SCE 4-17

DFA Study Data Elements

Data Element	Collection period	Collection frequency	Spatial granularity	Temporal granularity	Comments
Event Notification	2020 –2022+ (ongoing)	Continuous	Circuit	Continuous	Event Notification leads to evaluation of the events
Fault Location	2020 –2022+ (ongoing)	On Event	Circuit	Continuous	Requires additional tools for analysis
Device Failure	2020 –2022+ (ongoing)	Continuous	Circuit	Continuous	Loss of Communications to device

4. Methodology: The DFA program priority will begin to focus on the identification and accuracy of reported latent incipient events. The grid events and electric system data captured by the DFA systems is evaluated in real-time on an on-going basis. Evaluation and review of the events will bemonitored and compared to defined success measures.
    a. Incipient Event Detection – DFA notifications including pre-event notification with sufficient duration allowing for preventive measures
    b. Event Location – Accuracy of the specific location
    c. Hardware Failure Rate – Monitor equipment failures
5. Timeline: Started in 2020 and is ongoing. Updates provided in SCE's annual reports, as applicable.
6. Results: DFA notifies SCE with approximately 50 events per month for evaluation. Weekly meetings are held with the Texas A&M to discuss selected events of interest. These events are used to inform Texas A&M and identify algorithm improvements to identify event categories and further SCE's analysis and identification of events. In 2021 SCE installed 130 DFA units to provide additional data points, bringing total units to 190.
7. Follow-up Planned: 2022 activities will focus on alerts provided by the 190 installed units. SCE will continue to collaborate with Texas A&M to evaluate events.

4.5 MODEL AND METRIC CALCULATION METHODOLOGIES

4.5.1 Additional models for ignition probability, wildfire and PSPS risk

Each utility is required to report details on the models and methodologies used to determine ignition probability, wildfire risk, and PSPS risk. This must include the following for each model – a list of all inputs, details of data elements used in the analysis, modeling assumptions and methodologies, input from Subject Matter Experts (SMEs), model verification and validation (e.g., equation(s), functions, algorithms or other validation studies), model uncertainty and accuracy, output (e.g., windspeed model) and applications of model in WMP (e.g., in selection of mitigations, decision-making).

The narrative for each model must be organized using the headings described below. A concise summary of the model(s) must be provided in the main body of the WMP in this section, with additional detail provided for each model in an appendix.

1. **Purpose of model –** Brief summary of context and goals of model
2. **Relevant terms –** Definitions of relevant terms (e.g., defining "enhanced vegetation management" for a model on vegetation-related ignitions)
3. **Data elements –** Details of data elements used for analysis. Including at minimum the following:
    a. Scope and granularity (or, resolution) of data in time and location (i.e., date range, spatial granularity for each data element, see example table above).
    b. Explain the frequency of data updates.
    c. Sources of data. Explain in detail measurement approaches.
    d. Explain in detail approaches used to verify data quality.
    e. Characteristics of the data (field definitions / schema, uncertainties, acquisition frequency).
    f. Describe any processes used to modify the data (such as adjusting vegetative fuel models for wildfire spread based on prior history and vegetation growth).
4. **Modeling assumptions and limitations** – Details of each modeling assumption, its technical basis, and the resulting limitations of the model.
5. **Modeling methodology** – Details of the modeling methodology. Including at minimum the following:
    a. Model equations and functions
    b. Any additional input from SME input
    c. Any statistical analysis or additional algorithms used to obtain output
    d. Details on the automation process for automated models.
6. **Model uncertainty** – Details of the uncertainty associated with the model. This must include uncertainty related to the fundamental formulation of the model as well as due to uncertainty in model input parameters.
7. **Model verification and validation** – Details of the efforts undertaken to verify and validate the model performance. Including at minimum the following:
    a. Documentation describing the verification basis of the model, demonstrating that the software is correctly solving the equations described in the technical approach.
    b. Documentation describing the validation basis of the model, demonstrating the extent to which model predictions agree with real-world observations.
8. **Modeling frequency –** Details on how often the model is run (for example, quarterly to support risk planning versus daily to support on-going risk assessments).
9. **Timeline for model development** – Model initiation and development progress over time. If updated in last WMP, provide update to changes since prior report.

10. **Application and results** – Explain where the model has been applied, how it has informed decisions, and any metrics or information on model accuracy and effectiveness collected in the prior year.

11. **Key improvements from working group** – For each model, describe changes which have been implemented as a result of wildfire risk modeling working group discussions. Provide a high-level summary of recommendations from the wildfire risk modeling working group.

For ease of review, SCE structured this Guideline in the Model Inventory table below in Table SCE 4-18.

Table SCE 4-18

Wildfire and PSPS Risk Model Inventory

Model	Section	Purpose of Model	Relevant Terms	Data elements	Sources of Data	Collection period	Modeling frequency	Spatial granularity	Temporal granularity	Data Quality and Verification	Data Characteristics	Data Modification	Modeling Assumptions and Limitations	Modeling Methodology	Timeline for Model Development	Application and Results	Model Uncertainty	Model Verification and Validation	Modeling Frequency	Key Improvements from Working Group
Weather Modeling (ADS)	7.3.2.6.1	The Next Generation Weather Modeling System (NGWMS) will provide an extensive upgrade to SCE's current in-house weather modeling capabilities and enhance SCE's ability to make more targeted PSPS decisions.	Single Deterministic Model: Outcome from a single iteration of a model Ensemble Forecasting: Outcome from multiple iterations of a model Machine Learning: The study of computer algorithms that improve automatically through experience. It is seen as a part of artificial intelligence.	Temperature	NCEP (National Center for Environmental Prediction) Course Resolution Weather Models, European Centre for Medium-range Weather Forecasts (ECWMF) global model.	2019 - present	Twice Daily	Varies by model. Granularity ranges 1KM x 1KM or 2KM x 2KM	Varies by model. Hourly, out to seven days maximum	Vendor provides verification prior to implementation of forecasts against observations.	Data is received twice per day from NCEP and ECMWF to run the ADS models.	N/A	Two assumptions: 1) the input data coming from NCEP and ECMWF is accurate. 2) Terrain resolution in the models is limited due to computational constraints. The impacts of both of these result in forecast uncertainties that are vetted by meteorologists.	Standard Weather and Research Forecasting (WRF) 4.0 model specs; See full description of model solver, physics, equations, and system architecture can be found at https://www2.mmm.ucar.edu/wrf/users/wrfv4.0/wrf_model.html	Expand machine learning modeling in 2022.	Operationalized ensemble forecasting and found it to be useful in determining circuits targeted for potential proactive de-energization. Conceptual machine learning models suggest there will be significant improvement in wind forecast accuracy at site-specific locations. Experimental 1 KM resolution output shows improvement over complex terrain.	Model uncertainties arise from the initial condition source, physics parameterization choices, and terrain resolution. Initial condition uncertainty arises because global observations systems are subject to random error and do not fully cover the planet (beyond the control of SCE). Physics parameterization uncertainty arises due to scientific unknowns (i.e. there are meteorological processes where there is no exact equation to describe them with 100% certainty). Terrain uncertainty is the result of computational constraints.	Verifying the basis of the model (a) is N/A as the model is vetted by the National Center for Atmospheric Research and the academic community. For (b) Weather Services verifies circuit-level forecasts against observations along each circuit after each season for select variables.	Twice Daily	N/A
				Relative Humidity	NCEP (National Center for Environmental Prediction) Course Resolution Weather Models, European Centre for Medium-range Weather Forecasts (ECWMF) global model.	2019 - present	Twice Daily	Varies by model. Granularity ranges 1KM x 1KM or 2KM x 2KM	Varies by model. Hourly, out to seven days maximum	Vendor provides verification prior to implementation of forecasts against observations.	Data is received twice per day from NCEP and ECMWF to run the ADS models.	N/A	Two assumptions: 1) the input data coming from NCEP and ECMWF is accurate. 2) Terrain resolution in the models is limited due to computational constraints. The impacts of both of these result in forecast uncertainties that are vetted by meteorologists.					Verifying the basis of the model (a) is N/A as the model is vetted by the National Center for Atmospheric Research and the academic community. For (b) Weather Services verifies circuit-level forecasts against observations along each circuit after each season for select variables.	Twice Daily	N/A
				Fuel Moisture	Moderate Resolution Imaging Spectroradiometer (MODIS)	2019 - present	Twice Daily	2KM x 2KM	Out to seven days maximum	Vendor provides verification prior to implementation of forecasts against observations.	Data is received twice per day by ADS.	N/A	The primary assumption is that estimations of fuel moisture are within a reasonable range of observed values.					Verifying the basis of the model (a) is done by ADS. For (b) Fire Sciences verifies circuit-level forecasts against observations along each circuit throughout the year.	Twice Daily	N/A
				Wind Speed	NCEP (National Center for Environmental Prediction) Course Resolution Weather Models, European Centre for Medium-range Weather Forecasts (ECWMF) global model.	2019 - present	Twice Daily	Varies by model. Granularity ranges 1KM x 1KM or 2KM x 2KM	Varies by model. Hourly, out to seven days maximum	Vendor provides verification prior to implementation of forecasts against observations.	Data is received twice per day from NCEP and ECMWF to run the ADS models.	N/A	Two assumptions: 1) the input data coming from NCEP and ECMWF is accurate. 2) Terrain resolution in the models is limited due to computational constraints. The impacts of both of these result in forecast uncertainties that are vetted by meteorologists					Verifying the basis of the model (a) is N/A as the model is vetted by the National Center for Atmospheric Research and the academic community. For (b) Weather Services verifies circuit-level forecasts against observations along each circuit after each season for select variables.	Twice Daily	N/A

Model	Section	Purpose of Model	Relevant Terms	Data elements	Sources of Data	Collection period	Modeling frequency	Spatial granularity	Temporal granularity	Data Quality and Verification	Data Characteristics	Data Modification	Modeling Assumptions and Limitations	Modeling Methodology	Timeline for Model Development	Application and Results	Model Uncertainty	Model Verification and Validation	Modeling Frequency	Key Improvements from Working Group
Firespread Modeling (FireCast /FireSim)	7.3.2.6.2	Provides risk and consequence information on projecting how a wildfire will impact a community. As a result, these applications can be used to identify where the greatest impacts will be during critical fire weather events which will help proactive de-energization decisions be more targeted, allowing fewer customers to be affected by PSPS.	Fire Modeling: A process where a series of inputs (weather, fuels, vegetation type, fuel loading, etc.) are used to calculate the spread and intensity of wildfires Fire Managers: SCE resources that have a liaison role during major wildfires supporting on-site IMTs	Wind Speed	ADS Data Set	2020 - present	Daily	1000 meters / 200 meters	Hourly	Vendor provides verification prior to implementation of forecasts against observations.	Data is received once per day from ADS.	N/A	The primary assumption is that the forecast data is accurate and that incorrect forecasts do not cascade down to technosylva models.	Uses standard Rothermel model for fire spread equations; Weather prediction model outputs for a 91-hour horizon provided daily as a continuous raster dataset. The surface fire model is the Rothermel model (1972) together with the modifications proposed by Albini (1976), and the required expansion to admit Burgan (2005) fuel types. This model provides a scalar expression of the fire front speed, the flame intensity and the flame length according to the moisture, the wind, the slope and the fuel. The model is based on the following semi-empiric formula to obtain the rate of spread (ROS) of the fire on the direction of maximum spread: • $ROS= I_R \xi (1+\Phi_w+ \Phi_s) / \rho_b \varepsilon Q_{ig}$ Were I_R is the reaction intensity of the fire, ξ the propagation flux ratio, ρ_b the oven dry bulk density, ε the effective heating number, and Q_{ig} the required heat of ignition. The parameters Φ_w and Φ_s are related to the wind and surface effect. For other spread directions the fire is assumed to evolve as an ellipse where the direction of the major axis is given by a weighted sum of the vectors Φ_w and Φ_s and where the eccentricity of the ellipse is defined by the wind speed. The crown fire model is based on Rothermel (1991) and Van Wagner (1977). It determines if the fire remains burning in the surface fuels or makes a transition to burning in crown fuels, and whether it spreads actively through the tree crowns or simply torches individual trees. The model assumes a threshold intensity for the surface fire to affect the lower canopy layer and make its transition to crown, and an extra threshold rate of spread of the crown fire to be	In 2020, SCE implemented both FireCast and FireSim. Licenses for both applications have been provided to SCE's Fire Scientist and Fire Meteorologist, and extensive training on the use of FireCast/FireSim has been provided by Technosylva. In 2021, SCE will Implement FireCast/FireSim consequence data into the PSPS decision-making during a test phase.	These applications can be used to identify where the greatest impacts (acres burned, populations impacted, buildings impacted, fatalities and injuries) will be during critical fire weather events which will help proactive de-energization decisions be more targeted, allowing fewer customers to be affected by PSPS. Beginning in summer 2020, FireSim was used to run simulations to understand fire potential for various wildfires. Output was sent out to fire managers for them to get a sense of where fire was heading and potential impacts to infrastructure. During the 2020 fire season, FireCast was used to understand potential impact to communities while making PSPS decisions for de-energizations.	Fire spread modeling is dependent on static fuel models as well as dynamic weather and fuel moisture inputs. The static fuel models are used to inform the fire spread model (Rothermel) as to the type of vegetation (timber, slash, grass, brush or a combination of any or all of these four types) and the fuel load (amount of fuel on the ground) to help determine rates of spread and fireline intensity. The dynamic weather and fuel moisture inputs are also used to determine rates of spread and flame length. There are times when the fuel model being used does not properly represent the actual fuels where the simulation is occurring so other models that better represent spread and intensity need to be substituted. Also, weather and fuel moisture parameters are subject to error due to inherit problems with atmospheric modeling such as model resolution and boundary layer physics. All of these inputs can create uncertainty in the fire spread modeling outputs.	Fire spread modeling applications are currently undergoing a subjective verification process which is mainly based on PSPS events. These events allow the user to gage the model's performance by examining the fire risk and consequence output in real-time and to compare the risk with other internal metrics to get a sense of model reliability and accuracy. Since this process is subjective and informal at this point in time, there is no formal verification documentation that we can provide.	The Wildfire Risk Reduction Model (WRRM) is run several times of year to account to updates to the application and/or inputs to the modeling such as the fuels layer. Fire simulations used for FireCast are run once daily to assess fire risk and also to generate a list of circuits meeting specific consequence criteria.	The WRRM application has been updated to reflect the use of a new fuels layer as well as to include new metrics such as the Fire Behavior Index. FireCast has been updated to reflect a multitude of new functionality which include new metrics such as the Fire Behavior Index.
				Humidity	ADS Data Set	2021 - present	Daily	1000 meters / 200 meters	Hourly	Vendor provides verification prior to implementation of forecasts against observations.	Data is received once per day from ADS.	N/A	The primary assumption is that the forecast data is accurate and that incorrect forecasts do not cascade down to technosylva models.							
				Fuel Moisture	ADS Data Set	2022 - present	Daily	1000 meters / 200 meters	Hourly	Vendor provides verification prior to implementation of forecasts against observations.	Data is received once per day from ADS.	N/A	The primary assumption is that the forecast data is accurate and that incorrect forecasts do not cascade down to technosylva models.							
				Fuel Type	LandFire 2016 with Technosylva Updates to Oct. 2020	2018 - present	Annual Updates	HFRA wide	Quarterly Updates	Vendor provides verification prior to implementation of forecasts against observations.	Data is updated once per quarter and when there are land disturbances	N/A	The assumption is that the fuel type is assigned correctly based on LiDAR and fuels mapping by Technosylva.							
				Fuel Loading	LandFire 2016 with Technosylva Updates to Oct. 2021	2019 - present	Annual Updates	HFRA wide	Quarterly Updates	Vendor provides verification prior to implementation of forecasts against observations.	Data is updated once per quarter and when there are land disturbances	N/A	The assumption is that the fuel loading is assigned correctly based on the fuel type classified for any specified area.							
				Population data	Microsoft building dataset with Technosylva updates	2018	Annual Updates	centroid of Invidia buildings	Updated Periodically	Vendor provides verification prior to implementation of forecasts against observations.	Data is updated periodically	N/A	The primary assumption is that the population data source is the most accurate and Technosylva updates the data appropriately.							
				Building / Structures	LandScan 2018	2018	Annual Updates	aggregated count every 90 meters	Updated Periodically	Vendor provides verification prior to implementation of forecasts against observations.	Data is updated periodically	N/A	The primary assumption is that the population data source is the most accurate and Technosylva updates the data appropriately.							

Model	Section	Purpose of Model	Relevant Terms	Data elements	Sources of Data	Collection period	Modeling frequency	Spatial granularity	Temporal granularity	Data Quality and Verification	Data Characteristics	Data Modification	Modeling Assumptions and Limitations	Modeling Methodology	Timeline for Model Development	Application and Results	Model Uncertainty	Model Verification and Validation	Modeling Frequency	Key Improvements from Working Group
														considered active. Under certain circumstances surface fire may affect the overstory turning into a crown fire. The initiation model used is based on (Van Wagner 1977;Scott and Reinhardt 2001). The main initiation criterion is based on the a critical fireline intensity of the surface fire given by: • I= (CBH(460+25.9FMC)/100) 3/2 Where CBH is the canopy base height and FMC is the canopy fuel moisture content. The ROS of the associated active crown fire is given by 3.34 (R10)40% where (R10)40% is the spread rate predicted with Rothermel's (1972) surface fire model using the fuel characteristics for FM 10 and midflame wind speed set at 40 percent of the 6.1-m wind speed (Rothermel 1991). Finally, the two dimensional evolution of the fire is computed as a discrete process of ignitions across a regularly spaced landscape grid through a "minimum arrival time" function (Finney 2002). Surface spotting is included and repeatable for simulations with the same inputs. The urban encroachment model also uses an advanced method to encroach fire spread into urban areas using a combination of building density and surrounding fuel loads to determine the decay rate for encroachment. This approach ensures that buildings and population are more accurately captured to calculate impacts. CAL FIRE Damage Inspection (DINS) data is used to calibrate the decay rates based on historical fire impacts. DINS is the data collected by CAL FIRE post fire identifying the impacts to structures.						

Model	Section	Purpose of Model	Relevant Terms	Data elements	Sources of Data	Collection period	Modeling frequency	Spatial granularity	Temporal granularity	Data Quality and Verification	Data Characteristics	Data Modification	Modeling Assumptions and Limitations	Modeling Methodology	Timeline for Model Development	Application and Results	Model Uncertainty	Model Verification and Validation	Modeling Frequency	Key Improvements from Working Group
Fire Potential Index (FPI)	7.3.2.4.1	Better assess fire potential across SCE service territory	Wind speed: Wind velocity 20 feet above the surface Dew Point Depression: Difference between the air temperature and the dew point temperature at two meters above ground level Fuel Moisture: Water content within the dead and living vegetation Green-up of annual grasses: Uses the Normalized Difference Vegetation Index (NDVI) to access the level of grass green-up	Wind Speed	ADS Modeling Output	2019 - present	Twice Daily	Varies by model. Granuarity ranges 1KM x 1KM or 2KM x 2KM	Varies by model. Hourly, out to seven days maximum	Vendor provides verification prior to implementation of forecasts against observations.	Data is received twice per day from NCEP and ECMWF to run the ADS models.	N/A	Two assumptions: 1) the input data coming from NCEP and ECMWF is accurate. 2) Terrain resolution in the models is limited due to computational constraints. The impacts of both of these result in forecast uncertainties that are vetted by meteorologists.	FPI = (DL)/LFM + G) * FLM + Wx Where DL is dryness level which consists of dead fuel moisture. LFM is Live Fuel Moisture. G is green-up of the annual grasses. FLM is a fuel loading modifier which takes into account amount of vegetation on the ground. Wx is the weather component consisting of wind speed and dew point depression.;	In 2021 SCE will develop, test and evaluate FPI 2.0, which is an advancement over the current FPI	Built FPI 2.0 and performed initial verification using logistic modeling techniques	The uncertainty associated with the current FPI is due to the inherent error in the various weather and fuel inputs and also due to limitations of the model. These limitations include: 1) all three components (weather, fuels, and green-up) are essentially weighted the same, and 2) the wind speed input is capped at 29 mph which limits the index's ability to account for wind events stronger than that.	Fire science has documented the calibration of the FPI which includes the relationship that FPI has with historical fire activity.	Daily to support on-going fire threat assessments	FPI 2.0 has been developed which addresses the limitations of the current FPI model.
				Dew Point Depression	ADS Modeling Output	2020 - present	Twice Daily	Varies by model. Granuarity ranges 1KM x 1KM or 2KM x 2KM	Varies by model. Hourly, out to seven days maximum	Vendor provides verification prior to implementation of forecasts against observations.	Data is received twice per day from NCEP and ECMWF to run the ADS models.	N/A	Two assumptions: 1) the input data coming from NCEP and ECMWF is accurate. 2) Terrain resolution in the models is limited due to computational constraints. The impacts of both of these result in forecast uncertainties that are vetted by meteorologists.							
				Dead Fuel Moisture	ADS Modeling Output	2021 - present	Twice Daily	2KM x 2KM	Hourly, out to seven days maximum	Vendor provides verification prior to implementation of forecasts against observations.	Data is received twice per day by ADS.	N/A	The primary assumption is that estimations of fuel moisture are within a reasonable range of observed values.							
				Live Fuel Moisture	ADS Modeling Output	2022 - present	Twice Daily	2KM x 2KM	Hourly, out to seven days maximum	Vendor provides verification prior to implementation of forecasts against observations.	Data is received twice per day by ADS.	N/A	The primary assumption is that estimations of fuel moisture are within a reasonable range of observed values.							
				Green-up of annual grasses	ADS Modeling Output	2023 - present	Twice Daily	2KM x 2KM	Hourly, out to seven days maximum	Vendor provides verification prior to implementation of forecasts against observations.	Data is received twice per day by ADS.	N/A	The primary assumption is that estimations of fuel moisture are within a reasonable range of observed values.							

Model	Section	Purpose of Model	Relevant Terms	Data elements	Sources of Data	Collection period	Modeling frequency	Spatial granularity	Temporal granularity	Data Quality and Verification	Data Characteristics	Data Modification	Modeling Assumptions and Limitations	Modeling Methodology	Timeline for Model Development	Application and Results	Model Uncertainty	Model Verification and Validation	Modeling Frequency	Key Improvements from Working Group
POI - Component of WRRM	4.3.5	Quantify the POI at asset level which will then be used in the overall risk quantifications	POI: Probability of Ignition Risk=POI*Consequence of Fire	Historical Failure Data	ODRM	2015-2020+	Per outage	Structure/Circuit	Annual Updates	outage data were verified by grid-ops analyst before entering the system	Outage type, date time, locations etc.	N/A	For each machine learning, the best algorithm is selected based on the model train/test performances, which can be measured by area under the curve (AUC), which indicates the model's accuracy, and other types of accuracy measurements	SCE utilizes machine learning to identify patterns that may lead to faults that may cause sparks from conductors and equipment and use the trained model to predict the POIs at asset level. SCE has modeled EFF (Equipment and Facility Failures) and CFO (Contact Foreign Objects) at sub-driver level to better help risk-informed decisions	Model was developed over time. In 2019 and 2020, SCE developed models for distribution assets; towards the end of 2020, SCE has completed the modeling of transmission and sub-transmission systems	With the POI model and consequence models, SCE is able to quantify the wildfire related risks at asset and segment level, which enables more granular and targeted mitigations to better target locations with greater fire risks to better serve its customers	Most of the SCE predictive models are developed using tree-based ensemble models. One of the advantages of ensemble models is that it leverages the results from different ensembled models to minimize model uncertainty.	The models are measured by AUC of the tree based classification models. Also, SCE continues to improve model accuracy and reduce model uncertainty by improving the data quality.	Models are refreshed bi-annually	The data and modeling approaches will be more aligned with all other IOUs with the on-going working groups discussions
				Conductor Data	GE Smallworld	Continuous	Continuous	Segment	Annual Updates	conductor data is constantly being updated through operations and field verifications	attributes related to SCE conductors such as size, material, loading etc.	N/A								
				Circuit Connectivity	GE Smallworld	Continuous	Continuous	Circuit/Segment	Annual Updates	Circuit connectivity reflects the circuit configurations and constantly monitored/ updated by grid-ops	Circuit connectivity (network connections)	N/A								
				Asset Data	SAP	Continuous	Continuous	Equipment /Segment	Annual Updates	Asset data has been validated and updated through inspections and other programs	Equipment type, age, manufacture etc.	N/A								
				Historical Weather Data	ADS Modeling Output	2009-2020	Ongoing	2KM x 2KM	Hourly	data is validated against actual weather station observations	wind/temperature/ dew point and other measurement	N/A								
				Routine Tree Data	Fulcrum	Continuous	Continuous	Lat/Long	Annual Updates	data is validated by QC and field verifications	Tree type, location, count	N/A								
				Hazard Tree Data	Fulcrum	Continuous	Continuous	Lat/Long	Annual Updates	data is validated by QC and field verifications	Tree type, location, count	N/A								

Model	Section	Purpose of Model	Relevant Terms	Data elements	Sources of Data	Collection period	Modeling frequency	Spatial granularity	Temporal granularity	Data Quality and Verification	Data Characteristics	Data Modification	Modeling Assumptions and Limitations	Modeling Methodology	Timeline for Model Development	Application and Results	Model Uncertainty	Model Verification and Validation	Modeling Frequency	Key Improvements from Working Group
Consequence - Component of WRRM	4.3.6	Use match drop simulations based on historical weather data to model fire consequences at each asset locations. Technosylva provided the last wildfire consequences through its WRRM in 2020. SCE replaced Reax Consequence Modeling to Technosylva Consequence Modeling	Risk=POI*Consequence of Fire	Surface Fuels	LandFire 2016 with Technosylva Updates to Oct. 2020	2016 - Oct. 2021	Annual Updates	HFRA wide	Annual Updates			N/A	Simulations were performed based a set of historical weathers scenarios, need to add in climate impacts to reflect future looking consequences	Technosylva conducts millions of fire simulations based on a set of historical weather scenarios to derive consequence outputs for each Overhead (OH) distribution and transmission line asset, and each FLOC. The analysis used a predefined set of weather scenarios, reflecting the most common worst conditions for fires historically, and runs multiple simulations for each asset (for each scenario. Fire spread predictions are conducted using different weather scenarios to derive baseline risk metrics for each asset. The spread predictions assume a uniform ignition probability for each asset.	Reax Engineering developed wildfire consequences in early 2019 and SCE has been using the Reax scores in conjunction with its POI models to make risk-informed decisions. In 2020, Technosylva completed the fire risk consequence modeling which provides better wildfire consequence results with updated data and enhanced fire propagation engines. SCE has now transitioned from using Reax to using Technosylva consequence scores	The consequence of fire data was developed by Technosylva and verified independently by SCE. It's being used to quantify the potential fire impacts that were caused by SCE lines and equipment. The consequence of fire data is used in SCE's WRRMs to quantify fire risk in conjunction with the model output from the POI models.	Model uncertainty is addressed by running millions of simulations and provide results with different measurements including mean/max etc.	Model results are validated by comparing to historical fire propagation and impacts. Also, SCE performs QA/QC with the Technosylva WRRM data by validating the model input and output data. at the same time, SCE validates the model output by comparing and benchmarking with previous model outputs.	Twice a year to capture the fuel updates and latest burn scars	The data and modeling approaches will be more aligned with all other IOUs with the on-going working groups discussions
				Canopy Fuels	LANDFIRE 2016 canopy fuels	2017 - Oct. 2021	Annual Updates	HFRA wide	Annual Updates			N/A								
				Weather Data	ADS Modeling Output	444 Fire Weather Days from 2001-2020	2000-2020	2KM x 2KM	Hourly	data is validated against actual weather station observations	wind/temperature/ dew point and other measurement	N/A								
				Live/Dead Fuel Moisture Data	LFM/DFM models developed by ADS	444 Fire Weather Days from 2001-2020	2000-2020	2KM x 2KM	Hourly		Live/Dead Fuel Moisture	N/A								
				Building/Structure Data	Microsoft building dataset with Technosylva updates	2018	Annual Updates	centroid of Invidia buildings	Annual Updates	census data	Building/structure locations	N/A								
				Population Data	LandScan 2018	2018	Annual Updates	90 meters	Annual Updates	census data	population based on census track	N/A								
				SCE Assets	SCE Asset Databases	Ongoing	Annual Updates	Lat/Long	Annual Updates	Asset data has been validated and updated through inspections and other programs	Equipment type, location, POI	N/A								
PSPS Risk Model	4.3.4	PSPS is calculated as a risk instead of mitigations which include safety, financial and reliability using SCE's MARS2.0 risk framework	MARS: Multi-attribute risk score which provides a risk framework that combines safety, financial and reliability impacts into one unitless score	PSPS Frequency	ADS Modeling Output	2009-2020	Twice Daily	2KM x 2KM	Hourly		wind/gust speed and FPI	N/A	Model assumes PSPS would be operated based on SCE's recent PSPS operation protocols	SCE runs backcasting using ADS historical weather data to backcast PSPS events and evaluates frequency and duration of events at circuit level. MARS 2.0 risk framework is then applied to quantify the PSPS risks associated with the expected PSPS events based on the current operation protocol	The PSPS risk was added in 2020 for future WMP submittals and update in order to quantify PSPS as a risk element on top of wildfire risks	The PSPS risk was added in 2020 for future WMP submittals and update in order to quantify PSPS as a risk element on top of wildfire risks, which allows SCE to quantify risk related to PSPS events hence evaluate the RSE values including PSPS risks	Model uncertainty is addressed by using 10-year historical weather data and using the average frequency and duration of the PSPS	Model is validated by comparing to SCE's latest PSPS operation experiences	Annually for RSE calculations	The data and modeling approaches will be more aligned with all other IOUs with the on-going working groups discussions
				PSPS Duration	ADS Modeling Output	2009-2020	Twice Daily	2KM x 2KM	Hourly		wind/gust speed and FPI	N/A								
				Customer impacted	SCE Circuit and Customer Data	2021	Ongoing	service accounts	annually	Data is provided through SCE circuit connectivity	customers connected to circuit	N/A								

Model	Section	Purpose of Model	Relevant Terms	Data elements	Sources of Data	Collection period	Modeling frequency	Spatial granularity	Temporal granularity	Data Quality and Verification	Data Characteristics	Data Modification	Modeling Assumptions and Limitations	Modeling Methodology	Timeline for Model Development	Application and Results	Model Uncertainty	Model Verification and Validation	Modeling Frequency	Key Improvements from Working Group
Hazard Tree Risk Calculator	7.3.5.16.1	Individual tree risk assessment tool to document tree defects and likelihood of failure and target impact. A risk score is derived from Tree Defects (crown & branches, trunk, and root & root collar) and Site Conditions (i.e., history of failure, topography, site changes, soil conditions, common weather patterns).	High Fire Risk Area, Voltage/Line Type, Overall Tree Condition, Tree Defects, Site Conditions, Tree Lean, Tree Height, and Likelihood of Impact.	High Fire Risk Area	Vegetation Management database	2019 - Present	Continuous	Lat/Long	Date of inspection	Defer to SCE source data for system voltage and circuit information	Yes/No	The "Reason for difference" is required for any variation from the Suggested Work Prioritization. Risk assessors are allowed to determine an alternative prescription to be completed in the Suggested Treatment. Reference specific/detailed notes for reason. Provide greater detail about site conditions, tree maintenance, or tree defects that justify the override.	The final scoring results can range from 1-100 (100 being the highest risk score) and determines whether or not any sort of mitigation is required. The Arborist then provides the mitigation recommendation based on professional experience and judgement of the observed overall conditions.	Common arboriculture conditions are populated in drop down categories for Assessors to select the most appropriate condition/s, should any apply. Applying a score to each selection (and setting a ceiling for each category) allows a standardized process for subject tree evaluation. Each of the standardized drop-down selections are weighted with scores as agreed upon by SCE's Utility Arborists.	Hazard Tree Inspections are performed on a circuit-by-circuit basis based on defined TRI risk profile.	The Hazard Tree Management Plan (HTMP) is a wildfire mitigation program for designated High Fire Risk Areas (HFRA) in SCE's territory. The purpose of an HTMP assessment is to identify trees that pose a risk to electric facilities based on the tree's observed structural integrity and site conditions. A "Subject Tree" is any tree in the Utility Strike Zone (USZ) that has the potential to strike SCE's conductors, should it fail. If the Subject Tree's defects calculate to an intolerable risk, then mitigation measures will be prescribed to eliminate the risk. The scope of HTMP applies to all Subject Trees (including Palms and Subject Trees located on or around substation facilities) beyond the Grid Resiliency Clearance Distance (GRCD) from the high voltage conductor.	The model currently takes into account general "HFRA" classification but does take into account exact point location fuel loading. (Example, if the pole is in a paved parking lot and there are no ignition fuels in the area)	a. Regular user feedback channels from user groups and system engineer checks to validate tool functionality b. UVM QC process and HTMP Assessor field guide for the QC of risk assessments	Daily to support on-going risk assessments	New updates under development to roll out with Arbora tool implementation to address fuel loading concern in "model uncertainty" section
				Voltage/Line Type	SCE Asset Databases	2019 - Present	Continuous	Lat/Long	Annual	Defer to SCE source data for system voltage and circuit information	Voltage value in kV									
				Tree Defects	Vegetation Management database	2019 - Present	Continuous	Lat/Long	Date of inspection	Internal scheduling desktop reviews and field quality control to validate calculator results	Multiple[42]									
				Site Conditions	Vegetation Management database	2019 - Present	Continuous	Lat/Long	Date of inspection	Internal scheduling desktop reviews and field quality control to validate calculator results	Site - Change in drainage Site - Change in grade etc.									
				Tree Height	Vegetation Management database	2019 - Present	Continuous	Lat/Long	Date of inspection	Internal scheduling desktop reviews and field quality control to validate calculator results	Height rounded to nearest foot									

[42] Basal wound,Bleeding/resinous,Epicormic sprouts,Fungal fruiting bodies,Included Bark (Major),Included Bark (Minor),Included Bark (Moderate),Insect or mistletoe infestation (Major),Insect or mistletoe infestation (Minor),Insect or mistletoe infestation (Moderate),Lean (Major, >25 degrees),Lean (Minor, <7 degrees),Lean (Moderate, 8-25 degrees),Rot (Major),Rot (Minor),Rot (Moderate),Seams/ribs,Species prone to branch failure,Structurally unsound trunk/poor taper,Trunk failure evidence,Weak, unsound branch attachment,Branch failure evidence,Codominant top (bottom 1/4 of tree height),Codominant top (split at 1/2 to 3/4 of tree height),Codominant top (split at 1/4 to 1/2 tree height),Codominant top (split at top 1/4 of tree height),Crack in trunk or large branches (major),Crack in trunk or large branches (minor),Crack in trunk or large branches (moderate),Dead or Dying (beyond 50% dead),Dieback of crown and branches,Disease (early stages),Disease (late stages),Dead or Dying (beyond 50% dead),Dieback of crown and branches,Disease (early stages),Disease (late stages),Exposed or girdling roots (<25%),Exposed or girdling roots (>50%),Exposed or girdling roots (25-50%)

Model	Section	Purpose of Model	Relevant Terms	Data elements	Sources of Data	Collection period	Modeling frequency	Spatial granularity	Temporal granularity	Data Quality and Verification	Data Characteristics	Data Modification	Modeling Assumptions and Limitations	Modeling Methodology	Timeline for Model Development	Application and Results	Model Uncertainty	Model Verification and Validation	Modeling Frequency	Key Improvements from Working Group
Tree Risk Index	7.3.5	Establish a methodology to classify locations around our overhead equipment that have high vegetation contact risk In the near-term, TRI will be used for vegetation management (VM) inspections prioritization for line clearing, hazard trees, and quality control	Risk is classified A to D, with A being highest risk (equivalent to Level 1 in High Fire Risk Inspections). CFO Veg POI (refer to "POI" above) Technosylva consequence (acres only, refer to "Consequence" above)	TRI model utilizes a similar methodology to High Fire Risk Informed inspections (HFRI); factors in both the probability of a fire starting from an SCE asset (CFO Veg POI) and Technosylva consequence (acres only)	Refer to "POI" above Refer to "Consequence" above Vegetation Management database	2022+ (ongoing)	Annual	Circuit VM Distribution Grid	Annual	Leverage SCE data scientists to align data from other SCE risk modeling efforts; QC from SME's to confirm outputs align with operational practicality and field experiences	Tree Density looks at the number of trees in the vegetation management database that is around conductor segment Tree Proximity looks at the distance between trees and segments/structures using geospatial analysis Tree Species classifies vegetation by potential growth and for contact with utility assets TRI matrices developed for both vegetation management Grids and vegetation management HFRA Circuit	Annual updates planned to incorporate updated POI and Consequence values. Other inputs, such as tree health and canopy cover may be considered for incorporation to modeling	VM TRI is modeled at an aggregate circuit/grid level that takes weighted averages of POI and consequence of individual structures	TRI model utilizes a Risk matrix to Prioritize inspections; factors in both the probability of a fire starting from an SCE asset (CFO Veg POI) and Technosylva consequence (acres only) a. weighted average of aggregated POI, weighted average of aggregated consequence, HFRA Circuit Miles b. Tree inventory volume, grid count volume, and circuit mileage volume c. Definition of Risk = POI * Consequence d. refer to POI and Consequence above. Currently TRI is not automated.	2022 will be transitioning from previous prioritization models through 2021 and leveraging more updated tools for line clearing, hazard tree, and QC inspections; previous methodologies: Line Clearing – Subject Matter Expert input and resource balancing Hazard Tree – REAX consequence + tree faults QC inspections – REAX consequence only	Line Clearing prioritization: Annual schedule development for optimal trimming based on fire season Supplemental Patrols: Targeted incremental inspections over and above scheduled annual inspections on high-risk areas (Class A) Hazard Tree Management Program (HTMP): Used to prioritize remaining circuits in 2022 Quality Control: Inspect 100% of highest risk (Class A) HFRA areas annually with CL/CI of 99/1; 99/2 sampling for lower classes	Gather field intelligence on schedule adjustments and risk priorities for input refinements	a. Data within the model is provided from SCE source records for POI and consequence values. b. Subject Matter Expert review of final model results to be ongoing for fine tuning adjustments as needed.	Annually to support risk planning	The TRI model was introduced in January 2022. Working groups will be ongoing though 2022 and suggestions for improvements developed in working groups will be included in 2023 TRI iterations and in subsequent years.

4.5.2 Calculation of Key Metrics

Report details on the calculation of the metrics below. For each metric, a standard definition is provided with statute cited where relevant. The utility must follow the definition provided and detail the procedure they used to calculate the metric values aligned with these definitions. The utility must cite all data sources used in calculating the metrics below. In addition, the utility must include GIS layers showing contours/heat maps of Red Flag Warning (RFW) frequency and High Wind Warning (HWW) frequency (use data from the previous 5 years, 2016-2021), as well as GIS layers for distribution of Access Functional Need (AFN) customers, and urban/rural/highly rural customers, and disadvantaged communities[43] in its service territory.

1. **Red Flag Warning overhead circuit mile days –** *Detail the steps to calculate the annual number of red flag warning (RFW) overhead (OH) circuit mile days. Calculate as the number of circuit miles that are under an RFW multiplied by the number of days those miles are under said RFW. Refer to the National Weather Service (NWS) Red Flag Warnings. For historical NWS RFW data, refer to the Iowa State University archive of NWS watch / warnings.[44] Detail the steps used to determine if an overhead circuit mile is under a RFW, providing an example of how the RFW OH circuit mile days are calculated for a RFW that occurred within the utility service territory over the last five years.*

The RFW circuit-mile days are based on all overhead (OH) distribution and transmission circuits that traverse through NWS Fire Weather Zone (FWZ) from the NWS[45] and a historical database of RFW events from the NWS in the Iowa State University archive of NWS watch / warnings. The overhead OH lengths of distribution and transmission circuits are calculated within each FWZ polygon (the FWZ is divided geospatially into over approximately 1,000 polygons) and are then multiplied by the number of days (or fraction of days) that a particular polygon had an RFW in effect. The annual circuit mile days are calculated by totaling all circuit mile days for all FWZ that occurred within the calendar year.

To determine if a circuit mile is under an RFW warning, SCE intersects the OH distribution and transmission circuits with the RFW FWZ polygons to define circuits or portions of circuits within RFW. As an example of how this is computed, for the RFW on November 25, 2019 issued for FWZ CAZ226, SCE determined that there were 161.97 RFW circuit mile days. This was done by computing the 615.40 distribution and transmission OH circuit miles that intersected with the FWZ CAZ226 RFW FWZ polygon, then multiplying the circuit miles by the total duration of the RFW for the FWZ. Duration of the RFW is defined by the delta between issued and expired date/time for each RFW, in this case approximately 0.263 days.

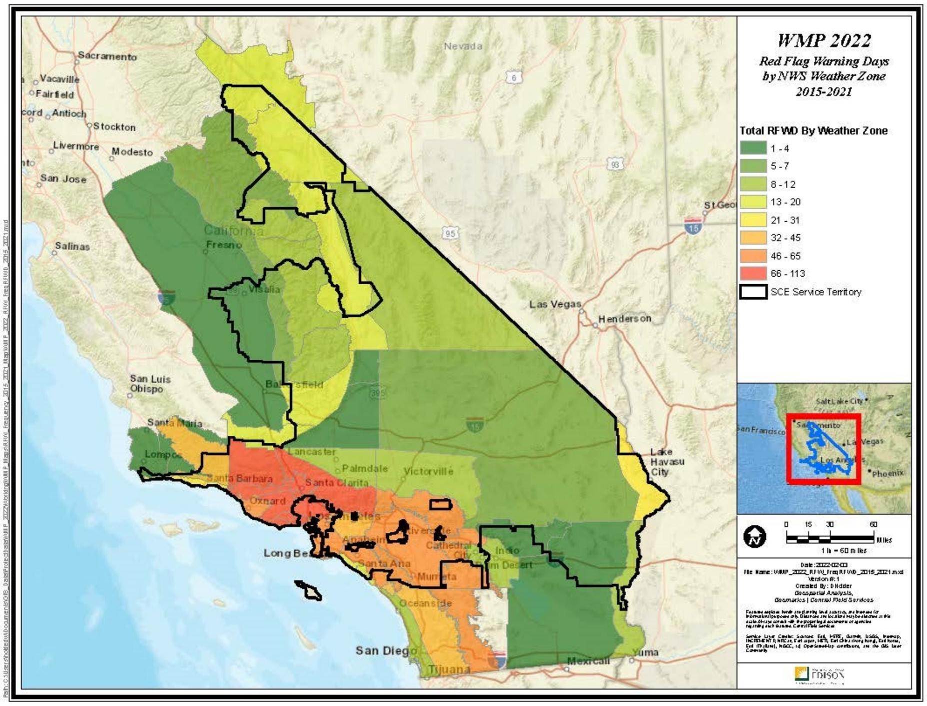
[43] Energy Safety recommends using CalEnviroScreen and Senate Bill 535 to identify disadvantaged communities.
[44] *https://mesonet.agron.iastate.edu/request/gis/watchwarn.phtml*
[45] https://www.weather.gov/gis/FireZones

The sources of data used in the calculation of this information include the Iowa State University Weather Warning Archive and SCE's Comprehensive Geographical Information System (cGIS) circuit data.

Please refer to the supplemental geospatial database submission for this GIS layer (see geodatabase titled "WMP_2022_GIS_Layers" and feature class titled "WMP_2022 _4_5_2_Red_Flag_Warning_Frequency") and see for a corresponding map.

Figure SCE 4-13

Red Flag Warning Frequency (2015-2021)



2. **High Wind Warning overhead circuit mile days** – Detail the steps used to calculate the annual number of High Wind Warning (HWW) overhead circuit mile days. Calculate as the number of OH circuit miles that are under an HWW multiplied by the number of days those miles are under said HWW. Refer to High Wind Warnings as issued by the NWS. For historical NWS data, refer to the Iowa State University archive of NWS watch / warnings.[46] Detail the steps used to determine if an OH circuit mile is under a HWW, providing an example of how the OH HWW circuit mile days are calculated for a HWW that occurred within the utility service territory over the last five years.

The HWW circuit-mile days are based on all OH distribution and transmission circuits that traverse through the NWS Wind Weather Zone (WWZ) from the NWS and a historical database of HWW events from the NWS in the Iowa State University archive of NWS watch / warnings. The OH lengths ofdistribution and transmission circuits are calculated within each WWZ polygon (the WWZ is divided geospatially into approximately 200 polygons) and are then multiplied by the number of days (or fraction of days) that a

[46] https://mesonet.agron.iastate.edu/request/gis/watchwarn.phtml

particular polygon had an HWW in effect. The annual circuit mile days are calculated by totaling all circuit mile days for all WWZ that occurred within the calendar year.

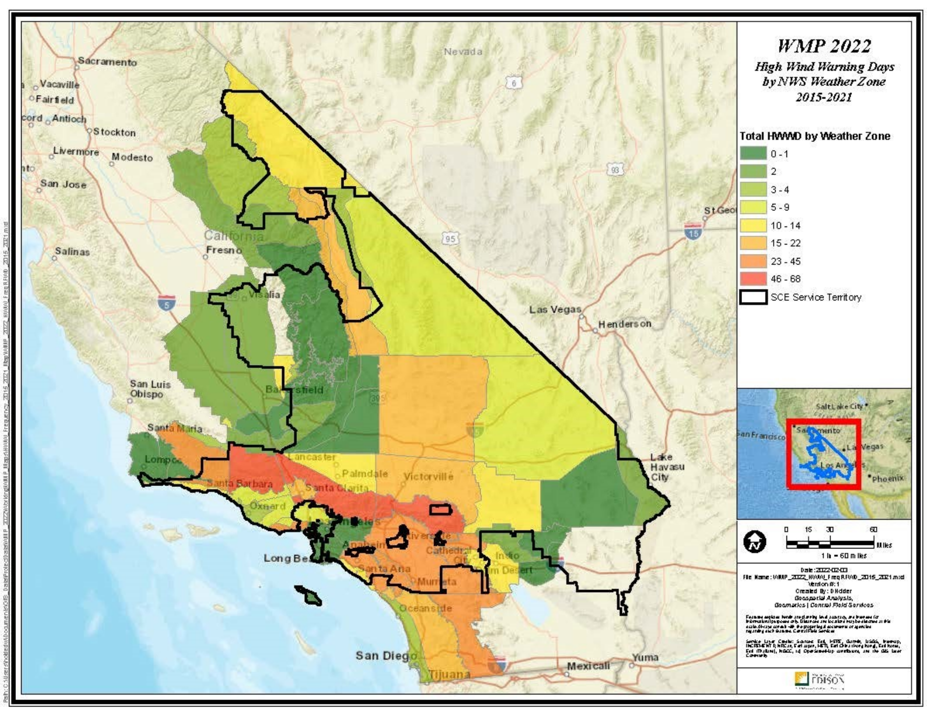
To determine if a circuit mile is under an HWW warning, SCE intersects the OH distribution and transmission circuits with the HWW WWZ polygons to define circuits/portions of circuits within HWW. As an example of how this is computed, for the HWW on December 31, 2019 issued for WWZ CAZ046, SCE determined that there were 136.99 HWW circuit mile days. This was done by computing the 196.87 distribution and transmission OH circuit miles that intersected with the WWZ CAZ046 HWW WWZ polygon, then multiplying the circuit miles by the total duration of the HWW for the WWZ. Duration is defined by the delta between issued and expired date/time for each HWW, in this case approximately 0.696 days.

The sources of data used in the calculation of this information include the Iowa State University Weather Warning Archive and SCE cGIS circuit data.

Please refer to the supplemental geospatial database submission for this GIS layer (see geodatabase titled “WMP_2022_GIS_Layers” and feature class titled “WMP_2022 _4_5_2_High_Wind_Warning_Frequency”) and see Figure SCE 4-14 for a corresponding map.

Figure SCE 4-14

High Wind Warning Frequency (2015-2021)



3. **AFN Population** – *Detail the steps to calculate the annual number of customers that are considered part of the AFN population. Defined in Government Code § 8593.3*[E7] *and D.19-05-042*[E8] *as individuals who have developmental or intellectual disabilities, physical disabilities, chronic conditions, injuries, limited English proficiency or who are non- English*

speaking[47], older adults, children, people living in institutionalized settings, or those who are low income, homeless, or transportation disadvantaged, including, but not limited to, those who are dependent on public transit or those who are pregnant.

In February 2020, SCE did an initial assessment of the proportion of its customers that fell within this definition and found that approximately 80 percent of its customer base would be considered AFN under this metric. To enable meaningful utility prioritization of resources, SCE collects data for a subset of this population annually, which include MBL, Critical Care, Low Income, limited English proficiency and self-certified vulnerable customers who are served by SCE through various programs and offerings. For other AFN individuals, SCE uses data from a third-party vendor to obtain consumer information based on SCE residential service accounts. However, it is important to note that some of the data available for AFN individuals is very limited (e.g., homeless or transient populations, transportation disadvantaged, and people living in institutionalized settings).

SCE relies on its customer data for information about the number of MBL, Critical Care, Low-Income, limited English proficiency and households that self-identify.[48] Based on 2021 data, SCE has identified 46% of customer accounts as AFN utilizing an aligned approach with Joint IOUs to identify and track customers with AFN based on available data. SCE takes the following steps to determine the annual number of customers and percentage of accounts within each group:

Customers enrolled in the following programs:

- California Alternate Rates for Energy (CARE): The annual number of Low-Income customers is calculated as the total number of service accounts enrolled in SCE's low-income programs such as CARE/FERA.
- Family Electric Rate Assistance (FERA): The annual number of Low-Income customers is calculated as the total number of service accounts enrolled in SCE's low-income programs such as CARE/FERA.
- MBL: The annual number of MBL customers is calculated as the total number of customers enrolled in SCE's MBL program. Customers who are enrolled in SCE's MBL program.
- Life-Support (Critical Care): Critical Care customers are a subset of the MBL population. The annual number of Critical Care customers is calculated as the total number of customers who have been identified to use medical equipment for life support purposes, meaning that the customer cannot be without life support equipment for at least two hours.
- Customers who receive their utility bill in an alternate format (e.g., Braille; large font).

[47] Guidance on calculating number of households with limited or no English proficiency can be found in D.20-03-004

[48] Households with one or more individuals who have self-certified that they have a serious illness or condition that could become life threatening if their electric or gas service is disconnected for nonpayment receives an in-person visit

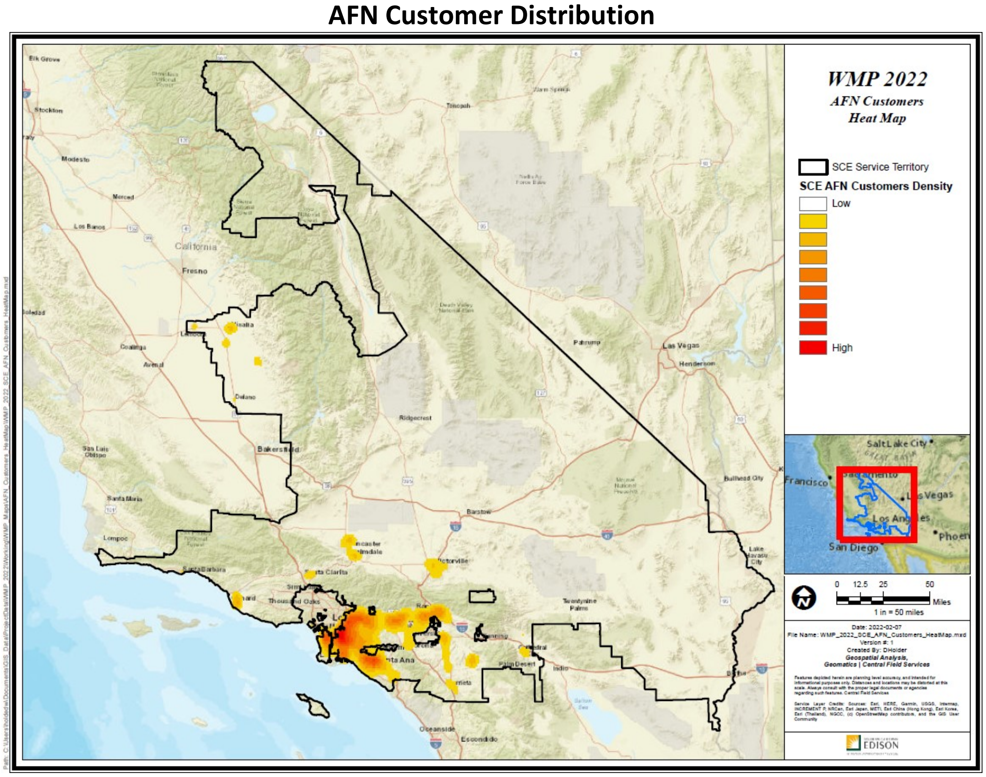
- Customers who have identified their preferred language as a language other than English: Limited English proficiency is calculated based on the total number of customers who have self-certified with SCE as their primary language is other than English.
- Older adults / seniors
- Customers who self-identify as sensitive: SCE also monitors information for households that self-identify as sensitive.

SCE also works to identify the population of AFN customers through Acxiom, a third-party vendor providing census-based data. Acxiom supplies data to SCE based on the residential service accounts SCE provides to them in order to obtain information about the residential profile in the home. Acxiom provides data on an annual basis. SCE's efforts to reach, engage and support AFN communities, including by developing partnerships with CBOs and providing for AFN needs at CRCs, can be found in the 2022 AFN Plan filed on January 31, 2022.[49]

Please refer to the supplemental geospatial database submission for this GIS layer (see geodatabase titled "WMP_2022_GIS_Layers" and feature class titled "WMP_2022 _4_5_2_AFN_Customer_Distribution_CONFIDENTIAL") and see Figure SCE 4-15 for a corresponding map.

Figure SCE 4-15

AFN Customer Distribution



[49] https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M449/K511/449511922.PDF

4. **Wildland-Urban Interface** – *Detail the steps to calculate the annual number of circuit miles and customers in Wildland-Urban Interface (WUI) territory. WUI is defined as the area where houses exist at more than 1 housing unit per 40 acres and (1) wildland vegetation covers more than 50% of the land area (intermix WUI) or (2) wildland vegetation covers less than 50% of the land area, but a large area (over 1,235 acres) covered with more than 75% wildland vegetation is within 1.5 mi (interface WUI) (Radeloff, et al., 2005).[50]*

The annual number of circuit miles in the WUI is calculated by SCE geospatial overlay/intersect of OH distribution and transmission circuits within WUI polygons and calculation of total circuit lengths in miles within the WUI. The sources of data used in the calculation of this information include University of Wisconsin-Madison WUI GIS data layer and SCE's cGIS circuit data.

The annual number of customers in the WUI is calculated by SCE geospatial overlay of customer meter locations within the WUI. The sources of data used in the calculation of this information include University of Wisconsin-Madison WUI GIS data layer and the SCE cGIS meter locations data layer.

Please refer to the supplemental geospatial database submission for this GIS layer (see geodatabase titled "WMP_2022_GIS_Layers" and feature class titled "2022 WMP _4_5_2_Wildland Urban Interface").

5. **Urban, Rural, and Highly Rural** – *Detail the steps for calculating the number of customers and circuit miles in utility territory that are in highly rural, rural, and urban regions for each year. Use the following definitions for classifying an area highly rural/rural/urban (also referenced in glossary):*

<u>Highly rural</u> – *In accordance with 38 CFR 17.701[E9], "highly rural" must be defined as those areas with a population of less than 7 persons per square mile as determined by the United States Bureau of the Census. For the purposes of the WMP, "area" must be defined as census tracts.*

<u>Rural</u> – *In accordance with GO 165[E10], "rural" must be defined as those areas with a population of less than1,000 persons per square mile as determined by the United States Bureau of the Census. For the purposesof the WMP, "area" must be defined as census tracts.*

<u>Urban</u> – *In accordance with GO 165 [E10], "urban" must be defined as those areas with a population of more than 1,000 persons per square mile as determined by the United States Bureau of the Census. For the purposes of the WMP, "area" must be defined as census tracts.*

Population density numbers are calculated using the American Community Survey (ACS) 1-year estimates on population density by census tract for each corresponding year (2016 ACS 1-year estimate for 2016 metrics, 2017 ACS 1-year estimate for 2017 metrics, etc.). For years with no ACS 1-year estimate available, use the 1-year estimate immediately before the missing year (e.g., use 2021 estimate if 2022 estimate is not yet published, etc.)

[50] Paper can be found here - https://www.fs.fed.us/pnw/pubs/journals/pnw_2005_radeloff001.pdf with the latest WUI map (form 2010) found here - http://silvis.forest.wisc.edu/data/wui-change/

SCE calculates the number of customers in utility service area that are in highly rural, rural and urban regions each year by using population density by census tract, based on population totals in the ACS. The population per square mile will be calculated for each census tract to define tracts as urban, rural, or highly rural, in accordance with the population density definitions. The number of customers that fall within these regions will be calculated by providing a geospatial overlay of customer meter locations with the urban/rural/highly rural census tracts and then calculating the total number of meters within each urban, rural, or highly rural region type.

The sources of data used in the calculation of this information include Topologically Integrated Geographic Encoding and Referencing (TIGER)/Line with Selected Demographic and Economic Data – 2018, ACS – 2018, SCE cGIS meter locations.

Please refer to the supplemental geospatial database submission for this GIS layer (see geodatabase titled "WMP_2022_GIS_Layers" and feature class titled "WMP_2022 _4_5_2_Urban_Rural_Highly Rural").

6. Disadvantaged Communities

SCE defines disadvantaged and vulnerable communities (DVC/DAC) using multiple criteria.

1. Senate Bill 535 (SB-535)

Bill Text – SB-535 California Global Warming Solutions Act of 2006: Greenhouse Gas Reduction Fund.

2. Assembly Bill 1550 (AB-1550)

Bill Text – AB-1550 Greenhouse gases: investment plan: disadvantaged communities. (ca.gov)

3. Commission's OIR on Climate Change Adaptation defines DVCs[51] as:

"Communities in the 25% highest scoring census tracts according to the most current versions of the California Communities Environmental Health Screening Tool (CalEnviroScreen), as well as all California tribal lands, census tracts that score in the highest 5% of Pollution Burden within CalEnviroScreen, but do not receive an overall CalEnviroScreen score due to unreliable public health and socioeconomic data, and census tracts with median household incomes less than 60% of state median income."

SCE is currently using CalEnviroScreen version 3.0 (CES3) to define disadvantaged communities at the census tract level. Native American tribal lands do not follow census tract boundaries. Tribal lands are represented by their own boundaries independent of the CES3 census tracts and may overlap with DVC census tracts defined by other DVC criteria.

Please refer to the supplemental geospatial database submission for this GIS layer (see geodatabase titled "WMP_2022_GIS_Layers" and feature class titled "WMP_2022 _4_5_2_Disadvantaged_Communities") and see Figure SCE 4-16 for a corresponding map.

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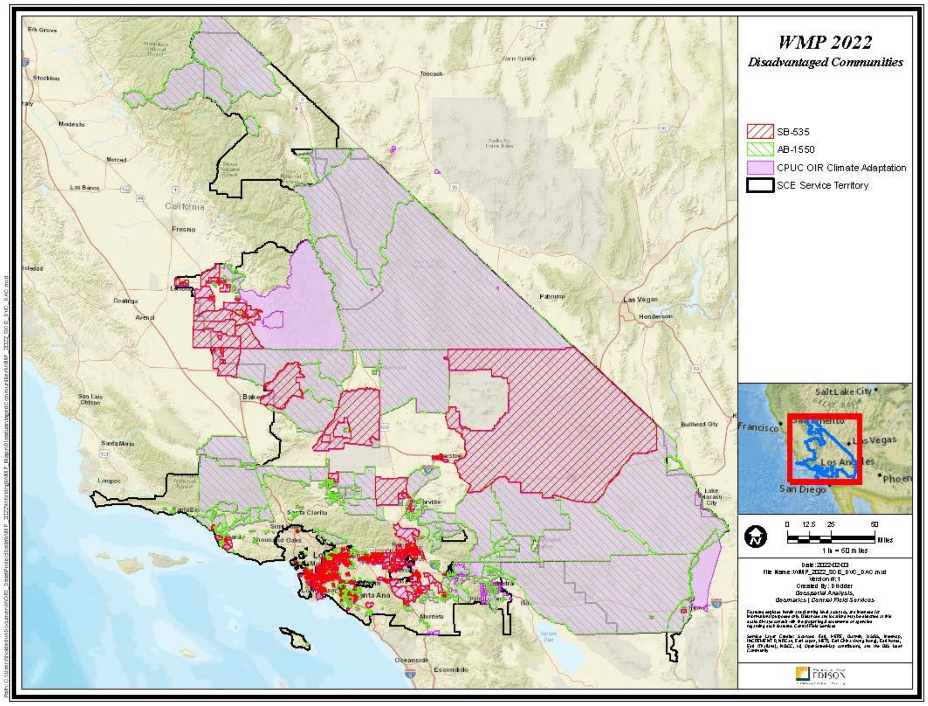
[51] D.20-08-046, p. 108, Conclusion of Law 2.

Figure SCE 4-16

Disadvantaged Communities



4.6 PROGRESS REPORTING ON KEY AREAS OF IMPROVEMENT

Report progress on all key areas of improvement identified in Section 1.3 of the utility's 2021 Action Statement. Provide a summary table of the actions taken to address these key areas and report on progress made over the year. Summarize the progress in a table using a high-level bullet point list of key actions, strategies, schedule, timeline for completion, quantifiable performance-metrics, measurable targets, etc. The table must also include a cross-referenced link to a more detailed narrative and substantiation of progress.

SCE submitted the 2021 WMP Update Progress Report[52] on November 1, 2021, providing progress, or in some cases resolution, to the 14 Key Areas of Improvement for the 2021 WMP as identified by OEIS in the Final Action Statement[53]. Table 4-1 below contains all 14 Key Areas of Improvement and a summary of progress made. Additionally, SCE also addressed Additional Issues and Remedies as identified by OEIS from the Action Statement where appropriate in this WMP Update, as shown in Table SCE 4-19.

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[52] https://www.sce.com/sites/default/files/AEM/Wildfire%20Mitigation%20Plan/2021/SCE%202021%20WMP%20Update%20Progress%20Report.pdf

[53] Final Action Statement on 2021 Wildfire Mitigation Plan Update – Southern California Edison, issued August 18, 2021, pp. 8-16.

Table 4-1

Progress on Key Areas of Improvement and Remedies, 2021

Utility-#	Issue Title	Remedies Required	Summary of Progress
SCE-21-01	RSE estimates not provided for all PSPS-related mitigation initiatives	SCE must provide RSE estimates for PSPS-related activities and include a clear description to explain how these were developed and what assumptions were used. If the RSE estimates are zero or unattainable, SCE must explain why and provide qualitative and quantitative information to demonstrate how the PSPS-related activities inform PSPS decision-making.	SCE provided an initial RSE methodology for PSPS-related activities in the Progress Report, including activities that were referenced as Enabling / PSPS in SCE's 2021 WMP Update Revision,[54] as well as other 2021 WMP Update activities that are PSPS-enabling for which SCE did not previously provide an update. SCE has developed RSEs for many of these activities in the 2022 WMP Update, except for those PSPS-related activities that were identified as pilots. For the most recent RSEs please see Section 4.3.8.
SCE-21-02	RSE values vary across utilities	The utilities must collaborate through a working group facilitated by Energy Safety to develop a more standardized approach to the inputs and assumptions used for RSE calculations. After Energy Safety completes its evaluation of the 2021 WMP Updates, it will provide additional detail on the specifics of this working group.	SCE is participating in a working group led by OEIS with SDG&E and PG&E on RSE approaches and inconsistencies among the utilities. The initial meeting was held December 9, 2021. More discussion on this working group is found in Section 4.3.8 and Section.9.8. This topic is also scheduled to be discussed in Phase II of R.20-07-013, Order Instituting Rulemaking to Further Develop a Risk-Based Decision-Making Framework for Electric and Gas Utilities.[55] As mentioned earlier, even with more common approaches to RSEs, each utility may have different RSE values due to different ignition risk drivers and high fire risk terrain among each utility.
SCE-21-03	Lack of consistency in approach to wildfire risk modeling across utilities	The utilities must collaborate through a working group facilitated by Energy Safety to develop a more consistent statewide approach to wildfire risk modeling. After Energy Safety completes its evaluation of all the utilities' 2021 WMP Updates, it will provide additional detail on the specifics of this working group.	SCE is participating a working group led by OEIS with SDG&E, PG&E, PacifiCorp, Bear Valley Electric Service, Inc. (BVES), and Liberty Utilities on developing a more consistent approach to risk modeling. Bi-weekly meetings started October 20, 2021 and are scheduled through September 7, 2022. More discussion on this working group is found in Section 9.8. This topic is also scheduled for discussion in Phase II of R.20-

[54] SCE 2021 WMP Revision – CLEAN, pp. 565 – 567 (Table SCE 9.8-2).

[55] See R.20-07-013, Assigned Commissioner's Scoping Memo and Ruling, p.8, Developing Comparable Risk Scores Across Utilities.

Utility-#	Issue Title	Remedies Required	Summary of Progress
		A working group to address wildfire risk modeling will allow for: 1. Collaboration among the utilities; 2. Stakeholder and academic expert input; and 3. Increased transparency.	07-013, Order Instituting Rulemaking to Further Develop a Risk-Based Decision-Making Framework for Electric and Gas Utilities.[56]
SCE-21-04	Limited evidence to support the effectiveness of covered conductor	The utilities must coordinate to develop a consistent approach to evaluating the long-term risk reduction and cost-effectiveness of covered conductor deployment, including: 1. The effectiveness of covered conductor in the field in comparison to alternative initiatives. 2. How covered conductor installation compares to other initiatives in its potential to reduce PSPS risk.	SCE is leading a working group with SDG&E, PG&E, PacifiCorp, BVES, and Liberty Utilities. Meetings are held biweekly. For progress and results stemming from this working group please see Section 9.8.
SCE-21-05	Out-dated risk assessment used to justify the selection and scope of covered conductor as a mitigation initiative	SCE must: 1. Provide an updated Figure 9.01-1 based on SCE's latest risk modeling assessment, including the ignitions shown. 2. Provide the cause of the nine ignitions shown in Figure 9.01-1. 3. For each of the nine ignitions shown, provide an assessment of the likelihood that covered conductor installation would have prevented the ignition. 4. Provide a similar risk buydown curve for all cumulative circuit miles, including historic ignitions and ignition size.	In the Progress Report, SCE provided an updated risk buydown curve based on SCE's latest risk modeling assessment. SCE provides the causes of the nine ignitions along with an assessment of the likelihood that covered conductor would have prevented the ignition. SCE also provided an additional version of the risk buydown curve showing all cumulative circuit miles and incorporating five additional fires as a result of the curve's expansion and the inclusion of recent fires. SCE concludes by emphasizing the intention of the risk models (to prioritize) and discusses modeling limitations (e.g., model employs an eight-hour burn duration).
SCE-21-06	Inadequate justification for scope	SCE must:	SCE is developing an Integrated Grid Hardening Strategy and analysis that can be

[56] Id.

Utility-#	Issue Title	Remedies Required	Summary of Progress
	and pace of its covered conductor program	1. Re-evaluate the scope, and pace of its future covered conductor program using the outputs of its updated Wildfire Risk Models with an emphasis on: i) The explicit consideration of all possible alternative mitigation initiatives along with a justification for why the preferred mitigation initiative was selected over and above the alternatives considered ii) Reduction of catastrophic wildfire risk iii) Reduction of PSPS events; iv) Selecting mitigation initiatives for individual circuit segments based on the specific location, circumstances, and risk of catastrophic wildfire.	applied at each circuit segment that considers wildfire risk drivers, PSPS risk, and which mitigation initiatives, or combination of mitigation initiatives, cost effectively address risk drivers. For more discussion on the Integrated Grid Hardening Strategy and scoping analysis please see Section 7.1.2.1.
SCE-21-07	Inadequate joint plan to study the effectiveness of enhanced clearances	SDG&E, PG&E, and SCE will participate in a multi-year vegetation clearance study. Energy Safety will confirm the details of this study in due course. The objectives of this study are to: 1. Establish uniform data collection standards. 2. Create a cross-utility database of tree-caused risk events (i.e., outages and ignitions caused by vegetation contact). 3. Incorporate biotic and abiotic factors into the determination of outage and ignition risk caused by vegetation contact. 4. Assess the effectiveness of enhanced clearances. In preparation for this study and the eventual analysis, SCE must collect the relevant data; the required data are currently defined by the WSD	SCE is working with PG&E and SDG&E to share their individual analyses of the effectiveness of enhanced clearances and will work to solicit proposals in 2022 for a third party to conduct the study. Please see 2021 WMP Progress Report Working Group Updates in Section 9.8 of the Appendix below for a detailed response on SCE-21-07, Inadequate Joint Plan to Study the Effectiveness of Enhanced Clearances.

Utility-#	Issue Title	Remedies Required	Summary of Progress
		Geographic Information System (GIS Data Reporting Standard for California Electrical Corporations - V2). Table 2 outlines the feature classes which Energy Safety believes will be most relevant to the study. Energy Safety will also be updating the GIS Reporting Standards in 2021, which may include additional data attributes for vegetation-related risk events.	
SCE-21-08	Incomplete identification of vegetation species and record keeping	SCE must: 1. Use scientific names in its reporting (as opposed to common names). This change will be reflected in the upcoming updates to the WSD GIS Reporting Standard. 2. Add genus and species designation input capabilities into its systems which track vegetation (e.g., vegetation inventory system and vegetation-caused outage reports). 3. Identify the genus and species of a tree that has caused an outage or ignition in the Quarterly Data Reports (QDRs) (in these cases, an unknown "sp." designation is not acceptable). 4. If the tree's species designation is unknown (i.e., if the inspector knows the tree as "Quercus" but is unsure whether the tree is, for example, Quercus kelloggii, Quercus lobata, or Quercus agrifolia), it must be recorded as such. Instead of simply "Quercus," use "Quercus sp." If referencing multiple species within a genus use "spp." (e.g., Quercus spp.).	SCE's vegetation management inventory list has been revised to include a more granular list for species identification including the common names and the scientific nomenclature for tree records. The updated list was benchmarked within the Vegetation Management Joint IOU working group for greater alignment among utilities. The species list was updated in Vegetation Managements circuit interruption database in Q3 2021. The species list is expected to be updated in Q1 2022 in the existing work management system and will be implemented with any future Vegetation Management work management systems.

Utility-#	Issue Title	Remedies Required	Summary of Progress
		5. Teach tree species identification skills in its Vegetation Management personnel training programs, both in initial and continuing education. 6. Encourage all Vegetation Management personnel identify trees to species in all Vegetation Management activities and reporting, where possible.	
SCE-21-09	Need for quantified vegetation management compliance targets	SCE must: Define quantitative targets for all Vegetation Management initiatives in Table 12. If quantitative targets are not applicable to an initiative, SCE must: 1. Fully justify this, 2. Define goals within that initiative, and 3. Include a timeline in which it expects to achieve those goals.	Please see Table 5.3-1 for additional quantified Vegetation Management compliance targets.
SCE-21-10	Inadequate transparency in accounting for ignition sources in risk modeling and mitigation selection	SCE must fully explain: 1. How third-party ignition sources feed into SCE's risk models; 2. How ignition sources impact SCE's mitigation selection process, including: a. How SCE prioritizes ignition sources; b. If SCE treats third-party ignition sources that are not under SCE's direct control differently than other ignition sources, and if so, how; c. How SCE targets its mitigations efforts to reduce ignitions that are more likely to result in catastrophic wildfire conditions.	In the Progress Report, SCE explained how third-party ignitions[57] feed into SCE's WRRM risk model to determine POI. SCE continues to describe how all causes of ignitions, third-party and otherwise, are categorized by driver and sub-cause and used as inputs in SCE's WRRM model to the prioritize deployment of initiatives to mitigate against ignitions most likely to result in catastrophic wildfire conditions. Further discussions on inputs into SCE's POI model and prioritization based on results is found in Section 4.3.5.

[57] In the context of this Key Issue, OEIS defines third-party ignition data as vehicle, balloon and animal; Final Action Statement on 2021 Wildfire Mitigation Plan Update – Southern California Edison, pg. 53.

Utility-#	Issue Title	Remedies Required	Summary of Progress
SCE-21-11	Unclear how SCE's ignition models account for correlations in wind speeds, ignitions, and consequence	SCE must: 1) Fully demonstrate that its probability of ignition (POI) models accurately account for the correlation between wind speed, ignition, and consequence 2) Explain: a) Why SCE finds that is does not have enough "wind-driven outage data at the circuit level," b) Specify the data required "to make determinations about correlations between wind speeds and outage rates," c) Explain how and when SCE plans to obtain such data moving forward.	In the Progress Report, SCE explained how wind speeds and wind directions are used as inputs to both POI and Technosylva fire consequence models. Wind speeds, wind directions, and other weather measurements are all important inputs into SCE's wildfire modeling efforts. SCE then clarified that it has sufficient quantities of data to draw correlations between wind speeds and wind-driven outages for a climate zone level (consisting of many circuits), but the correlation is more challenging at a circuit level as some circuits do not have enough data points (e.g., at least 10). SCE also states that correlations between wind and outages should focus on the last five years due to changing weather patterns, recent grid hardening and circuit reconfigurations. Further discussion on inputs into SCE's POI model and prioritization based on results is found in Section 4.3.5.
SCE-21-12	Insufficient evidence of effective covered conductor maintenance program	SCE must: Provide all supporting material to demonstrate that its maintenance programs effectively maintain its covered conductor, including the following information: - Pace and quantity of scheduled maintenance; - Pace and quantity of inspections - Pace and quantity of vibration dampener installations. If SCE finds that its existing maintenance programs do not provide effective maintenance for covered conductor, SCE shall: 1. Enhance its current operations to provide such maintenance; 2. Detail the enhancements to its existing programs;	In the Progress Report, SCE described how its inspection and maintenance program sufficiently inspects installed covered conductor for potential hazards and maintains covered conductor through remediation work if any issues are uncovered during inspections. For more information on covered conductor maintenance please see Section 7.3.3.4.

Utility-#	Issue Title	Remedies Required	Summary of Progress
		3. Provide all supporting material for the enhancements to its existing program, including the information listed above.	
SCE-21-13	Lack of specificity regarding how increased grid hardening will change system operations, change PSPS thresholds, and reduce PSPS events	For each mitigation alternative, including pilot program initiatives, SCE must provide quantitative analysis on: 1. Changes in system operations; 2. Changes in PSPS thresholds; 3. Estimated changes in the frequency, duration, and number of customers impacted by PSPS events.	In the Progress Report SCE provided analysis on how covered conductor, circuit segment exceptions, automated switches and load rolling, temporary generators, undergrounding and microgrids result in changes to system operations or PSPS thresholds for de-energization, and estimated changes to frequency, duration and number of customers impacted by PSPS events. For more information on grid hardening impacts to PSPS please see 2022 Anticipated PSPS Reductions Section 8.2.4.
SCE-21-14	Equivocating language used to describe RSE calculation improvements	SCE must make measurable, quantifiable, and verifiable commitments to calculate RSE estimates for all potential initiatives in Non-HFTD, Zone 1, HFTD Tier 2, and HFTD Tier 3 territory.	In the Progress Report SCE committed to developing RSEs whenever it is reasonable to do so and included additional RSEs in this WMP. In 2022, SCE expanded the number of mitigation activities for which RSEs were calculated, from 23 in 2021 to 39 in 2022, an increase of approximately 70%. SCE also included another six enabling activities within its RSE calculations. For the most recent RSEs please see Section 7.3.7. SCE also committed to providing all RSEs for all WMP initiatives that directly reduce either wildfire or PSPS risk in the 2023-2025 WMP.

Table SCE 4-19

Matrix of 2021 WMP Additional Issues in the 2022 WMP[58]

2021 WMP Additional Issues	How Remedies Addressed in the 2022 WMP	WMP Section & Page Number
The requested intent of Table 2-1 was to direct readers of the WMP to the section and page where the requirement was addressed. SCE provided only the section reference.	SCE provided section and page numbers in Table 2-1.	Chapter 2, pg. 20
Protocols for disabling reclosers not addressed in 7.3.6.1, rather references Standard/System Operating System, and discussed (but not pointed to from 7.3.6.1) in WMP Section 8.1.3 "Description of the utility's protocols and thresholds for PSPS implementation".	SCE provided requested information to OEIS confidentially.	Section 7.3.5.1.1, pg. 439
SCE did not always provide information in the correct sections as specified by the WMP Guidelines. For example, SCE provided its PSPS Directional Vision in Section 8.1.3, as opposed to Section 8.3, provided information in Section 7.0 that should have been included in Section 8.0, and referenced information outside the WMP (i.e., PSPS Corrective Action Report).	SCE provided information where requested and included links for references throughout the document.	Multiple Sections
According to the WMP Guidelines, SCE must provide a "list that identifies, describes, and prioritizes all wildfire risks, and drivers for those risks." SCE did not provide this list and instead included a footnote that referenced a list. This list was later provided via a data request (see Appendix 10.2).	SCE provided a table with a prioritized list of wildfire risks and drivers and the rationale for prioritization.	Section 4.3.2.1, pg. 54
SCE provided vague information regarding "where the electrical corporation considered undergrounding electrical distribution lines within those areas of its service territory identified to have the highest wildfire risk in a commission fire threat map."	SCE provided specific, locational information as requested in the Guidelines, including spatial data on underground distribution lines. SCE is developing an Integrated Grid Hardening Strategy and analysis that can be applied at each circuit segment that considers wildfire risk drivers, PSPS risk, and which mitigation	Section 7.3.1, pg. 255 Section 7.3.2.1, pg. 265

[58] As found in the WSD-020 Final Action Statement on SCE 2021 WMP

2021 WMP Additional Issues	How Remedies Addressed in the 2022 WMP	WMP Section & Page Number
	initiatives, or combination of mitigation initiatives, including undergrounding, cost effectively address risk drivers.	
Spend data reported via data request and content calls resulted in data being reported in multiple forms requiring extensive cross-referencing and additional explanations to determine if the new numbers correctly aligned with the original tables informing the WMP.	SCE provided spend in the requested Table 12 format (mitigation activity spend, by year, capital expenditure/operational expenditure) and provides clarifications on HFTD/non-HFTD spend.	Section 6.8.3, pg. 188 Table 12 in Appendix 9.9
Explanations and amounts of large expenditure shifts in mitigation categories and individual initiatives (2020 actual vs. 2021 planned) were difficult to pin down across a number of phone conversations and data requests (See Appendix 10.1 Data Request Appendix).	SCE reported wildfire mitigation related activity spend in its 2022 WMP Update, using Energy Safety's classification scheme.	Section 3.1, pg. 26 Table 12 in Appendix 9.9
SCE indicates historical climatology was used in its risk modeling and intends to develop forward looking climate scenarios into the 2022 modeling process. However, the maturity matrix model indicates progress in 2021.	SCE demonstrated historical climatology improvements that have been implemented to support the corresponding progress indicated by its maturity matrix model.	Section 7.3.1.2, pg. 262
SCE did not show improvement in the maturity matrix model in the areas of: 1) ignition risk estimation, and 2) risk maps and simulation algorithms. SCE predicts improvement in 2021 due to WRRM consequence modeling.	SCE reported on achieved capability improvements in: 1) ignition risk estimation, and 2) risk maps and simulation algorithms. SCE provided quantitative advancement results.	Section 7.3.1.1.1, pg. 260
SCE is not moving forward with continuous monitoring pilots at the same installation pace as other utilities. Regarding continuous monitoring technology, at this point, SCE is not working towards greater coverage until the technology is proven to be beneficial.	SCE provided an update on the status of its continuous monitoring sensor pilots, including any intentions on expanding projects.	Section 7.3.2.2.1.1, pg. 272
SCE answered the questions related to its 2020 Class B Deficiencies (SCE-6, Actions SCE-14, and SCE-15; see Appendix 10.1), but there is no indication that SCE will be installing weather stations in locations requested in SCE-6 Class B Deficiency. It is unclear on whether SCE will be able to track predicted weather conditions away from its assets prior to them	SCE discussed: 1) how the present and future effects of climate change are potentially informing weather station outputs and placement 2) how SCE's weather station network is being used in its operations beyond PSPS de-energization related decision-making	Section 7.3.2.1.1, pg. 268

2021 WMP Additional Issues	How Remedies Addressed in the 2022 WMP	WMP Section & Page Number
materializing in its service territory as well as its peer utilities.	3) progress and locations of weather stations derived from any partnerships with or applications to the USFS to install weather stations and "meteorological sample sites" as it relates to 36.2 Code of Federal Regulations (CFR) 220.6.	
SCE plans to replace all C-hooks in its service territory over the next two years. However, SCE's current estimate of C-hooks in its HFTD areas is based on statistical modeling, not inspections. Additionally, SCE does not detail how it is determining the order in which C-hooks are replaced. Therefore, it is not possible to determine if SCE is appropriately considering the condition of each of its C-hooks in determining the highest priority areas for replacement. C-hooks are difficult to inspect and can cause wildfires when ignored.	SCE: 1) Performed inspections of its HFTD territory to identify all C- hooks in HFTD zones 2) Detailed how SCE is prioritizing the order in which C-hooks are replaced 3) Demonstrated that it has an existing plan that addresses C- Hook replacements	Section 7.3.3.15.1.1, pg. 333
SCE's existing drone inspection pilot programs appear to show promising results as an effective and cost-effective method of inspection. However, SCE does not provide details as to how it intends to move forward with its drone inspection programs.	SCE explains the evaluation of the drone pilot program and assessed the potential for broader use of and investment in drones.	Section 7.3.4.9.1.1, pg. 373
In 2020, SCE fell far short of its target for pole loading assessments. SCE forecasted completing 1,205 pole loading assessments but in actuality completed only 29 percent (or 345) of its assessments.	SCE clarified it completed and exceeded their goal for 2020 pole loading assessments.	Section 7.3.4.14.1, pg. 387
As identified in 2021 through the Quarterly Reports, SCE does not have a WMP specific activity for hotline clamp replacements.	SCE provided evidence demonstrating its maintenance programs effectively track, repair, and replace hotline clamps.	Section 7.3.3.10.1, pg. 317
SCE inspects and manages the vegetation at substations "outside the fence line for potential encroachment" in its HFRA. However, it is unclear what standards or guidelines it adheres to ensure consistent vegetation management at all HFRA substations.	SCE described the standards and/or guidelines SCE uses to manage vegetation around substations (e.g., radial zones).	Section 7.3.5.17.1, pg. 428

2021 WMP Additional Issues	How Remedies Addressed in the 2022 WMP	WMP Section & Page Number
SCE adequately details future capabilities, research, and improvements under the reoccurring SCE's 2021 WMP Update header "5) Future improvements to initiative." However, SCE does not provide a timeline for the implementation or exploration of these improvements.	SCE provided expected timelines for exploration, development, and implementation of the improvement(s) for vegetation management initiatives.	Entire Section 7.3.5, pg. 392
In Section 7.3.5.13, SCE's description in reoccurring SCE's 2021 WMP Update header "1) Risk to be mitigated" is narrower in scope as compared to its peer utilities, PG&E and SDG&E. SCE states that quality control and quality assurance audits mitigate risk when "Trimming crews may not prune enough of a tree to maintain the minimum clearance distance;" SCE does not include auditing for other standards beyond attaining minimum clearance distance.	SCE broadened its "Risk to be mitigated" considerations in Section 7.3.5.13.	Section 7.3.5.13.1, pg. 417
SCE's 2020 QC audit target was 3,000 circuit miles; SCE exceeded this target, completing over 6,000 circuit miles. However, SCE's 2021 QC target is 5000 circuit miles. It is apparent that SCE has the resources and ability to complete over 6,000 miles of QC audit per year.	SCE adjusted targets for QC audits based on known, demonstrated capabilities.	Section 7.3.5.13.2, pg, 417
In Section 7.3.5.1, SCE does not provide detail regarding it customer, agency, and government vegetation management notification process.	Provided a visual description (e.g., flow chart, decision tree, etc.) of customer, agency, and government notifications for vegetation management activities and emergency work. Include the methods of notification(s) (e.g. phone calls, emails, door hangers, etc.) and sequences of notification(s).	Section 7.3.5.1.1, pg. 395
QR Action-SCE-28 required SCE to provide a copy of its study to "determine the best use of fuel reduction." However, SCE inadvertently stated in its First Quarterly Report that the study would be complete by year-end 2020; SCE intends to complete by year-end 2021	SCE will provide a copy of its study to "determine the best use of fuel reduction" as an attachment to the 2022 WMP Update when the study is completed.	Section 7.3.5.5.1, pg.402
SCE failed to provide all supporting documents referenced within its WMP, and while SOB 322	SCE provided Energy Safety with SOB 322 confidentially contemporaneously with the 2022 WMP Update under separate cover.	Section 7.3.6.1.1, pg. 439

2021 WMP Additional Issues	How Remedies Addressed in the 2022 WMP	WMP Section & Page Number
was discussed in Section 7.3.6.1, SCE did not provide the actual procedures.		
SCE failed to provide details on its Work Restrictions During Elevated Fire Conditions Program.	SCE included: a) all procedures affected as a result of the Program b) a description of how such procedures are affected c) the threshold(s) used to determine elevated fire conditions d) defined and provided the criteria for a "PSPS Proximity Threat."	Section 7.3.6.3.1, pg. 441
SCE does not have on-call ignition prevention and suppression resources, instead relying on fire agency partners for fire suppression activities.	SCE described plans to continue or expand on its program of partnering with fire agencies.	Section 7.3.6.7.1, pg. 460
In section 7.3.7.3 SCE states that it "created predictive models for its transmission and sub transmission systems and updated its existing models for the distribution asset risk models." It is not clear what is being modeled	SCE provided information on what is being modeled, specific to the asset type.	Section 7.3.7.3.1, pg. 471
In section 7.3.7.1 SCE describes several products or platforms which are in development to further its goal of having centralized data repositories. No specific dates are proposed for implementation of any of these products /platforms. Furthermore, SCE reported considerably lower Data Governance spend compared to PG&E and SDG&E (Figure 5.7.b). The WSD suggest that SCE could do more to prioritize its centralized data capabilities.	SCE provided a timeline for implementation of centralized data repositories.	Section 7.3.7.1.1, pg. 466
SCE's non-spatial data (Tables 1-12) were received in accordance with WSD templates. Several inconsistencies in spend, as reported in Table 12, were noted, particularly concerning the breakdown of spend in HFTD and non-HFTD. These inconsistencies were the subject of data requests in spring of 2021 (see Appendix 10.2). All spend on activities that mitigate wildfires must be included in Table 12,	SCE segregated spend by HFTD and non-HFTD projects in Table 12	Table 12 (See Appendix 9.9)

2021 WMP Additional Issues	How Remedies Addressed in the 2022 WMP	WMP Section & Page Number
regardless of whether that spend goes to projects inside or outside the HFTD.		
SCE's spatial QDR data submissions have shortcomings that must be remedied. SCE lacks internal quality control on its data submissions. Data are sometimes incomplete.	SCE is now providing asset aging data for equipment and structures found in the following Asset Point feature classes: Connection Device, Customer Meter, Substation, Support Structure, Switch Gear, Weather Station, Transmission Line, Primary Distribution Line and Secondary Distribution Line. SCE is continuing to target and seek additional improvements for subsequent submissions.	Q4 2021 QDR GIS Data Submission
For Capability 41c of the 2021 maturity survey, SCE selected "RSE estimates are verified by historical or experimental pilot data and confirmed by independent experts or other utilities in CA" starting 2023. However, SCE does not detail who the independent experts or other utilities in CA are to verify the RSE estimations.	SCE has conveyed the substantial progress made in developing RSEs for this 2022 WMP Update, including the use of independent internal data, modeling and engineering personnel to review a variety of inputs and coding used to develop the RSEs for the 2022 WMP. SCE has further collaborated with other utilities in California, including via the OEIS RSE Working Group.	Section 4.3.8, pg. 68
The discussion in section 8.1.4 appears to provide a narrow plan for how SCE plans to achieve reductions and appears to report only on mitigated circuits and resulting PSPS scope, frequency, and duration reductions without seeming to explain this in the full context of broader impacts to all customers, for instance, those on non-mitigated circuits (previously de-energized or not). Energy Safety is not convinced on whether these targets apply to all customers or only those benefitting from circuits mitigated during 2021. It is unclear what the plan is for remaining circuits outside the 72 circuits targeted for mitigation, discussed in Section 8.1.4 or what customers dependent on those circuits may experience. For next year, Energy Safety expects the discussion of "8.1.4 Customers Impacted by PSPS" to describe the	SCE: 1) Described the PSPS planning strategy and metrics in the context of all circuits relating directly to the metrics provided in Table 11. 2) Described in detail, how calculations were made for Table 11. Explained how the risk model was employed, if at all, in achieving PSPS reductions. 3) Described whether it met targets of the 2021 PSPS Action Plan and describe if/how expedited /enhanced mitigation measures reduced PSPS. If PSPS reduction targets were not met identify lessons learned and corrective actions for next year.	Section 8.5, pg. 570

2021 WMP Additional Issues	How Remedies Addressed in the 2022 WMP	WMP Section & Page Number
broader plan of all circuits at risk for PSPS, including non-mitigated circuits, and resulting impacts.		

5 INPUTS TO THE PLAN AND DIRECTIONAL VISION FOR WMP

5.1 GOAL OF WILDFIRE MITIGATION PLAN

The goal of the WMPs are shared across Energy Safety and all utilities: Documented reductions in the number of ignitions caused by utility actions or equipment and minimization of the societal consequences (with specific consideration to the impact on AFN populations and marginalized communities) of both wildfires and the mitigations employed to reduce them, including PSPS.

The following sub-sections report utility-specific objectives and program targets towards the WMP goal. No utility response is required for Section 5.1.

5.2 THE OBJECTIVES OF THE PLAN

Objectives are unique to the utility and reflect the 1, 3, and 10-year projections of progress towards WMP goals. Objectives are determined by the portfolio of mitigation strategies proposed in the WMP. The objectives of the plan must, at a minimum, be consistent with the requirements of California Pub. Util. Code § 8386(a) – Each electrical corporation shall construct, maintain, and operate its electrical lines and equipment in a manner that will minimize the risk of catastrophic wildfire posed by those electrical lines and equipment.

Describe utility WMP objectives, categorized by each of the following timeframes, highlighting changes since the prior WMP:

1.Before the next Annual WMP Update
2. Within the next 3 years
3. Within the next 10 years – long-term planning beyond the 3-year cycle

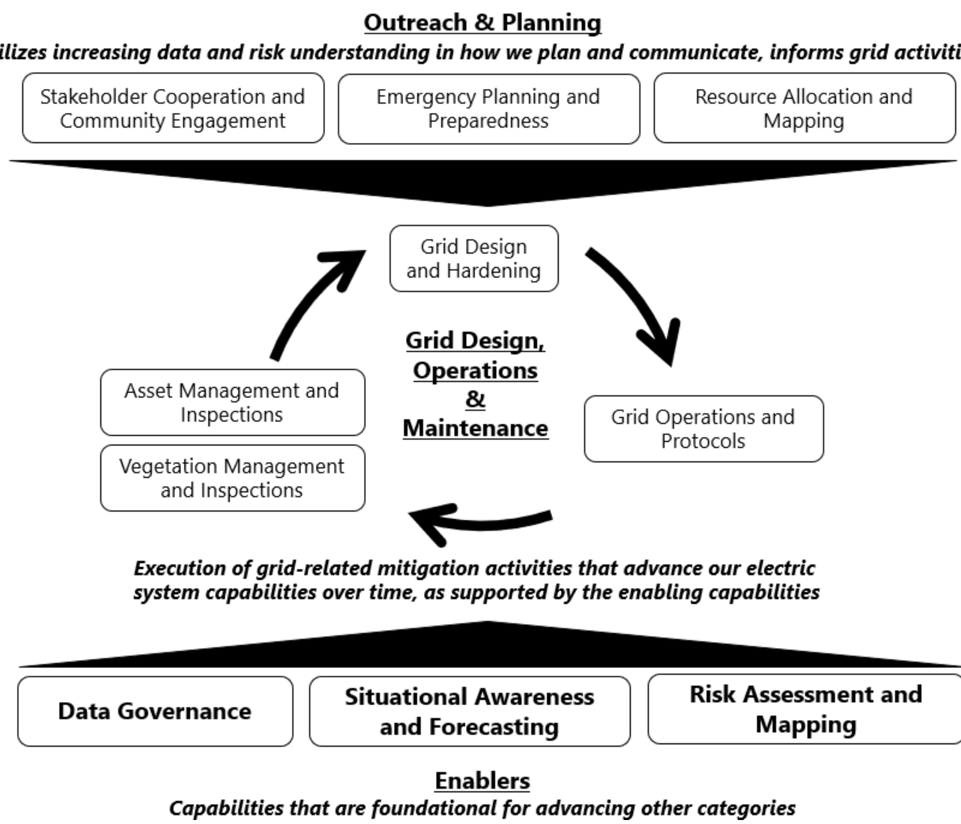
SCE's 2022 WMP Update includes an actionable, measurable, and adaptive plan through 2022 to reduce the risk of potential ignitions associated with SCE's electrical infrastructure in HFRA by increasing system hardening, bolstering situational awareness, and enhancing operational practices. These objectives are, in turn, supported and enabled by greater data governance, improvements in risk assessment and mapping, as well as other stakeholder and resource initiatives. Below SCE describes the objectives of its plan.

SCE submitted its Guidance 12 response, Long Term Plan (LTP), as part of its first Quarterly Report which identified objectives for the current WMP period, as well as future WMP periods. SCE continues to build upon and execute our wildfire mitigation plan in accordance with these objectives. SCE's LTP is based on present knowledge and understanding of wildfire risk and mitigation programs. SCE expects its knowledge of and approach to wildfire risk mitigation activities will continue to grow and evolve. Likewise, any changes to legislation, regulatory policy, technology, or other foundational assumptions will influence the objectives and approach identified herein. SCE's ability to execute towards long-term objectives will also depend on the OEIS's timely approval of our WMPs and CPUC's timely approval of the associated costs.

Figure SCE 5-1 illustrates how SCE utilizes the relationships among the OEIS's various Maturity Model categories to drive toward long-term objectives. SCE's long-term strategy for wildfire risk mitigation is a multi-pronged approach. Grid design, operations, and maintenance in the center of Figure SCE 5-1 represents the work SCE performs that most directly reduces the risk of ignition from utility infrastructure. As SCE executes on the near-term objectives and deploys system hardening mitigation, the long-term focus will be on growing the maturity of the supporting categories above and below. Gains in these areas do not always directly reduce ignition risks but have an important role in helping to ensure that SCE is executing its wildfire risk mitigation programs with higher effectiveness and efficiency.

Figure SCE 5-1

Relational Diagram of OEIS Categories for SCE Objectives



SCE's short-term objectives, which cover the current WMP period, are focused on executing our current WMP activities to harden the system, reduce the need for PSPS and impacts, and further develop risk mitigation capabilities. This includes the completion of our program targets for 2022 outlined in Table 5.3-1, as well as the category level near-term objectives identified in Section 7.1.3. SCE's long-term objectives are to achieve mature capability levels, as SCE operationalizes new technologies and further integrates systems and processes to increase the granularity and automation of its data and risk modeling. Category level long-term objectives are discussed in Section 7.1.3 and updates associated with SCE's Integrated

Grid Hardening Strategy and analysis are also described in Section 7.1.2.10. Individual activity level strategy and objectives are discussed in Section 7.3.

Throughout the near- and long-term period, SCE is using an integrated, data-driven, risk-informed operational approach that helps SCE affordably balance the scale, complexity, and uncertainties associated with wildfire risks in California, inclusive of PSPS risks. SCE's approach to wildfire mitigation is one that better positions SCE, and its customers, to be more resilient and responsive to address future challenges, either from wildfires or other emerging climate-related risks. For example, grid hardening technologies (e.g., covered conductor installation and advanced protection and control technology deployment) and inclusion of real-time diagnostics that can identify and isolate anomalies and weaknesses mitigate wildfire risks in the near-term and help SCE modernize and strengthen the grid to withstand the impacts of longer-term climate change. Resilience, rapid response capability, emergency preparedness and customer engagement will also be imperative to withstand severe weather events, and to both better prepare customers for and reduce the impact of potential PSPS events. SCE's plan will not only mitigate the risks of wildfire but also lead to enhanced system reliability and resiliency that help achieve environmental goals by ensuring the grid will be ready to support increasing load associated with electrification necessary to reduce greenhouse gas emissions.

5.3 PLAN PROGRAM TARGETS

Program targets are quantifiable measurements of activity identified in WMPs and subsequent updates used to show progress t*owards reaching the objectives.*

List and describe *all program targets the electrical corporation uses to track utility WMP implementation and utility performance over the last five years. For all program targets, list the 2019 to 2021 performance, a numeric target value that is the projected target for end of year 2022 and 2023*[59]*, units on the metrics reported, the assumptions that underlie the use of those metrics, update frequency, and how the performance reported could be validated by third parties outside each utility, such as analysts or academic researchers. Identified metrics must be of enough detail and scope to effectively inform the performance (i.e., reduction in ignition probability or wildfire consequence) of each targeted preventive strategy and program.*

Pub. Util. Code Section 8386.3(*c)(5)(A)*[60] *requires a utility to notify Energy Safety "after it completes a substantial portion of the vegetation management (VM) requirements in its wildfire mitigation plan." To ensure compliance with this statute, the utility is required to populate Table 5.3-1 with VM program targets that the utility can determine when it has completed a "substantial portion"*[61] *and that Energy Safety can subsequently audit. Energy Safety has provided some required, standardized VM targets below. It is expected that the utilities provide additional VM targets beyond those required. The identification of other VM targets and units for those targets (e.g., for inspections, customer outreach, enhanced vegetation management, etc.) are at the discretion of the utility.*

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[59] Projected target for 2023 was removed from Table 5.3.1 in 2022 WMP Update Guidelines Template Attachment 2, p. 55.

[60] Energy Safety's citation to Cal. Pub. Util. Code §8386.3(c) has been was corrected.

[61] Energy Safety intends to define "substantial portion" in its forthcoming Compliance Guidelines. This definition may be included in the Final version of the 2022 WMP Update Guidelines.

Additionally, *in Table 5.3-1 utilities must populate the column "Target%/ Top-Risk%" for each 2022 performance target related to initiatives in the following categories: Grid design and system hardening; Asset management and inspections; and Vegetation management and inspections. This column allows utilities to identify the percentage of the target that will occur in the highest risk areas. For example, if a utility targets conducting 85% of its vegetation management program in the top 20% of its risk-areas, it should input "85/20" in this column. In the "Notes" column, utilities must provide definitions and sources for each of the "Top-Risk%" values provided. In the given example above, an acceptable response would be: "The top 20% of risk areas used for this target relate to the circuit segment risk rankings from [Utility Company's] Wildfire Risk Model outputs, as described in [hyperlink to Section XX] of the 2022 WMP Update."*

For the purpose of responding to this requirement, SCE generally chose a value of 25% to represent the "Top Risk %" metric, wherein SCE has developed a risk-ranked list for each activity, typically using circuit segments or structures (specific details are provided below for each applicable activity), and indicated what percentage of the scope addresses the circuit segments or structures in the top 25% of the risk-ranked list. SCE recognizes that this analysis could have been performed using a "Top Risk %" value of 1%, 5%, 50%, 100%, etc., as the threshold. Therefore, is it important to note that deployment beyond 25% of the noted risk metric is necessary to consider to adequately mitigate wildfire and PSPS risk. The targeted top risk percentage is based on forecasted scope for 2022, but that scope is subject to change due to operational issues (e.g., permitting causes delay and requires other scope to be advanced instead). Further, SCE notes that this metric represents *a relative* risk-ranking based on SCE's risk models, and not *absolute* risk. Merely mitigating the top 25% highest-risk circuit segments or structures could incorrectly lead to a conclusion that the remaining absolute risk on the system after those mitigations are completed is acceptable. But the concept of relative risk is important for prioritization and sequencing of mitigation measures; it is not relevant for determining the appropriate final scope of mitigation deployment. In other words, *relative* risk appropriately informs a utility where to begin mitigation measures; but it is only *absolute* risk that should determine where to stop.

Table 5.3- 1

List and Description of Program Targets, Last Five Years

Program Target	2019		2020		2021		2022		Units	Audited by Third-Party? (Y/N)	Notes (Including definitions and sources for Top-Risk%[61])
	Target	Perf.	Target	Perf.	Target	Perf.	Target	Target% / Top Risk%[62]			
Weather Stations SA-1	Install at least 315 units in HFRA	352	Install 375 Weather Stations	593	SCE expects to install 375 weather stations but will attempt to install as many as 475	Installed 406 weather stations in 2021, for a cumulative total of 1,463 installations since program inception (as of 12/31/2021).	Install 150 weather stations in SCE's HFRA. SCE will strive to install up to 175 weather stations in SCE's HFRA, subject to resource and execution constraints.	N/A	Weather Stations	Y	
Weather and Fuels Modeling SA-3	High Performing Computer Weather Modeling System - Procure and install High Performance Computing Cluster weather and fuels modeling system	N/A	Complete installation of second HPCC	Developed methodology for end use case	Install two additional High Performance Computing Clusters (HPCCs) to facilitate the installation and operationalization of the Next Generation Weather Modeling System allowing for more precise, higher resolution output	Installed two HPCCs, extended PSPS forecast from 5 to 7 days, and incorporated European forecasting model to add redundancy and accuracy to the NextGen weather modeling.	Equip 400 weather station locations with machine learning capabilities. SCE will strive to equip up to 500 weather station locations with machine learning capabilities, subject to resource and execution constraints.	N/A	Weather Stations	Y	
Fire Science SA-8	N/A	N/A	Implement enhanced forecasting capability and improved fuel modeling	Created 40-year historical data set	Evaluate current wildfire events in context of 40-year history of wildfires.	SCE did not meet target. Vendor developed a climatology output containing a 40-year history of wildfires for multiple variables but unable to complete because vendor work was reprioritized to support other emergent work.	Calibrate FPI 2.0 and evaluate its performance over the 2022 fire season. Improve fire spread modeling applications (i.e., FireSim and FireCast) to include 1) fire suppression and 2) buildings destroyed by fire.	N/A	N/A	Y	
Distribution Fault Anticipation (DFA) SA-9	N/A	Procured 60 DFA units and initiated installations	N/A	Completed installations and evaluated the 60 DFA units and identified additional 150 circuits for deployment in 2021.	Complete installation of 120 DFA units on circuits in SCE's HFRA and continue evaluation of DFA technology which may	Completed installation of 130 DFA units on circuits in SCE's HFRA	SCE will evaluate the performance of installed fault anticipation technology and develop recommendations for	N/A	N/A	Y	

[62] The targeted top risk percentage is based on forecasted scope for 2022, but that scope is subject change due to operational issues (e.g. permitting causes delay and requires other scope to be advanced instead).

Program Target	2019		2020		2021		2022		Units	Audited by Third-Party? (Y/N)	Notes (Including definitions and sources for Top-Risk%[61])
	Target	Perf.	Target	Perf.	Target	Perf.	Target	Target% / Top Risk%[62]			
					result in SCE installing up to 150 units		future use by year-end 2022.				
High Definition (HD) Cameras SA-10	Install at least 62 cameras on 31 towers	Installed 91 cameras	N/A	Installed 5 cameras	N/A	N/A	Install 10 HD Cameras. SCE will strive to install up 20 HD Cameras, subject to resource and execution constraints.	N/A	HD Cameras	Y	
Covered Conductor SH-1	Install at least 96 circuit miles of covered conductor in HFRA	372	Install 700 circuit miles of covered conductor in HFRA. 700 circuit miles is SCE's program target. SCE will strive to complete 1,000 circuit miles subject to resource constraints and other execution risks	982	SCE expects to install 1,000 circuit miles of covered conductor in SCE's HFRA but will attempt to install as many as 1,400 circuit miles of covered conductor in SCE's HFRA, subject to resources constraints and other execution risks	1,503	Install 1,100 circuit miles of covered conductor in SCE's HFRA. SCE will strive to install up to as many as 1,250 circuit miles of covered conductor in SCE's HFRA, subject to resource constraints and other execution risks.	50% / 25%	Circuit miles covered	Y	Approximately 50% of SCE's 2022 WCCP scope will target the remaining top 25% riskiest circuit segments. The top 25% riskiest circuit segments relate to the circuit segment risk rankings from SCE's WRRM, as described in Section 4.3. Please see Section 7.1.2.1 for a description of SCE's Integrated Grid Hardening strategy and potential impacts on potential scope of covered conductor.
Undergrounding Overhead Conductor SH-2	Conduct evaluation of undergrounding for HFRA	Completed evaluation	Refine evaluation methodology for targeted undergrounding as a wildfire mitigation activity	Refined targeted undergrounding methodology and began scoping for 2021	Install 4 miles of undergrounded HFRA circuits SCE will attempt to install 6 miles of undergrounded HFRA circuits, subject to resource constraints and other execution risks, such as permitting, environmental or coordinating with other utilities.	Installed nearly 6 miles of undergrounding in HFRA	Install 11 circuit miles of targeted undergrounding in SCE's HFRA. SCE will strive to install up to 13 miles of targeted undergrounding in SCE's HFRA, subject to resource constraints and other execution risks.	100% / 25%	Circuit miles undergrounded	Y	100% of SCE's 2022 scope for Undergrounding Overhead Conductor will target the top 25% riskiest circuits. The top 25% riskiest circuits relate to the risk rankings from SCE's WRRM, as described in Section 4.3 Going forward, SCE will scope new Undergrounding work pursuant to the new Integrated Grid Hardening Strategy

Program Target	2019		2020		2021		2022		Units	Audited by Third-Party? (Y/N)	Notes (Including definitions and sources for Top-Risk%[61])
	Target	Perf.	Target	Perf.	Target	Perf.	Target	Target% / Top Risk%[62]			
											discussed in Section 7.1.2.1.
Branch Line Protection Strategy SH-4	Install at least 7,500 CLF in HFRA locations	7,765	Install/replace fuses at 3,025 locations	3,025	Install or replace fusing at 330 fuse installation locations SCE will strive to install or replace fusing at 421 fuse locations, subject to resource constraints and other execution risks	352	Install or replace fusing at 350 fuse locations that serve HFRA circuitry. SCE will strive to install or replace fusing at up to 483 locations that serve HFRA circuitry, subject to resource constraints and other execution risks.	25% / 25%	Fuse locations	Y	Approximately 25% of SCE's 2022 scope for SH-4 will target the remaining top 25% riskiest circuit segments. By the end of 2022, 100% of the currently identified remaining top 25% riskiest segments for SH-4 will be addressed. The top 25% riskiest circuit segments relate to the program circuit segment risk rankings from SCE's WRRM, as described in Section 4.3.
Remote Controlled Automatic Reclosers Settings Update SH-5	Install at least 50 new RAR	71	Install 45 RARs/RCSs	49	Based on SH-7 analysis, SCE is proceeding with preliminary scope per the Action Plan	23	Install 15 sectionalizing devices such as RARs/RCSs driven by the results of evaluations / assessments conducted under SH-6 and SH-7. SCE will strive to install up to 31 sectionalizing devices such as RARs/RCSs driven by the results of evaluations / assessments conducted under SH-6 and SH-7, subject to resource	N/A	RAR/RCSs installed	Y	Target% / Top Risk% not provided as this activity is largely informed by PSPS reduction considerations.

Program Target	2019		2020		2021		2022		Units	Audited by Third-Party? (Y/N)	Notes (Including definitions and sources for Top-Risk%[61])
	Target	Perf.	Target	Perf.	Target	Perf.	Target	Target% / Top Risk%[62]			
							constraints and other execution risks.				
Circuit Breaker Relay Hardware for Fast Curve SH-6	1) Develop engineering plan to upgrade remaining CB relays and update settings 2) Conduct CB upgrades and setting updates according to plan	Updated Fast Curve Operating Settings for 156 RAR installations and developed plans for CB Relay updates	Replace/upgrade 55 relay units in HFRA. SCE will strive to replace up to 110 relay units in HFRA. These targets are subject to resource constraints and other execution risks	109	Replace/upgrade 60 relay units in HFRA SCE will strive to replace/upgrade 86 relay units in HFRA, subject to resource constraints and other execution risks	FC Settings on 95 relays	Replace/upgrade 104 relay units in SCE's HFRA. SCE will strive to replace/ upgrade up to 125 relay units in SCE's HFRA, subject to resource constraints and other execution risks.	33% / 25%	FC settings updated / CB relays	Y	Approximately 33% of SCE's 2022 SH-6 scope will target the remaining top 25% riskiest circuits. By the end of 2022, 76% of the remaining top 25% riskiest circuits will be addressed. The top 25% riskiest circuits relate to the program circuit risk rankings from SCE's WRRM, as described in Section 4.3. It should be noted that, as described in Section 7.3.3.2, SH-6 is not prioritized based on risk; rather, SCE primarily factors in construction and scheduling feasibility.

Program Target	2019		2020		2021		2022		Units	Audited by Third-Party? (Y/N)	Notes (Including definitions and sources for Top-Risk%[61])
	Target	Perf.	Target	Perf.	Target	Perf.	Target	Target% / Top Risk%[62]			
PSPS-Driven Grid Hardening Work SH-7	N/A	N/A	Review 50% of all distribution circuits within HFRA to determine if modifications may improve sectionalizing capability within HFRA	Reviewed 50% of all distribution circuits within HFRA to determine if modifications may improve sectionalizing capability within HFRA	SCE will develop a methodology to project probability of PSPS de-energization and impact. Utilizing this methodology, SCE will adopt a more targeted approach by evaluating highly impacted circuits from the remaining 50% circuits in HFRA.	Completed evaluation 140 HFRA circuits comprised of 72 FICS, an additional 62 circuits previously impacted by PSPS in 2019 to 2020, and an additional six circuits with no previous PSPS outages but identified as having a POD of one event every two years.	Evaluate approximately 70 highly impacted circuits including 2021 PSPS events to determine additional deployment of PSPS mitigations.	N/A	Circuits analyzed based on number of PSPS events and CMI	Y	Target% / Top Risk% not provided as this activity evaluates opportunities to reduce PSPS impacts, and the actual mitigation work resulting from this evaluation is performed through other WMP activities.
Transmission Open Phase Detection SH-8	N/A	1 pilot transmission circuit completed, not part of the 2019 WMP	Continue deployment of transmission open phase detection on six additional transmission/sub-transmission circuits	6	Install transmission open phase detection devices on 10 transmission circuits	10	Deploy open phase logic on five transmission lines. SCE will strive to deploy open phase logic on up to 11 transmission lines, subject to resource constraints and other execution risks.	N/A	Transmission circuits with open phase detection devices	Y	Target% / Top Risk% not provided as this activity is not risk prioritized and based primarily on operational considerations.
Tree Attachment Remediation SH-10	N/A	101	Remediate 325 tree attachments. SCE will strive to complete 481 tree attachment remediations subject to resource constraints and other execution risks	405	Remediate 500 tree attachments SCE will strive to complete over 600 tree attachment remediations, subject to resource constraints and other execution risks	538	Remediate 500 tree attachments in SCE's HFRA. SCE will strive to complete up to 700 tree attachment remediations in SCE's HFRA, subject to resource constraints and other execution risks.	33% / 25%	Tree attachment remediations	Y	Approximately 33% of SCE's 2022 Tree Attachment scope will target the remaining top 25% riskiest circuits. By the end of 2022, 86% of the remaining top 25% riskiest circuits for Tree Attachments will be addressed. The top 25% riskiest circuits relate to the program circuit risk rankings from SCE's WRRM, as described in Section 4.3.

Program Target	2019		2020		2021		2022		Units	Audited by Third-Party? (Y/N)	Notes (Including definitions and sources for Top-Risk%[61])
	Target	Perf.	Target	Perf.	Target	Perf.	Target	Target% / Top Risk%[62]			
Legacy Facilities SH-11	N/A	N/A	Evaluate risk, scope, and alternatives for identified circuits; evaluation of additional system hardening mitigation for wildlife fault protection and grounding /lightning arresters	100% of milestones achieved	Hydro Control Circuits – Perform evaluation on five circuits for possible system hardening improvements Low Voltage Site Hardening – Create two project plans based on 2020 engineering assessments Grounding Studies/Lightning Arrestor Assessments: Complete 12 additional assessments	Completed five Hydro Control Circuits assessments, Completed two Low Voltage Site Hardening project plans based on 2020 engineering assessments, and Completed 12 additional Grounding Studies/Lightning Arrestor assessments.	Hydro Control Circuits: Based on 2021 assessments, perform grid hardening on three control circuits at three legacy facility sites Low Voltage Site Hardening: Based on 2021 assessment, perform one grid hardening project at a legacy facility site Grounding Studies/Lightning Arrestor Assessments and Remediations: Based on 2021 assessments perform four remediation projects at legacy facility sites. Additionally, complete 13 assessments.	N/A	Hydro Control Circuits: Legacy Facility Site Low Voltage Site Hardening: Legacy Facility Site Grounding Studies/Lightning Arrestor Assessments: Legacy Facility Site	Y	Target% / Top Risk% not provided as scope is largely informed by best practices and operational considerations.
Microgrid Assessment SH-12	N/A	N/A	N/A	Initial RFP executed	Perform internal assessment of vendor bid and location options. If assessment is favorable, SCE will issue engineering, procurement, construction (EPC) contract to a vendor that meets SCE's design requirements.	Completed internal assessment of vendor bid and location options. Conditional Engineering-Procurement-Construction (EPC) contract is in place with contingency on finalization of land.	SCE will actively attempt to obtain approval of easement with the landowner of the microgrid site, and if approval is received, SCE will move forward with microgrid project. If an approval is not received by June 30, 2022, or rejected, SCE will start to pursue other microgrid opportunities.	N/A	Design Package	Y	Target% / Top Risk% not provided as this is a single location pilot that was community driven, not scoped by risk analysis.
C-Hooks SH-13	N/A	N/A	N/A	N/A	Replace C-Hooks on at least 40 structures in HFRA SCE will strive to replace all C-Hooks in HFRA, currently estimated between 50-60 structures	50	SCE will replace C-Hooks on 10 structures in SCE's HFRA and strive to replace up to 21 C-Hooks, subject to execution risks such as environmental clearance.	29% / 25%	Transmission structures with C-Hooks	Y	While C-Hooks replacements were not risk prioritized, approximately 29% of SCE's 2022 scope for C-Hooks will target the remaining top 25% riskiest structures. By the end of 2022, 100% of

Program Target	2019		2020		2021		2022		Units	Audited by Third-Party? (Y/N)	Notes (Including definitions and sources for Top-Risk%[61])
	Target	Perf.	Target	Perf.	Target	Perf.	Target	Target% / Top Risk%[62]			
											the remaining top 25% riskiest structures for C-Hooks will be addressed. The top 25% riskiest structures relate to the program structure risk rankings from SCE's WRRM, as described in Section 4.3
Long Span Initiative (LSI) SH-14	N/A	N/A	N/A	N/A	Complete all field assessments for locations and corresponding remediations. Remediate the highest risk locations, estimating that 300, and up to 600, locations will be remediated in 2021, subject to the completion timeline for inspections, resource constraints and other execution risks.	361	Remediate 1,400 spans in SCE's HFRA. SCE will strive to remediate up to 1,800 spans in SCE's HFRA, subject to resource constraints and other execution risks.	22% / 25%	Number of locations remediated	Y	Approximately 22% of SCE's 2022 scope for Long Span Initiative will target the remaining top 25% riskiest circuit segments. By the end of 2022, 80% of the remaining top 25% riskiest long spans will be addressed. The top 25% riskiest long spans relate to the program long span prioritization ranking using WRRM and number of wire clash issues as described in Section 7.3.3.12.
Vertical Switches SH-15	N/A	N/A	N/A	Performed inspections and internal analysis/ governance	Install 20 switches in HFRA SCE will strive to install 30 switches in HFRA	16	Install 15 vertical switches in SCE's HFRA. SCE will strive to install 25 vertical switches in SCE's HFRA.	21% / 25%	Vertical switches	Y	Approximately 21% of SCE's 2022 scope for Vertical Switches will target the remaining top 25% riskiest structures. By the end of 2022, 71% of the remaining top 25% riskiest structures for Vertical Switches will be addressed. The top 25% riskiest structures relate to the program structure risk rankings from SCE's

Program Target	2019		2020		2021		2022		Units	Audited by Third-Party? (Y/N)	Notes (Including definitions and sources for Top-Risk%[61])
	Target	Perf.	Target	Perf.	Target	Perf.	Target	Target% / Top Risk%[62]			
											WRRM, as described in Section 4.3.
Vibration Damper Retrofit SH-16	N/A	N/A	N/A	N/A	N/A	N/A	Retrofit vibration dampers on 100 structures where covered conductor is already installed in SCE's HFRA. SCE will strive to retrofit vibration dampers on up to 115 structures where covered conductor is already installed in SCE's HFRA.	98% / 25%	Structures	Y	Approximately 98% of SCE's 2022 scope for Vibration Damper Retrofits will target the remaining top 25% riskiest circuit segments. The top 25% riskiest segments relate to the program's risk ranking using SCE's WRRM model with additional consideration for other factors as described in Section 7.3.3.3.3.
Rapid Earth Fault Current Limiter (REFCL) SH-17	N/A	N/A	N/A	N/A	N/A	N/A	SCE will produce a report summarizing performance and lessons learned from previous REFCL installations. SCE will also initiate engineering and material purchase for the ground fault neutralizers (GFNs) to be constructed in 2023 at Acton and Phelan Substations.	N/A	Performance Report; Engineering and Material Purchase Orders	Y	Target% / Top Risk% not provided as this activity is piloting various REFCL initiatives and evaluating performance in 2022. As discussed in Section 7.3.3.12.2. The pilot performances will inform plans for 2023 and beyond; for 2023, SCE will use the risk scoring from WRRM, in addition to space, costs, and other constraints, to locate future REFCL installations.

Program Target	2019		2020		2021		2022		Units	Audited by Third-Party? (Y/N)	Notes (Including definitions and sources for Top-Risk%[61])
	Target	Perf.	Target	Perf.	Target	Perf.	Target	Target% / Top Risk%[62]			
Distribution High Fire Risk-Informed (HFRI) Inspections and Remediations IN-1.1	1) Complete visual inspection of all distribution circuits in HFRA before 5/31 2) Remediate all conditions that create a fire risk in accordance with CPUC requirements	385,292 ground; 113,900 aerial	Inspect 165,000 structures in HFRA	199,050 ground; 168,017 aerial	Inspect between 163,000 and 198,000 structures in HFRA, via both ground and aerial inspections. This target includes HFRI inspections, compliance-due structures in HFRA and emergent risks during the fire season.	179,683 ground; 180,264 aerial	Inspect 150,000 structures in HFRA via both ground and aerial inspections. Subject to resource constraints and other factors, SCE will strive to inspect up to 180,000 structures in HFRA via both ground and aerial inspections. This target includes HFRI inspections, compliance due structures in HFRA and emergent risks identified during the fire season.	32% / 25%	Structures	Y	In 2022, approximately 32% of SCE's Distribution Overhead Inspections in HFRA will address the top 25% riskiest distribution structures. These inspections will address 100% of the top 25% riskiest structures. The top 25% riskiest structures relate to the structure risk rankings from SCE's WRRM, as described in Section 4.3
Transmission High Fire Risk-Informed (HFRI) Inspections and Remediations IN-1.2	1) Complete visual inspection of all transmission circuits in HFRA before 5/31 2) Remediate all conditions that create a fire risk in accordance with CPUC requirements	50,583 ground; 38,998 aerial	Inspect 22,500 structures in HFRA	35,561 ground; 31,381 aerial	Inspect between 16,800 and 22,800 structures in HFRA, via ground and aerial inspections. This target includes HFRI inspections, compliance-due, and other structures within the vicinity for operational efficiency purposes in HFRA and emergent risks during the fire season.	20,815 ground 20,799 aerial	Inspect 16,000 structures in HFRA via both ground and aerial inspections. Subject to resource constraints and other factors, SCE will strive to inspect up to 19,000 structures in HFRA via both ground and aerial inspections. This target includes HFRI inspections, compliance due structures in HFRA and emergent risks identified during the fire season.	44% / 25%	Structures	Y	In 2022, approximately 44% of SCE's Transmission Overhead Inspections in HFRA will address the top 25% riskiest transmission structures. These inspections will address 100% of the top 25% riskiest structures. The top 25% riskiest structures relate to the structure risk rankings from SCE's WRRM, as described in Section 4.3.
Infrared Inspection of Energized Overhead Distribution Facilities and Equipment IN-3	1) Inspect 50% of overhead circuit lines in HFRA 2) Remediate conditions as required based on inspection results	4,962	Inspect 50% of distribution circuits in HFRA	5,900	Inspect approximately 50% of distribution circuits in HFRA	4,410	Inspect 4,408 distribution overhead circuit miles in HFRA	25% / 25%	Circuit miles	Y	Approximately 25% of SCE's 2022 scope for Infrared Inspections will target the remaining top 25% riskiest structures. These inspections performed over the

Program Target	2019		2020		2021		2022		Units	Audited by Third-Party? (Y/N)	Notes (Including definitions and sources for Top-Risk%[61])
	Target	Perf.	Target	Perf.	Target	Perf.	Target	Target% / Top Risk%[62]			
											two-year 2021-2022 inspection period will address 100% of the top 25% riskiest structures. The top 25% riskiest structures relate to the structure risk rankings from SCE's WRRM, as described in Section 4.3.
Infrared Inspection, Corona Scanning, and High-Definition Imagery of Energized Overhead Transmission Facilities and Equipment IN-4	1) Complete IR, Corona, and HD image scanning of all overhead transmission lines in HFRA that are loaded to 40% of rated capacity or higher 2) Integrate remediation with EOI activities	6,700	Inspect 1,000 transmission circuit miles in HFRA	1,005	Inspect 1,000 transmission circuit miles on HFRA circuits	1,046	Inspect 1,000 transmission overhead circuit miles in HFRA	84% / 25%	Circuit miles	Y	Approximately 84% of SCE's 2022 scope for IN-4 will target the top 25% riskiest circuits. The top 25% riskiest circuits relate to the transmission circuit risk rankings from SCE's WRRM,, as described in Section 4.3.
Generation High Fire Risk-Informed Inspections and Remediations in HFRA IN-5	N/A	449	Perform inspection of 200 generation-related assets	268	Complete inspection of 181 generation-related assets in HFRA	232	Inspect 190 generation-related assets in HFRA	N/A	Asset inspections	Y	Target% / Top Risk% not provided as inspections are performed on each asset every other year in HFRA Tier 2 and 3. As discussed in Section 7.3.4.10, SCE attempts to perform more inspections in Tier 3 in the first year of the two-year cycle.
Inspection and Maintenance Tools IN-8	N/A	N/A	N/A	N/A	•Transition Aerial and Transmission Ground inspection processes to a single digital platform with at least 75% of inspectors trained to use the tool by year end 2021. • Key AI/ML models leveraged by the Aerial inspection process; • Deploy scope mapping tool with GIS	T&D Aerial completed transition of inspection processes to a single digital platform and met target to train at least 75% of inspectors. Transmission Ground did not complete transition of inspection processes to a single digital platform and did not	• Design capability for the legacy Distribution Ground inspection application in 2022 to transition to a single digital inspection platform in a future year • In support of remediation efforts, conduct assessment to identify enhancements for Field Crew	N/A	Capability Implemented	Y	Target% / Top Risk% not provided as this activity is a technology platform applicable across all HFRA.

Program Target	2019		2020		2021		2022		Units	Audited by Third-Party? (Y/N)	Notes (Including definitions and sources for Top-Risk%[61])
	Target	Perf.	Target	Perf.	Target	Perf.	Target	Target% / Top Risk%[62]			
					visualization to Distribution Planning and Engineering users • Deploy remediation mobile software and iPad devices for transmission and distribution.	meet target to train at least 75% of inspectors. Key artificial intelligence/machine learning (AI/ML) models met target. Scope Mapping Tool (SMT) did not meet target to deploy tool to Distribution Planning and Engineering users. Remediation mobile software and iPad devices were deployed for Transmission however target was not met for Distribution users.	application, and evaluate applicability of enhancements by year-end 2022				
Transmission Conductor & Splice Assessment IN-9	N/A	N/A	N/A	N/A	N/A	N/A	Will inspect 75 spans[63] with Line Vue, inspect 50 splices[64] with X-Ray and obtain 5 Conductor Samples[65]; SCE will strive to inspect up to 150 spans with Line Vue, inspect up to 70 splices with X-Ray, and obtain up to 15 Conductor Samples, subject to execution constraints.	99% / 25%	Spans/splices Inspections	Y	Approximately 99% of SCE's 2022 scope for Transmission Conductor & Splice will target the remaining top 25% riskiest structures. The top 25% riskiest structures relate to the program structure risk rankings from SCE's WRRM combined with an environmental multiplier, as described in Section 7.3.4.5.1.

[63] Span defined as 1 phase from one structure to another
[64] Splice defined as individual splice
[65] Conductor Sample defined as 15ft segment of conductor

Program Target	2019		2020		2021		2022		Units	Audited by Third-Party? (Y/N)	Notes (Including definitions and sources for Top-Risk%[61])
	Target	Perf.	Target	Perf.	Target	Perf.	Target	Target% / Top Risk%[62]			
Hazard Tree Management Program VM-1	1) Perform at least 125,000 tree-specific threat assessments in HFRA 2) Perform at least 7,500 risk-based tree removals or mitigations in HFRA	~130,000	Assess 75,000 trees for hazardous conditions and perform prescribed mitigations in accordance with program guidelines and schedules	~100,000	Assess between 150,000 and 200,000 trees for hazardous conditions and perform prescribed mitigations in accordance with program guidelines and schedules Updated forecast shared in SCE's Nov 1 change order to OEIS was 120K-130K.	~131,400	Inspect 330 circuits and assess any trees with strike potential along those circuits.	44% / 36%	Circuits inspected	Y	Approximately 44% of SCE's 2022 scope for HTMP will target the remaining top 36% riskiest circuits. The remaining top 36% riskiest circuits relate to rankings from SCE's Tree Risk Index, as described in Section 4.5.
Expanded Pole Brushing VM-2	1) Inspect and clear brush to 10 feet radial clearance at the base of the pole (at least 25,000) poles 2) Clear brush as necessary to achieve 10 feet of clearance	~160,000	Perform brush clearance of 200,000 poles. SCE will strive to perform brush clearance for 300,000 poles subject to resource constraints and other execution risks	~230,000	SCE plans to pole brush between 200,000 and 300,000 Distribution poles	~163,100	SCE will inspect and clear (where clearance is needed) 78,700 poles in HFRA, with the exception of poles for which there are customer access or environmental constraints. SCE will strive to inspect and clear (where clearance is needed) up to 170,000 distribution poles in HFRA. These poles are in addition to poles subject to PRC 4292.	N/A	Poles brushed	Y	As discussed in Section 7.3.4.5.1, Pole brushing is performed annually and is subject to availability of resources to perform the work; therefore, SCE considers operational efficiency as a major driver in prioritizing categories of poles to brush. As such, Target% / Top Risk% is not provided for this activity. The pole count in this goal is based in part on the number of poles included in identified AOCs in 2021. If the AOC boundaries change significantly in 2022, due to changed climate conditions or other factors used to determine AOC scope, SCE will make reasonable attempts to access, inspect and clear, where necessary, all

Program Target	2019		2020		2021		2022		Units	Audited by Third-Party? (Y/N)	Notes (Including definitions and sources for Top-Risk%[61])
	Target	Perf.	Target	Perf.	Target	Perf.	Target	Target% / Top Risk%[62]			
											environmentally approved poles within the defined/identified AOC boundaries for 2022, whether that pole count is lesser or greater than the anticipated 26,400.
Expanded Clearances for Legacy Facilities VM-3	N/A	N/A	Perform assessments of all identified facilities in HFRA. Establish enhanced buffers at 30% of identified facilities	61 sites treated	Treat 46 sites	62 sites treated	Perform expanded clearances at 32 legacy facility locations	66% /28%	Sites treated	Y	Approximately 66% of SCE's 2022 scope for VM-3 will target the remaining top 28% riskiest legacy facilities. The remaining top 28% riskiest legacy facilities relate to the risk rankings from the program's prioritization method, as described in Section 7.3.5.5.3.
Dead and Dying Tree Removal VM-4	1) Perform all quarterly Dead and Dying Tree inspections. 2) Remove identified dead, dying, or diseased trees in accordance with SCE's vegetation management program	All planned assessments completed, ~13,500 removals identified	Perform Dead and Dying Tree annual inspection scope and complete prescribed mitigations in accordance with internal Dead and Dying Tree program guidelines	All planned assessments completed, ~9,000 removals identified	Perform Dead and Dying Tree annual inspections and perform prescribed mitigations in accordance with program guidelines and schedules	Assessments performed on 1,301 Circuits	Inspect 900 unique circuits and prescribe mitigation for dead and dying trees with strike potential along those circuits.	N/A	Circuits inspected	Y	Target% / Top Risk% not provided as this activity SCE patrols the entire HFRA areas several times a year as conditions warrant to identify and remove compromised trees.
Vegetation Management Work Management Tool (Arbora) VM-6	N/A	N/A	N/A	Implemented release 1 application functionality for pilot user group for Dead & Dying Tree Removal	Continue Work Management Tool (Arbora) agile development and releases in accordance with project plan – complete full rollout of Dead & Dying Tree Removal and Hazard Tree Mitigation, and conduct discovery and design architecture	SCE did complete initial discovery and design architecture for the routine Line Clearing portion of this activity and deployed as planned. However, SCE had to re-design architecture for the Hazard Tree Management Program and Dead and	SCE will implement the following programs within the VM Work Management Tool, Arbora: (1) Hazardous Tree Program (HTP) (including: Dead & Dying Tree Removal and Hazard Tree Mitigation) and (2) Routine Line Clearing	N/A	N/A	Y	Target% / Top Risk% not provided as this activity is a technology platform applicable across all HFRA.

Program Target	2019		2020		2021		2022		Units	Audited by Third-Party? (Y/N)	Notes (Including definitions and sources for Top-Risk%[61])
	Target	Perf.	Target	Perf.	Target	Perf.	Target	Target% / Top Risk%[62]			
					associated with Line Clearing	Dying Tree Removal due to data volume limitations and inability to calculate and assess risk scores, requiring additional development time and moving timeline to 2022.					
Detailed inspection s and management pract ices for vegetation clearances around distribution electri cal lines, and equip ment	N/A	N/A	SCE inspected 470,000 trees adjacent to distribution lines	SCE inspected 470,000 trees adjacent to distribution lines	SCE inspected 600,000 trees adjacent to distribution lines	SCE inspected 600,000 trees adjacent to distribution lines	In its HFRA for 2022, SCE plans to inspect approximately 600,000 trees adjacent to distribution lines, based on current unique tree inventory count. Tree inventory is subject to fluctuations based on actual field conditions.	N/A	Trees Inspected	Y	In accordance with Pub. Util. Code Section 8386.3I(5), SCE has populated Table 5.3-1 with vegetation management program targets that the utility can determine when it has completed a "substantial portion" and that Energy Safety can subsequently audit. As the additional vegetation management program targets are not designated SCE wildfire programs they do not have an associated Target% / Top Risk%.
Detailed inspection s and management practices for vegetation clearances around transmission infras tructure lines, and equipment	N/A	N/A	SCE inspected 180,000 trees adjacent to transmission lines	SCE inspected 180,000 trees adjacent to transmission lines	SCE inspected 190,000 trees adjacent to transmission lines	SCE inspected 190,000 trees adjacent to transmission lines	In its HFRA for 2022, SCE plans to inspect approximately 100,000 trees adjacent to transmission lines, based on current unique tree inventory count. Tree inventory is subject to fluctuations based on actual field conditions.	N/A	Trees Inspected	Y	In accordance with Pub. Util. Code Section 8386.3I(5), SCE has populated Table 5.3-1 with vegetation management program targets that the utility can determine when it has completed a "substantial portion" and that Energy Safety can subsequently audit.

Program Target	2019		2020		2021		2022		Units	Audited by Third-Party? (Y/N)	Notes (Including definitions and sources for Top-Risk%[61])
	Target	Perf.	Target	Perf.	Target	Perf.	Target	Target% / Top Risk%[62]			
											As the additional vegetation management program targets are not designated SCE wildfire programs they do not have an associated Target% / Top Risk%.
Emergency respon se vegetation man agement due to re d flag warning or o ther urgent climate conditions	N/A	N/A	N/A	N/A	N/A	N/A	SCE will inspect and clear (where clearance is needed) approximately 26,400 poles in identified Areas of Concern (AOC), with the exception of poles for which there are customer access or environmental constraints. These poles are included in the count of the Expanded Pole Brushing (VM-2) goal.	N/A	Poles brushed	Y	In accordance with Pub. Util. Code Section 8386.3I(5), SCE has populated Table 5.3-1 with vegetation management program targets that the utility can determine when it has completed a "substantial portion" and that Energy Safety can subsequently audit. As the additional vegetation management program targets are not designated SCE wildfire programs they do not have an associated Target% / Top Risk%. The pole count in this goal is based on the number of poles included in identified AOCs in 2021. If the AOC boundaries change significantly in 2022, due to changed climate conditions or other factors used to determine AOC scope, SCE will make reasonable attempts

Program Target	2019		2020		2021		2022		Units	Audited by Third-Party? (Y/N)	Notes (Including definitions and sources for Top-Risk%[61])
	Target	Perf.	Target	Perf.	Target	Perf.	Target	Target% / Top Risk%[62]			
											to access, inspect and clear, where necessary, all environmentally approved poles within the defined/identified AOC boundaries for 2022, whether that pole count is lesser or greater than the anticipated 26,400.
Recruiting and training of vegetation management personnel	N/A	N/A	N/A	N/A	N/A	N/A	Maintain the current staffing levels of 95 International Society of Arboriculture (ISA) certified arborists performing work within SCEs service territory. Inclusive of SCE personnel and contractors.	N/A	ISA Certified Arborists	Y	In accordance with Pub. Util. Code Section 8386.3I(5), SCE has populated Table 5.3-1 with vegetation management program targets that the utility can determine when it has completed a "substantial portion" and that Energy Safety can subsequently audit. As the additional vegetation management program targets are not designated SCE wildfire programs they do not have an associated Target% / Top Risk%.
Substation Inspections	N/A	N/A	N/A	N/A	N/A	N/A	SCE performs substation inspections on 169 substations in HFRA. SCE plans to inspect all 169 substations, 5 times a year for GO174 Substations (146 Substations) and ISO & FERC Substations (23 Substations), for a total of 845 inspections.	N/A	Substation Inspected	Y	In accordance with Pub. Util. Code Section 8386.3I(5), SCE has populated Table 5.3-1 with vegetation management program targets that the utility can determine when it has completed a "substantial portion" and that Energy

Program Target	2019		2020		2021		2022		Units	Audited by Third-Party? (Y/N)	Notes (Including definitions and sources for Top-Risk%[61])
	Target	Perf.	Target	Perf.	Target	Perf.	Target	Target% / Top Risk%[62]			
											Safety can subsequently audit. As the additional vegetation management program targets are not designated SCE wildfire programs they do not have an associated Target% / Top Risk%.
Vegetation Inspections Audited Annually	400 Transmission circuit miles 450 Distribution circuit miles	870 Transmission circuit miles 2,155 Distribution circuit miles	Perform 3,000 risk based HFRA circuit mile vegetation management Quality Control inspections	SCE achieved over 6,000 HFRA circuit mile inspections	Perform 3,000 risk-based HFRA circuit mile vegetation management Quality Control inspections	SCE achieved over 6,000 HFRA circuit mile inspections	SCE plans to perform risk-based circuit mile Quality Control (QC) inspections on approximately 15% of SCEs total tree inventory.	N/A	% of vegetation inspections audited	Y	In accordance with Pub. Util. Code Section 8386.3I(5), SCE has populated Table 5.3-1 with vegetation management program targets that the utility can determine when it has completed a "substantial portion" and that Energy Safety can subsequently audit. As the additional vegetation management program targets are not designated SCE wildfire programs they do not have an associated Target% / Top Risk%.
Poles brushed per PRC 4292	N/A	N/A	N/A	N/A	N/A	N/A	SCE will inspect and clear (where clearance is needed) 55,100 poles in State Responsibility Area with the equipment identified by PRC 4292, with the exception of poles for which there are customer access or environmental constraints, or poles that are exempt under 14 Cal. Code of	N/A	# of poles brushed (cleared)	Y	In accordance with Pub. Util. Code Section 8386.3I(5), SCE has populated Table 5.3-1 with vegetation management program targets that the utility can determine when it has completed a "substantial portion" and that Energy Safety can

Program Target	2019		2020		2021		2022		Units	Audited by Third-Party? (Y/N)	Notes (Including definitions and sources for Top-Risk%[61])
	Target	Perf.	Target	Perf.	Target	Perf.	Target	Target% / Top Risk%[62]			
							Regulations 1255 (e.g., poles in fruit orchards that are plowed or cultivated).				subsequently audit. As the additional vegetation management program targets are not designated SCE wildfire programs they do not have an associated Target% / Top Risk%.
LiDAR Vegetation Inspections – Distribution	N/A	N/A	N/A	N/A	Perform LiDAR inspections on approximately 90 circuit miles	Performed LiDAR inspections on approximately 90 circuit miles	SCE will inspect at least 500 HFRA circuit miles	N/A	Number of Circuit Miles	Y	In accordance with Pub. Util. Code Section 8386.3I(5), SCE has populated Table 5.3-1 with vegetation management program targets that the utility can determine when it has completed a "substantial portion" and that Energy Safety can subsequently audit. As the additional vegetation management program targets are not designated SCE wildfire programs they do not have an associated Target% / Top Risk%.
LiDAR Vegetation Inspections – Transmission	Perform LiDAR inspections on approximately 1,000 circuit miles	Perform LiDAR inspections on approximately 1,570 circuit miles	Perform LiDAR inspections on approximately 1,700 circuit miles	Perform LiDAR inspection on approximately 1,700 circuit miles	Perform LiDAR inspections on approximately 1,590 circuit miles	Perform LiDAR inspections on approximately 1,590 circuit miles	SCE will inspect at least 1600 HFRA circuit miles	N/A	Number of Circuit Miles	Y	In accordance with Pub. Util. Code Section 8386.3I(5), SCE has populated Table 5.3-1 with vegetation management program targets that the utility can determine when it has completed a "substantial portion" and that Energy Safety can subsequently audit.

Program Target	2019		2020		2021		2022		Units	Audited by Third-Party? (Y/N)	Notes (Including definitions and sources for Top-Risk%[61])
	Target	Perf.	Target	Perf.	Target	Perf.	Target	Target% / Top Risk%[62]			
											As the additional vegetation management program targets are not designated SCE wildfire programs they do not have an associated Target% / Top Risk%.
Substation vegetation inspections	N/A	N/A	N/A	N/A	N/A	N/A	SCE will perform Vegetation Management substation inspections in Tier 2 & Tier 3 totaling 169 substations.	N/A	# of substations inspected	Y	In accordance with Pub. Util. Code Section 8386.3I(5), SCE has populated Table 5.3-1 with vegetation management program targets that the utility can determine when it has completed a "substantial portion" and that Energy Safety can subsequently audit. As the additional vegetation management program targets are not designated SCE wildfire programs they do not have an associated Target% / Top Risk%.
Customer Care Programs PSPS-2	N/A	CRC: Contracted with 13 CRCs. Community Resiliency Programs: Identified, and secured agreement from one pilot customer. Customer Resiliency Equipment: N/A	Have 23 sites available across SCE service territory for customers impacted by a PSPS Develop a customer resiliency equipment incentive pilot program that provides financial support to customers willing to increase resiliency within its HFRA One customer will	CRC: 56 contracted CRCs. Community Resiliency Programs: Secured Customer Agreements for four Resiliency Zone sites. Completed installation of microgrid islanding capability for first pilot customer for CREI. Customer Resiliency Equipment: CCBB - Reached out to all	CRC: Adjust as needed. Community Resiliency Programs: Goals for Resilience Zones dependent on community potential customers. Targeting to obtain 5 to 10 agreements. Complete installation of microgrid islanding (CREI) capability on second pilot customer. Customer Resiliency	CRC: contracted 11 new indoor CRC and 2 outdoor CRC locations resulting in a total of 64 active CRC sites as of 12/31/2021. Community Resiliency Programs: Executed on four out of 5 customer agreements. Customer Resiliency Equipment: CCBB: Expanded program to eligible	Customer Resiliency Equipment: CCBB: Enroll 2,750 customers in the CCBB program (35% of forecasted eligible population). Continue to identify new eligible customers each month to offer program. Portable Power Station Rebates and Portable Generator Rebates: SCE to issue 3,000 rebates	N/A	Number of customers participating in the program	Y	

Program Target	2019		2020		2021		2022		Units	Audited by Third-Party? (Y/N)	Notes (Including definitions and sources for Top-Risk%[61])
	Target	Perf.	Target	Perf.	Target	Perf.	Target	Target% / Top Risk%[62]			
			be implemented for this pilot in 2020.	eligible 'Critical Care' MBL customers enrolled in CARE/FERA residing in an HFRA. 837 customers enrolled; 721 batteries deployed. Residential Battery Station Rebates: 856 redeemed Well Water: 185 rebates redeemed	Equipment: CCBB: Expand program to eligible MBL customers who are enrolled in CARE/ FERA and reside HFRA. Expand marketing and outreach plans. Well Water & Res Battery Station Rebates: Enhance the programs to increase customer participation by 20% - 40%	MBL customers enrolled in CARE/FERA and reside HFRA and established additional partners (CBOs). Res Battery Station Rebate & Well Water Generator Rebate: Increased customer participation by 93%.	and will strive to issue 4,000 rebates.				
Customer Education and Engagement – Community Meetings DEP-1.2	Develop Local Government Education and Engagement Community Meeting plan. Execute Local Government Education and Engagement Community Meeting according to plan	Hosted 13 in-person community meetings	Host 8-12 community meetings in areas impacted by 2019 PSPS plus other meetings including online as determined to share information about PSPS, emergency preparedness, and SCE's wildfire mitigation plan	Hosted nine virtual community meetings	Host at least nine virtual community meetings SCE will complete additional meetings as needed in 2021, based on PSPS impact to communities, up to 18	Hosted 11 wildfire safety community livestream meetings for communities to learn more about SCE's wildfire mitigation plan, PSPS, and emergency preparedness. SCE exceeded its 2021 goal of hosting nine meetings.	SCE will host at least nine wildfire community safety meetings in targeted communities based on the impact of 2021 PSPS events and ongoing wildfire mitigation activities.	N/A	Community meetings	Y	
Customer Education and Engagement – Marketing Campaign DEP-1.3	Conduct a direct mail campaign to inform customers in HFRA	PSPS Awareness of 54% exceeded goal of 40%	Marketing campaign to reach 5,000,000 Customer Accounts (goal of 40% awareness about the purpose of PSPS, emergency preparedness, and SCE's wildfire mitigation plan)	PSPS Awareness of 56% exceeded goal of 40%	PSPS Awareness goal: 50%	2021 PSPS awareness was at ~60%	PSPS Awareness goal: 50%	N/A	Customer awareness percentage	Y	
SCE Emergency Responder Training DEP-2	1) Wildfire response training for new or existing responders 2) Conduct internal IMT Training around wildfire response and de	IMT – Trained 100% of the members. Unmanned Aerial Systems (UAS – N/A, program started in 2020	Hold SCE IMT member training on de- energization protocols, determine additional staffing needs and train, exercise and qualify new staff	IMT – Trained 100% of the members. UAS – Trained 50 operators	IMT – Have all PSPS IMT and Task Force members fully trained and qualified or requalified by July 1, 2021 UAS – In 2021 SCE plans to expand the	IMT – Trained 100% of the members. UAS – 60 Resources passed the FAA) 107 exam in 2021	IMT – Have all PSPS IMT and Task Force members fully trained and qualified or requalified by July 1, 2022 UAS – SCE plans to expand the program by	N/A	Persons trained (IMT) Persons qualified (UAS)	Y	

Program Target	2019		2020		2021		2022		Units	Audited by Third-Party? (Y/N)	Notes (Including definitions and sources for Top-Risk%[61])
	Target	Perf.	Target	Perf.	Target	Perf.	Target	Target% / Top Risk%[62]			
					program by an additional 50 operators over 2020 levels		technically qualifying 50 UAS Operators that have passed the FAA 107 exam.				
Customer Research and Education DEP-4	N/A	N/A (commenced planning for the 2019 PSPS Tracker to capture feedback on the 2019 events)	Develop/implement various research activities that gauge customer awareness, preparedness for, and satisfaction with outage experiences; to include but not be limited to: town hall meetings, online & telephone surveys, focus groups, and assessments of programs & services to prepare customers before and after PSPS outages	Administered 5 surveys (PSPS Tracker Survey to capture feedback on the 2019 events; wildfire community meeting feedback survey, CRC/CCV feedback survey, PSPS digital user experience survey, In-Language Wildfire Mitigation Communications Effectiveness Pre/Post Survey	Administer at least 4 PSPS-related surveys (PSPS Tracker Survey to capture feedback on the 2020 events, wildfire community meeting feedback survey, CRC/CCV feedback survey, In-Language Wildfire Mitigation Communications Effectiveness Pre/Post Survey)	Administered 9 surveys: PSPS Tracker, wildfire safety community meeting surveys, CRC/CCV visitation surveys, In-Language Wildfire Mitigation Communications Effectiveness Pre-/Post-Surveys, AFN Customer & CBO Research Study, AFN Webpage User Experience Research, PSPS Working Groups/Advisory Board Surveys, Post PSPS Event Surveys for Public Safety Partners, Voice of Customer Surveys	SCE plans to conduct at least six PSPS-related surveys in 2022, including the PSPS Tracker survey, wildfire safety community meeting feedback survey, CRC/CCV feedback survey, In-Language Wildfire Mitigation Communications Effectiveness Surveys, PSPS Working Group and Advisory Board Surveys, and the Voice of Customer surveys.	N/A	Number of surveys	Y	
Aerial Suppression DEP-5	N/A	N/A	N/A	Provided funding for 1 aerial suppression resource in partnership with Orange County Fire Authority	Will enter a Memorandum of Understanding (MOU) with local county fire departments to provide standby cost funding for up to 5 aerial suppression resources strategically placed around the SCE service area	Provided funding to support three local fire agencies. In consultation with the fire agencies, SCE identified the optimal strategy for the placement of these resources, based on SCE's budget parameters, placing one resource in Ventura County, one in Los Angeles County and two in Orange County.	Will enter into a Memorandum of Understanding (MOU) with local county fire departments to provide standby cost funding for up to five aerial suppression resources strategically placed around the SCE service area	N/A	Aerial Suppression resources	Y	

Program Target	2019		2020		2021		2022		Units	Audited by Third-Party? (Y/N)	Notes (Including definitions and sources for Top-Risk%[61])
	Target	Perf.	Target	Perf.	Target	Perf.	Target	Target% / Top Risk%[62]			
Wildfire Safety Data Mart and Data Management (WiSDM / Ezy) DG-1	N/A	N/A	N/A	N/A	WiSDM: - Complete the WisDM solution analysis and design for centralized data repository - Initiate staggered consolidation of datasets from SCE Enterprise systems Ezy Data: - Implement the cloud platform infrastructure for Ezy Data - Build a solution for data consumption, storage and visualization of inspection data (LiDAR, HD video, photograph) - Enable an environment for Artificial Intelligence (AI) assisted analytics	Ezy Data met target to include implementing the cloud platform infrastructure for Ezy Data and enabling an environment for Artificial Intelligence (AI) assisted analytics. WiSDM met target in December 2021 after initiating the staggered consolidation of datasets and included two datasets, weather stations and HD cameras, into the WiSDM centralized repository.	**Ezy Data:** **1)** Expand cloud Artificial Intelligence (AI) platform **2)** Enable LIDAR data storage capability **WiSDM:** **1)** Complete wildfire data repository design **2)** Consolidate wildfire data storage onto wildfire data repository platform	N/A	N/A	Y	

5.4 PLANNING FOR WORKFORCE AND OTHER LIMITED RESOURCES

Report on worker qualifications and training practices regarding wildfire and PSPS mitigation for workers in the following target roles:

1. *Vegetation inspections*
2. *Vegetation management projects*
3. *Asset inspections*
4. *Grid hardening*
5. *Risk event inspection*

For each of the target roles listed above:

1. List all worker titles relevant to target role (target roles listed above).

2. For each worker title, list and explain minimum qualifications with an emphasis on qualifications relevant to wildfire and PSPS mitigation. Note if the job requirements include the following:

a. Going beyond a basic knowledge of General Order 95 requirements to perform relevant types of inspections or activities in the target role.

b. Being a "Qualified Electrical Worker" (QEW) and define what certifications, qualifications, experience, etc. is required to be a QEW for the target role for the utility.

c. Include special certification requirements such as being an International Society of Arboriculture (ISA) Certified Arborist with specialty certification as a Utility Specialist.

3. Report percentage of Full Time Employees (FTEs) in target role with specific job title.

4. Provide a summarized report detailing the overall percentage of FTEs with qualifications listed in (2) for each of the target roles.

5. Report plans to improve qualifications of workers relevant to wildfire and PSPS mitigation. The utility must explain how they are developing more robust outreach and onboarding training programs for new electric workers to identify hazards that could ignite wildfires.

5.4.1 Target role: Vegetation inspections

1. *Worker titles in target role*
2. *Minimum qualifications*
3. *FTE percentages by title in target role*
4. *Percent of FTEs by high-interest qualification*

5. *Plans to improve worker qualifications*

5.4.2 Target role: Vegetation management projects

1. *Worker titles in target role*
2. *Minimum qualifications*
3. *FTE percentages by title in target role*
4. *Percent of FTEs by high-interest qualification*
5. *Plans to improve worker qualifications*

5.4.3 Target role: Asset Inspections

1. *Worker titles in target role*
2. *Minimum qualifications*
3. *FTE percentages by title in target role*
4. *Percent of FTEs by high-interest qualification*
5. *Plans to improve worker qualifications*

5.4.4 Target role: Grid hardening

1. *Worker titles in target role*
2. *Minimum qualifications*
3. *FTE percentages by title in target role*
4. *Percent of FTEs by high-interest qualification*
5. *Plans to improve worker qualifications*

5.4.5 Target role: Risk event inspections

1. *Worker titles in target role*
2. *Minimum qualifications*
3. *FTE percentages by title in target role*
4. *Percent of FTEs by high-interest qualification*
5. *Plans to improve worker qualifications*

SCE summarizes the applicable information pertaining to items 1 through 4 in the tables below, for each of the five target roles identified. Full time employee (FTE) figures represent counts and percentages as of year-end 2021 and include SCE and Contractor field workers relevant to each target role. It is important to note that worker counts can fluctuate throughout the year depending on work required, resource availability, etc., particularly with contract workers. Below each table, SCE provides a more detailed description of the qualifications for each role (Item 2), as well as discussion on training and plans to improve worker qualifications (Item 5).

5.4.1 Target Role: Vegetation Inspections

SCE's Vegetation Management program performs several types of inspections to identify the risk of vegetation contact with energized conductors and electrical assets. See Section 7.3.5 for detailed information on vegetation management inspections.

Table SCE 5-1 and Table SCE 5-2 detail the worker titles and associated qualifications pertaining to Vegetation Inspections.

Table SCE 5-1

Vegetation Inspections (SCE)

(1)	(2a.b.c)	(3)	(4)[66]
SCE Worker Titles	Minimum Qualifications relevant to wildfire and PSPS mitigation	FTE % by Target Role	FTE % by High-Interest Qualification
SPECIALISTS	See Below	22.9%	33%[67]
SENIOR SPECIALISTS	ISA Arborists	77.1%	100%
		100%	

Table SCE 5-2

Vegetation Inspections (Contractor)

(1)	(2a.b.c)	(3)	(4)
Contractor Worker Titles	Minimum Qualifications relevant to wildfire and PSPS mitigation	FTE % by Target Role	FTE % by High-Interest Qualification
SENIOR SPECIALISTS	ISA Arborists	5.3%	100%
LEAD PRE-INSPECTORS	ISA Arborists	8.9%	100%
PRE-INSPECTORS	See below	48.4%	N/A

[66] SCE defines High-Interest Qualification as one of the three listed sub-qualifications identified in part 2 of this prompt.

[67] A Specialist who obtains ISA-certification is eligible to apply to become a Senior Specialist

(1)	(2a.b.c)	(3)	(4)
Contractor Worker Titles	Minimum Qualifications relevant to wildfire and PSPS mitigation	FTE % by Target Role	FTE % by High-Interest Qualification
CUSTOMER COORDINATORS	See below	11.8%	N/A
GENERAL FOREMAN	See below	17.9%	N/A
QC INSPECTORS	ISA Arborists; See Below	7.6%	59%
		100%	

All Vegetation Management field workers must meet certain minimum qualifications. In some cases, certain worker types are required to be International Society of Arboriculture (ISA) certified. Specific qualifications for each position are detailed below.

Additional Minimum Qualifications:

SPECIALISTS: Provides oversight and guidance to field contractors performing vegetation work. All of SCE's Specialists must have three or more years' experience in Utility Vegetation Management.

SENIOR SPECIALISTS: Provides oversight and guidance to field contractors performing vegetation work. Senior Specialists have additional responsibilities such as being able to perform post-work verification (to help ensure that work is done to regulatory requirements and program standards), responding to trouble orders, and performing review of work performed on SCE's Bulk Transmission System and must be ISA Certified Arborists.

- To earn a credential as an ISA Certified Arborist, an individual must be trained and knowledgeablein all aspects of arboriculture and adhere to the ISA's Code of Ethics. To be eligible, individuals must have one or both of the following: Three or more years of full time, eligible, practical work experience in arboriculture; a degree in the field of arboriculture, horticulture, landscape architecture, or forestry from a regionally accredited educational institute

PRE-INSPECTORS: Personnel performing pre-inspections without supervision responsibilities. Pre-Inspectors are qualified if they meet one of the following conditions at date of hire: Possess a 4-year degree in related field with ability to obtain ISA certification in 12 months; possess a 2-year degree in related field with one year experience and ability to obtain certification in 12 months; possess two years of industry experience with the ability to obtain ISA certification in 12 months.

CUSTOMER COORDINATORS: Issues notifications regarding upcoming vegetation management work, fields customer constraints (e.g., refusals, issues with site access, etc.) related to vegetation management work, and works to obtain customer permissions, e.g., for recommended enhanced clearances. To qualify, the individual must possess a minimum of two years of related utility vegetation management pruning, inspection, or planning experience.

GENERAL FOREMAN: Oversees crew operations by helping to ensure crew safety, scheduling work based on crew qualifications, resolving escalated customer constraints, and coordinating with the Senior

Specialists in their district. At a minimum, SCE's contracts require one designated General Foreman per every eight crews. The General Foremen must be ISA Certified Arborists and/or must possess a minimum of three years of related utility vegetation management pruning, inspection, or planning experience.

QUALITY CONTROL (QC) INSPECTORS: QC Inspectors are independent of vegetation management operations and perform inspections to verify that regulatory and program standards have been achieved. They must have either an ISA Arborist Certification or have a minimum of two years of experience performing utility vegetation inspections and have experience measuring vegetation to conductor clearance using precision measuringtools. Once the inspector is eligible for ISA certification, it is expected that the inspector will become certified within six months of eligibility.

(5) Training and plans to improve worker qualifications:

SCE provides annual training – Utility Vegetation Management Core Plans Training – to all vegetation management employeesand vegetation contractor lead personnel. This training provides detailed reviews of program requirements, practices, and procedures, and any updates or enhancements pertaining to SCE's vegetation management program. Typical training included in Core Plans Training reviews the following vegetation management process documents that guide work in this space: Transmission Vegetation Management Plan (TVMP); Distribution Vegetation Management Plan (DVMP); Hazard Tree Management Plan; Vegetation Threat Management; Customer Refusals; and QC and SCE's Oversight Strategy. As it pertains to wildfire mitigation practices, this training identifies and conveys differences in inspecting and pruning practices (e.g., clearance distances) within SCE's HFRA vs. non-HFRA.

In addition to Core Plans Training, all vegetation management personnel receive training to identify and understand the actionsrequired when work is being performed in environmentally sensitive locations. For SCE's Bulk Transmission vegetation management inspections, SCE also provides technical training on how to use LiDAR-acquired data to determine vegetation encroachments into the minimum vegetation clearance distance.

To grow the pool of ISA-certified arborists, SCE plans to continue to hire Specialists who do not yet have an ISA-certification but who will, under the guidance of Senior Specialists, acquire the vegetation management-relatedexperience necessary to meet the experience requirement for an ISA-certification.[68]

[68] More information about how SCE grows its pool of ISA Certified Arborists can be found in SCE's response to deficiency Guidance-11, filed September 9, 2020.

5.4.2 Target Role: Vegetation Management Projects

SCE's vegetation management projects are programs focused on removing hazards, such as dead and dying trees and those that are in proximity and may pose a risk to electric facilities. The two programs are described below.

- **The Hazard Tree Management Program (HTMP)** program identifies, documents, and mitigates trees that are located within the Utility Strike Zone (USZ) and are expected to pose a risk to electricfacilities based on the tree's observed structural condition and site considerations. The program mitigates the potential risk to SCE's electric facilities from structurally unsound trees that can fail in total or in part, and palm trees that can dislodge palm fronds during high winds.

- **The Dead and Dying Trees initiative (formerly Drought Relief Initiative (DRI))** removes trees that are dead, dying, or diseased as part of activities that historically comprised the Bark Beetle Infestation Remediation and Drought Remediation programs. SCE has and continues to proactively remove dead, dying, and diseased trees that could fall on or contact SCE's electrical facilities. Unlike trees located near power lines that must be trimmed to prevent encroachment, large dead or dying trees can be located outside of the Right-of-Way and still fall into power lines.

Table SCE 5-3 and Table SCE 5-4 below detail the worker titles and associated qualifications pertaining to Vegetation Projects.

Table SCE 5-3

Vegetation Management Projects (SCE)

(1)	(2a.b.c)	(3)	(4)
SCE Worker Titles	Qualifications relevant to wildfire and PSPS mitigation	FTE % by Target Role	FTE % by High Interest Qualification
SPECIALISTS	See Below	22.9%	33%
SENIOR SPECIALISTS	ISA Arborists	77.1%	100%
		100%	

Table SCE 5-4

Vegetation Management Projects (Contractor)

(1)	(2a.b.c)	(3)	(4)
Contractor Worker Titles	Qualifications relevant to wildfire and PSPS mitigation	FTE % by Target Role	FTE % by High Interest Qualification
SENIOR SPECIALISTS	ISA Arborists	11.1%	100%
HTMP ASSESSORS	ISA Arborists	19.4%	100%
DEAD AND DYING TREE ASSESSORS	See Below	21.7%	N/A
QC HTMP ASSESSORS	ISA Arborists[69]	1.7%	100%
FOREMAN	See Below	6.1%	N/A
HAZARDOUS TREE SPECIALIST	See Below	2.8%	N/A
POLE BRUSHERS	See Below	37.2%	N/A
		100%	

Additional Minimum Qualifications:

SPECIALISTS: Support Senior Specialists in their HTMP and Dead and Dying Tree Program work. Specialists are also not assigned to specificgeographic Districts and are available to support where needed. See qualifications of Specialist in Section 5.4.1.

SENIOR SPECIALISTS: Resolve customer constraints and help ensure that the HTMP and Dead and Dying Tree Program work is done. See qualifications of Senior Specialist in Section 5.4.1

HTMP ASSESSORS: Responsible for conducting risk assessments on trees located in the USZ. They are qualified if, at date of hire, they possess an ISA Arborist Certification and a minimum of three years of related utility vegetation management inspection/planning experience.

DEAD AND DYING TREE ASSESSORS: are responsible for performing visual inspections to detect dead, dying and diseased treesin the field. They are qualified if, at date of hire, they have the requisite

[69] ISA certification is required when performing QC of the risk-score. ISA certification is not required when QC is only verifying tree has been mitigated. ISA certification is not required when QC is only verifying tree has been mitigated.

experience as a vegetation management professional and have two years of previous utility vegetation management experience.

QC HTMP ASSESSORS: are independent of HTMP operations and perform two specific roles related to QC of HTMP: Perform an independent risk assessment to verify the accuracy of the risk assessment score achieved by the HTMP assessors; and verify all HTMP remediations have been performed. ISA Certification is only required for HTMP QC personnel who perform risk assessment. All other QC work requires a minimum of two years of experience performing utility vegetation inspections.

FOREMAN: Oversees work performed by crews to help ensure proper tools and equipment are available and the work is performed safely; help ensures process adherence and conducts QC reviews. Must have knowledge of: Brush clearance requirements; herbicide restrictions; and environmental requirements. Skills and abilities required for this job are of a level comparable with those normally acquired through a high school education and extensive training and experience as a Pole Brusher.

HAZARDOUS TREE SPECIALIST: Conducts the felling of trees and identifies the hazards and obstacles before and after felling each tree. Provides direction to crews and helps allocate resources and equipment such that work is performed safely and efficiently, and without compromising surrounding trees and environment. The knowledge, skills, and abilities required for this job are of a level comparable with those normally acquired through a high school education, supplemented by one year of experience as a timber faller with thorough knowledge tree soundness and cutting techniques to directionally fall trees.

POLE BRUSHERS: Responsible for conducting pole brushing on trees by eliminating weeds, grass, and other flammable materials to bare soil by mechanical and/or chemical methods from 10-foot radius at ground level to a height of 8 feet. Skills and abilities required for this job are of a level comparable with those normally acquired through a high school education and annual environmental training.

(5) Training summary and plans to improve worker qualifications:

Training for HTMP and the Dead and Dying Tree Program includes: Training of specific HTMP and Dead and Dying Tree Program processes; refusal management; vegetation threat management; QC requirements; Tree Risk Calculator training for those involved in HTMP; and environmental-specific training.

Through the substantive minimum qualifications established for the various roles within Vegetation Projects, SCE has established the foundation of a strong skilled workforce. SCE will continue requiring the qualifications discussed above and encourage continued advancement of SCE and Contract workers. For example, once an assessor is eligible for ISA certification, it is expected that he or she will become certified within twelve months of eligibility.

As part of continuing education and improvement of the vegetation management program, SCE updates its training programs based on lessons learned. SCE also provides refresher training and relevant communications to workerson updated guidelines, as there are typically changes in protocols that occur each year.

5.4.3 Target Role: Asset Inspections

SCE performs inspections of SCE's overhead distribution and transmission electric system in its HFRA that go beyond compliance requirements. These inspections are performed at ground level and aerially.For details on SCE wildfire-related inspection programs, please see Section 7.3.4.

SCE performs aerial and ground inspections of its transmission and distribution assets to identify hazards that could lead to safety and reliability issues. SCE uses employees and contractors to take high-definition imagery of assets from the air, either via helicopter or UAS. In some cases, helicopters will also collect LiDAR data.

SCE Aircraft Operations employs a rigorous aviation vendor qualification audit to determine a prospective aviation vendor's suitability to provide aviation services for SCE. Appropriate Federal Aviation Administration (FAA) certifications[70] are a basic conditional check during aviation audits. Only aviation vendors approved under this process are eligible for SCE contracts involving aviation activities.

SCE uses employee and contract Inspectors to perform ground and aerial inspections. These Inspectors identify structural issues that may require possible remediations based on these inspections and create a notification.

Our worker qualifications and training for Asset Inspections will evolve and adapt in accordance with any future changes to our inspection programs, designs, and operational practices.

Table SCE 5-5 and Table SCE 5-6 detail the worker titles and associated statistics pertaining to Asset Inspections.

Table SCE 5-5

Asset Inspections (SCE)

(1)	(2a.b.c)	(3)	(4)
SCE Worker Titles	Qualifications relevant to wildfire and PSPS mitigation	FTE % by Target Role	FTE % by High Interest Qualification
ELECTRICAL SYSTEM INSPECTOR	See Below	34.4%	N/A
JOURNEYMAN DISTRIBUTION/TRANSMISSION LINEMAN	QEW	43.0%	100%
PATROLMAN	QEW	14.5%	100%
HELICOPTER PILOT	FAA Certified	2.7%	100%

70 FAA certification required for helicopter pilots are 14 CFR 61, 91 and 133; FAA certification required for UAS pilots is 14 CRF 107 or higher. FAA certification is not required for UAS observers.

(1)	(2a.b.c)	(3)	(4)
SCE Worker Titles	Qualifications relevant to wildfire and PSPS mitigation	FTE % by Target Role	FTE % by High Interest Qualification
SENSOR OPERATOR	See Below	0.8%	N/A
GENERATION: HYDRO ELECTRICIAN & INSTRUMENT CONTROL TECHNICIAN	QEW	2.0%	100%
GENERATION: HYDRO ELECTRICIAN & INSTRUMENT CONTROL TECHNICIAN FOREMAN	QEW	1.6%	100%
GENERATION: HYDRO OPERATOR MECHANIC	See Below	0.4%	N/A
		100%	

Table SCE 5-6

Asset Inspections (Contractor)

(1)	(2a.b.c)	(3)	(4)
Contractor Worker Titles	Qualifications relevant to wildfire and PSPS mitigation	% by Target Role*	% by Minimum Qualification
HELICOPTER PILOT	FAA Certified	7.8%	100%
SENSOR OPERATOR	See Below	7.8%	N/A
UAS OPERATOR	FAA Certified	40.0%	100%
UAS VISUAL OBSERVER	See Below	40.0%	N/A
INFRARED THERMOGRAPHER	See Below	3.3%	N/A
INFRARED GENERAL MANAGER THERMOGRAPHER	See Below	1.1%	N/A
		100%	

*Percentage by target role for the Contractor Worker Titles listed in this table reflects a monthly average for 2021.

General Minimum Qualifications:

Workers who conduct detailed transmission, distribution overhead (or underground) and aerial electrical inspections must have knowledge of the basic uses and functions of electrical equipment, hand tools, power tools, techniques in performing electrical system inspections andrepairs. Workers must understand the fundamentals of electric circuitry and operation of electrical equipment. Further, workers must understand SCE standards, policies and procedures, and basic GO 95 requirements[E12].

A Qualified Electrical Worker (QEW) is an individual who has a minimum of two years' training and experience with exposed high voltage circuits and equipment and demonstrated familiarity with the services to be performed and the hazards involved. In addition, for roles where it is applicable, SCE specifies in its contracts with vendors that the contractors at a minimum should meet the qualifications for a QEW as defined by the International Brotherhood of Electrical Workers (IBEW) Local No 47. SCE also specifies thatcontractors that perform Journeyman Lineman tasks on SCE's Distribution system must be certified "Journeyman Linemen" as determined by criteria set forth by IBEW Local No 47.

Additional Minimum Qualifications:

ELECTRICAL SYSTEM INSPECTOR: Responsible for performing inspections of poles and equipment and must have either a certificate of completion from an accredited trade school or at least one year of experience in construction/maintenance work in electrical distribution. Inspectors must also have knowledge of: Basic electricity and electrical distribution principles; computer programs and email systems; company work rules, regulations and policies, construction methods, procedures, and standards; SCE's Accident Prevention Manual and safe work practices; and the motor vehicle code.

JOURNEYMAN TRANSMISSION/DISTRIBUTION LINEMAN: Responsible for performing construction and maintenance work on overhead and underground facilities. Journeyman linemen are QEWs and must have working experience as a lineman or groundman and graduated from SCE's apprenticeship program, working knowledge of SCE's Accident Prevention Manual. Linemen must also have successfully passed a pre-hire physical assessment. Skills and abilities required by this jobare of a level normally acquired by completion of job-related high school courses and the apprenticeshipprogram for Lineman.

PATROLMAN: Responsible for patrolling, inspecting and ensuring assigned transmission lines are properly maintained. Transmission Senior Patrolmen are QEWs and must have knowledge of: Equipment, tools, techniques, and methods employed in the construction, installation, maintenance and repair of overhead line facilities, roads, trails and rights-of-way (ROWs); stresses, strains, and rigging; safety regulations; capabilities and limitations of insulator washing equipment; transmission overhead and underground circuitry and switching; SCE's Accident Prevention Manual. The knowledge, skills, and abilities required for this job are of a level comparable with those normally acquired through ahigh school education, supplemented by technical study and extensive training and experience as a journeyman, patrolman or lineman.

HELICOPTER PILOT: Responsible for conducting routine and complex missions including power line patrols, passenger transports, photo flights, positioning flights, snow surveys, and external load missions, as required. Pilots are FAA certified and must also have knowledge of: All applicable governmental aviation regulations, Company policies, procedures, practices, and work instructions; and FAA Regulations, 14 CFR Part 91 & 133. The knowledge, skills and abilities required of this job are of a level comparable with those with a high school education and a minimum of 3,000 hours of helicopter pilot in command and 250 hours pilot in command above 5,000 feet. Pilots must also possess and maintain a Class II FAA Medical Certificate and a valid California driver's license.

SENSOR OPERATOR: Responsible for remote sensing mission planning, sensor configuration, and understanding complex sensing system technology from data collection to product hand off. The knowledge, skills, and abilities required for this job include operating and maintaining complex sensing equipment as part of an aircrew onboard a helicopter; and understanding the evolution of advanced three-dimensional geospatial tools and analysis as this has a direct bearing on the collection of data with remote sensing equipment.

GENERATION: HYDRO ELECTRICIAN & INSTRUMENT CONTROL TECHNICIAN: Responsible for maintaining, repairing and installing computerized control systems. Must have knowledge of: Basic power plant system operations; electrical and pressure instruments and devices and functions as related to power plant systems; tools, methods, materials and techniques used in repair, adjustment and testing, including computerized tooling and interface hardware and software; theory of electricity, mechanics and instruments; materials, methods, practices and tools used in installation and maintenance; principles of physics and advanced mathematics; county and state electrical code; SCE's Accident Prevention Manual and environmental regulations and procedures. The knowledge, skills, and abilities for this job are of a level comparable to those normally acquired through a high school education, additional technical study, and knowledge of complex digital and analog control systems and equipment; plus, experience typically attained in a similar technical field or journeyman electrician.

GENERATION: HYDRO ELECTRICIAN & INSTRUMENT CONTROL TECHNICIAN FOREMAN: Supervises and oversees repairs and installations of control systems. Must have knowledge of: Basic power plant system operations; electrical and pressure instruments and devices and functions as related to power plant systems; tools, methods, materials and techniques used in repair, adjustment and testing, including computerized tooling and interface hardware and software; theory of electricity, mechanics and instruments; materials, methods, practices and tools used in installation and maintenance; principles of physics and advanced mathematics, county and state electrical code; SCE's Accident Prevention Manual, safety rules and regulations, environmental regulations and procedures. The knowledge, skills, and abilities for this job are of a level comparable to those normally acquired through a high school education, additional technical study, and knowledge of complex digital and analog control systems and equipment; plus, experience typically attained in a similar technical field or journeyman electrician.

GENERATION: CHIEF HYDRO STATION OPERATOR: Supervises and controls the operation of hydroelectric generating stations and related equipment; dams, intakes, forebays, spillways, and water conduits to assure efficient loading and operations of the Hydro Division plants. Must have knowledge of: Fundamentals of electricity, basic Alternate Current-Direct Current (AC-DC) theory, computer theory and language; hydraulics and the principles of physics; dispatching, system operating and water management procedures and operator's duties; general electrical and mechanicalmaintenance; overall plant facilities and operating characteristics; and SCE's Accident Prevention Manual. The knowledge, skills, and abilities required for this job are of a level comparable to those normally acquired through a high school education and extensive progressive training and experience in hydro generating plant operations.

GENERATION: HYDRO OPERATOR MECHANIC: Operates attended and unattended hydroelectric generation stations; dams, intakes, fore bays, spillways, and water conduits; and related electronic, electrical, mechanical, hydraulic and pneumatic equipment. Must have knowledge of: Electrical, hydraulic, pneumatic and mechanical equipment; basic computer theory and language, system construction, capacity, limitation, theories of operation and operating procedures; plant design and equipment locations, valve configurations, and normal range of flows, temperatures, levels, methods to clear equipment; tools, safety rules, equipment and systems malfunctions; reporting procedures and practices, maintenance procedures and practices; and electrical and mechanical prints, rigging standards, generation plant terminology and nomenclature. The knowledge, skills and abilities required of this job are of a level comparable to those normally acquired through a high school and considerable experience operating and maintaining a generation facility.

UAS OPERATOR: Responsible for conducting UAS missions- preflight inspections, including specific aircraft and ground control station checks, maintenance and operational safety. Must possess a current and valid Federal Aviation Remote Pilot Certificate (14 CRF 107 or higher, as appropriate) and be proficient in operating each UAS model appropriate to the current pending mission profile. The knowledge, skills, and abilities required for this job include the capability of mission planning relative to the appropriate level of mission complexity and federal certification.

UAS VISUAL OBSERVER: A visual observer is considered an optional crewmember for most operations under 14 CFR Part 107; there are, however, more complex instances in which at least one visual observer will be required by SCE UAS Operations. The UAS Operator and UAS Observer are responsible for functioning as a crew in a safe, responsible and coordinated manner.

INFRARED THERMOGRAPHER: Responsible for performing thermal inspections of poles and equipment. Must be certified as a level-one thermographer and possess 40-hours minimum of field and office training and pass an associated written exam administered by Osmose or an outside agency. The knowledge, skills, and abilities required for this job include a basic understanding of electrical and communication infrastructure and GO 95. Additionally, level-one thermographers are provided specific training on the cameras used for the patrol and capture of IR images used for SCE's reports.

INFRARED GENERAL MANAGER THERMOGRAPHER: Responsible for training and managing of level-one thermographers and must be certified as a level-three thermographer. Minimum qualifications include the level-one thermographer requirements, plus an additional 32-hour training program and certification exam administered by an outside agency. Level-three thermographers are also responsible for the creation and evaluation of reports containing IR imagery; designing and implementing written procedures; and understanding regulatory requirements with a focus on safety and compliance. Level-three thermographers are trained and certified through the IR Training Center systems company.

Training and plans to improve worker qualifications:

To facilitate asset inspection work, SCE implements training for those performing inspections. This technical training prepares workers to perform their jobs safely, comply with regulatory requirements and laws, maintain system reliability, and meet the demands of new technology. SCE will continue to deploy new work methods and technologies in support of wildfire activities. SCE's risk-informed inspection strategy involves using new tools to help perform field inspections, modify inspection checklists to evaluate asset conditions, and establish new processes. These new technologies and work methods require the creation of new training material and deployment of the training to SCE employees. In addition to technical competency, this training must provide education and clarification on new procedures and standards, building upon lessons learned obtained from field activities. SCE also conducts training for workers in this target role related to its wildfire mitigation and PSPS work, which is described in Table SCE 5-13 below.

Separately, SCE surveys its workers to identify where more focused training may be needed. These surveys provide information at the employee and supervisor level, which allows SCE to identify specific areas where individuals may benefit from additional training.

As technical aspects (e.g., process, technology, or tool changes) of SCE's various inspection programs change, SCE will provide the requisite training to those who will be performing inspections. Further, SCE will update its training program based on lessons learned and provide refresher training as necessary to communicate changes in protocols. For example, SCE recently updated its training for Electrical System Inspectors (ESIs) who perform inspections through SCE's Overhead Detail Inspection and/or HFRI programs, as shown in Table SCE 5-7.

SCE requires all new ESIs to take the comprehensive training identified below. In addition, all ESIs take regular refresher training every 12 months to incorporate new processes, procedures, and lessons-learned relevant to inspection practices. Additionally, in 2021, ESIs engaged in a comprehensive quality and consistent program to help ensure accurate and consistent inspections. The program consisted of four major components all focused on improving inspection quality and to help ensure inspection results are consistent.

Table SCE 5-7

SCE Training Courses Specific to Asset Inspections

Course Name	Course Description
New Electrical System Inspector(ESI) Training is comprised of 12 modules 1. Introduction 2. Safety 3. Tools 4. Equipment Recognition 5. Clearances 6. Detailed Inspection 7. Inspect App 8. Notifications 9. Repairs 10. Private Property 11. Quality Assurance (QA)	1. Describe GOs 95 & 165, explain purpose of inspection programs 2. Requirements of Inspection safety for ESIs, guidelines for PPE, safe driving & parking 3. Identify tools, proper maintenance of tools, how to use tools safety 4. Identify common Distribution equipment and purpose ofequipment. How to identify damage 5. Measure & report clearances that legally define basic minimum allowable vertical clearance values 6. Purpose & duties regarding inspections, steps of the inspection method, describe P1 conditions, purpose of Annual Grid Patrol 7. Layout of survey questions by category, practice answering survey questions on iPad 8. Categorize different types of Priority conditions, how & when to document notifications, how to make changes in the field tool 9. Precautions to take prior to making repairs, proper actions to takefor repairs they cannot make 10. Outline responsibilities of ESI, describe access issues an ESI facesand how to approach and remedy 11. At the end of this module ESI's will be able to explain elements & purpose of QA Program and how it applies to ESI 12. Explain their part in the inspection, repair and reporting of overhead structures
Existing ESI Inspection Training	1. ODI Survey App Reference Guide (Responding to SurveyQuestions) 2. Inspection App User Guide 3. ESI Help Guide 4. Laser Rangefinder – TruePulse 360 Quick Start Manual 5. Overhead Detail Inspections (ODI) Covered Conductor Training 2021 13. New ESI Training (Details above)

5.4.4 Target Role: Grid Hardening

SCE's Grid Hardening activities focus on implementing grid infrastructure that mitigates the risks of ignitions associated with utility equipment. This includes several activities, such as deploying covered conductor, undergrounding of overhead lines, installing system automation equipment, remediating issues with long conductor spans, replacing old and potentially faulty equipment, and more. For more information on SCE's Grid Hardening programs, please see Section 7.3.3.

Table SCE 5-8 and Table SCE 5-9 detail the worker titles and associated qualifications pertaining to Grid Hardening.

Table SCE 5-8 [71]

Grid Hardening (SCE Workers)

(1)	(2a.b.c)	(3)	(4)
SCE Worker Titles	Qualifications relevant to wildfire and PSPS mitigation	FTE % by Target Role	FTE % by High Interest Qualification
APPRENTICE LINEMAN	See Below	12.3%	N/A
JOURNEYMAN DISTRIBUTION/ TRANSMISSION LINEMAN	QEW	31.2%	100%
FOREMAN	QEW	19.4%	100%
GROUNDMAN	See Below	20.2%	N/A
SPLICER	QEW	3.0%	100%
SUBSTATION MAINTENANCE ELECTRICIAN	QEW	6.7%	100%
TEST TECHNICIAN	QEW	7.0%	100%
GENERATION: HYDRO ELECTRICIAN & INSTRUMENT CONTROL TECHNICIAN	QEW	0.1%	100%
GENERATION: HYDRO	QEW	0.1%	100%

[71] The SCE worker population identified in this Table overlaps with the SCE worker population identified in Section 5.4.1 (Risk Event Inspections), as these FTE can perform both target roles.

(1)	(2a.b.c)	(3)	(4)
SCE Worker Titles	Qualifications relevant to wildfire and PSPS mitigation	FTE % by Target Role	FTE % by High Interest Qualification
ELECTRICIAN & INSTRUMENT CONTROL TECHNICIAN FOREMAN			
GENERATION: CHIEF HYDRO STATION OPERATOR	See Below	0.1%	N/A
		100%	

Table SCE 5-9

Grid Hardening (Contractor Workers)

(1)	(2a.b.c)	(3)	(4)
Contractor Worker Titles	Qualifications relevant to wildfire and PSPS mitigation	FTE % by Target Role	FTE % by High Interest Qualification
APPRENTICE LINEMAN	See Below	16.6%	N/A
JOURNEYMAN DISTRIBUTION/ TRANSMISSION LINEMAN	QEW	39.5%	100%
FOREMAN	QEW	21.5%	100%
GROUNDMAN	See Below	22.1%	N/A
SPLICER	QEW	0.1%	100%
SUBSTATION MAINTENANCE ELECTRICIAN	QEW	0.3%	100%
		100%	

General Minimum Qualifications: Workers, with the exception of Apprentice Lineman, are required to have knowledge of applicable Accident Prevention Manual rules, SCE standards, policies and procedures, GO 95 [E12]/128[E13]; electrical theory and mechanical principals.

Additional Minimum Qualifications:

APPRENTICE LINEMAN: Knowledge of and proficiency in the principles of electricity and mechanics; characteristics of electrical AC and DC circuits; the connections of electrical apparatus; equipment, circuits and their functions; principles of Physics and advanced mathematics. In addition, must possess knowledge of SCE's Accident Prevention Manual and proficiency in safe work practices, County and State Electrical Code; rigging practices; and proper and safe use of cleaning agents. The knowledge, skills, and abilities required for this job are of a level comparable with those normally acquired through courses taken in obtaining a high school education and considerable working experience in electrical repair work. Table SCE 5-10 below details the associated training pertaining to the Apprentice Lineman.

JOURNEYMAN TRANSMISSION/DISTRIBUTION LINEMAN: See qualifications of Lineman in Section 5.4.3.

FOREMAN: Oversee work performed by their crews and helps to ensure the work is performed safely. Requires knowledge of and proper use of approved tools, material, equipment, as applied to the construction, maintenance and repair of overhead and underground electrical systems. Skills and abilities required for this job are of a level comparable with those normally acquired through a high school education and extensive training and experience as a Journeyman Lineman.

GROUNDMAN: Assist with overhead and underground work as assigned. General knowledge of principles of electricity and mechanics; characteristics of electrical AC and DC circuits; and the connections of electrical apparatus; equipment, circuits and their functions. In addition, must possess knowledge of SCE's Accident Prevention Manual and safe work practices; rigging practices; and proper and safe use of tools and cleaning agents. The knowledge, skills, and abilities required for this job are of a level comparable with those normally acquired through courses taken in obtaining a high school education.

SPLICER: Responsible for all types of power cable and major electrical equipment and related facilities. Must have knowledge of and proficiency in electrical theory and shop mathematics; methods, practices, and procedures; tools, instruments, equipment and materials; SCE's Accident Prevention Manual and safety rules; established codes and standards; and the nomenclature and functions of parts necessary for installation, replacement, inspection, servicing, overhauling and repairing overhead and underground lines, electrical equipment and related facilities. The knowledge, skills, and abilities required for this job are of a level comparable with those normally acquired through experience as an Electrical Helper or Apprentice Electrician.

SUBSTATION MAINTENANCE ELECTRICIAN: Responsible for the installation, maintenance, and repair of high voltage electrical substation apparatus. Utilizes various meters, testing and diagnostic devices, performs routine testing, troubleshoots equipment problems, performs wiring of substation equipment, dismantles and overhauls CBs, transformers, regulators, and associated substation equipment. Qualification includes completion of the Substation Apprentice Electrician Program and Substation Operators School. The knowledge, skills, and abilities required by the job are of a level comparable with those normally acquired through courses taken in obtaining a high school diploma and the training and experience required to successfully complete the apprentice electrician program.

TEST TECHNICIAN: Responsible for programs and tests, inspections, repairs, relay adjustments, instrumentation equipment, local controllers, pilot wire equipment, battery chargers, and associated devices for the protection, control, and indication of system equipment. Must be a qualified substation operator. The knowledge, skills, and abilities required for this job are normally acquired through completion of high school and/or formal training in electrical engineering, or experience with extensive comprehension of electrical theory and use of principles of electrical theory in actual performance.

HYDRO ELECTRICIAN & INSTRUMENT CONTROL TECHNICIAN: See qualifications of Hydro Electrician & Instrument Control Technician in Section 5.4.3.

HYDRO ELECTRICIAN & INSTRUMENT CONTROL TECHNICIAN FOREMAN: See qualifications of Hydro Electrician & Instrument Control Technician Foreman in Section 5.4.3.

CHIEF HYDRO STATION OPERATOR: See qualifications of Chief Hydro Station Operator in Section 5.4.3.

Training and plans to improve SCE worker qualifications:

To facilitate grid hardening work, SCE implements training for SCE workers, such as those identified above. This technical training includes core technical training for working on the electric system, as well as specialized training on PSPS, HFRA, grid hardening, etc., and prepares workers to perform their jobs safely, comply with regulatory requirements and laws, maintain system reliability, and meet the demands of new technology. SCE will continue to deploy new work methods and technologies in support of wildfire activities. Wildfire activities may also require the use of new technology, such as situational awareness tools or information technology (IT). The use of new technology is usually accompanied by end-user training to help ensure the appropriate click-through of the application and accurate capture of data. New work methods also require the creation of new training material and deployment of the training to SCE employees. In addition to technical competency, this training will provide education and clarification on new procedures and standards, building upon lessons learned obtained from field activities. For example, these trainings can include Hot Sticks Training, Aerial Construction Training, etc. SCE provides these trainings through ongoing efforts with existing employees and through its Apprenticeship programs for new employees. SCE also conducts training for workers in this target role related to its wildfire mitigation and PSPS work, which is described in Table SCE 5-13 below.

Table SCE 5-10:

SCE Training Courses Specific to an Apprentice Lineman

Course Name	Course Description
1st Step Distribution Apprentice Lineman Training is comprised of 13 modules 1. Orientation 2. Climbing Basics 3. Grounding	Basic Climbing Climbing and Pole Top Rescue, and safety & equipment basics.

Course Name	Course Description
4. Guying 5. Meter Panels 6. OH Services 7. Pole Framing 8. Pole Top Rescue 9. PPE and Safety 10. Primary Conductors 11. Rigging Basics 12. Secondary Conductors 13. Streetlights	
2nd Step Distribution Apprentice Lineman Training is comprised of 14 modules 1. Wire Banks 2. AC vs DC 3. Delta vs Wye 4. Ferroresonance 5. Interconnected Systems 6. Orientation 7. Ohms Law 8. Temp Grounding Devices 9. Transformer Design & Theory 10. Transformer Load Calcs 11. Transformer Nameplates 12. Polarity 13. Vectoring 14. Voltage Problems	Basic Theory Introduction to Electrical Theory, vectoring and Ferroresonance.
3rd Step Distribution Apprentice Lineman Training is comprised of 9 modules 1. Orientation 2. UG Components 3. UG Conductors 4. UG Fuses 5. UG Grounding 6. UG Rules & Regulations 7. UG Structures 8. UG Switches 9. UG Transformers	Underground Underground equipment, rules, and procedures.

Course Name	Course Description
4th Step Distribution Apprentice Lineman Training is comprised of 14 modules 1. Orientation 2. Ohms Law 3. Vectoring 4. Ferroresonance 5. Reclosers 6. Fuses 7. HV Testing & Phasing 8. Capacitor Banks & PF 9. Metering Theory 10. Voltage Regulators 11. RCS Theory 12. Ground Banks 13. PE Gear	Advanced Theory Application and deep dive of Electrical Theory. Equipment theory.
5th Step Distribution Apprentice Lineman Training is comprised of 9 modules 1. Orientation 2. Fuses 3. 4kV Rubber Gloving 4. Hot Stick Basics 5. Armor Rods & Gins 6. Corner Pole Taps & Phasing 7. Double Dead-Ending 8. Hot Splicing 9. Hot Stick Skills	Step Hot Stick & Live line Tools Rubber gloving and hot sticking.
6th Step Distribution Apprentice Lineman Training is comprised of 25 modules 1. Orientation 2. Safety Protocol 3. 6.6 Streetlights 4. Capacitors 5. SOB 322 6. Remote Automatic Reclosers (RAR) 7. Remote Sectionalizing Recloser (RSR) 8. N-1 SOB 311 9. Event Response 10. Circuit Balancing 11. Circuit Maps 12. Clearances & No Test Orders 13. Co-Generation 14. Dist. Ops Responsibilities 15. Emergency Primary Trouble shooting	Operations and troubleshooting.

Course Name	Course Description
16. Fault Indicators 17. Fault Interrupters 18. Patrol Collector App 19. Metering ESR 20. PE Gear 21. RCS Switches – Operating 22. Secondary Trouble Shooting 23. Substation Entry & Logbook 24. Switching Procedures 25. Switching Techniques	

5.4.5 Target Role: Risk Event Inspection

SCE inspects various risk events – ignitions, outages, wire-down, faults, etc. – to determine cause and to remediate issues. This work is performed by the same qualified field personnel who also perform other work on the system, such as Grid Hardening work.

Table SCE 5-11 and Table SCE 5-12 below detail the worker titles and associated qualifications pertaining to these Risk Event Inspections.

Table SCE 5-11[72]

Risk Event Inspection (SCE)

(1)	(2a.b.c)	(3)	(4)
SCE Worker Titles	Qualifications relevant to wildfire and PSPS mitigation	FTE % by Target Role	FTE % by High Interest Qualification
APPRENTICE LINEMAN	See Below	12.0%	N/A
JOURNEYMAN DISTRIBUTION/ TRANSMISSION LINEMAN	QEW	30.3%	100%
FOREMAN	QEW	18.9%	100%
GROUNDMAN	See Below	19.7%	100%

[72] The SCE worker population identified in this Table overlaps with the SCE worker population identified in Section 5.4.4 (Grid Hardening), as these FTE can perform both target roles.

PATROLMAN	QEW	2.0%	100%
SPLICER	QEW	2.9%	100%
APPARATUS TECHNICIAN	See Below	2.9%	N/A
TROUBLEMAN	QEW	11.2%	100%
		100%	

Table SCE 5-12

Risk Event Inspection (Contractor)

(1)	(2a.b.c)	(3)	(4)
Contractor Worker Titles	Qualifications relevant to wildfire and PSPS mitigation	FTE % by Target Role	FTE % by High Interest Qualification
APPRENTICE LINEMAN	See Below	16.6%	N/A
JOURNEYMAN DISTRIBUTION/ TRANSMISSION LINEMAN	QEW	39.5%	100%
FOREMAN	QEW	21.5%	100%
GROUNDMAN	See Below	22.1%	100%
SPLICER	QEW	0.1%	100%
SUBSTATION MAINTENANCE ELECTRICIAN	See Below	0.3%	N/A
		100%	

Minimum qualifications:

APPRENTICE LINEMAN: See qualifications of Apprentice Lineman in Section 5.4.4.

JOUYNEYMAN DISTRIBUTION/TRANSMISSION LINEMAN: See qualifications of Lineman in Section 5.4.3.

FOREMAN: See qualifications of Foreman in Section 5.4.4.

GROUNDMAN: See qualifications of Groundman in Section 5.4.4

PATROLMAN: See qualifications of Groundman in Section 5.4.3.

SPLICER: See qualifications of Lineman in Section 5.4.4.

APPARATUS TECHNICIAN: Responsible for performing inspections and maintenance on equipment unique to electric distribution overhead and underground systems. Must have knowledge of: Advanced principles of three phase electrical theory, mathematics, phasor analysis, use of scientific engineering calculator, publications and standards, including system operating bulletins, grounding and G.O. 95 [E12]/128[E13] manuals, equipment design and programming manuals. Must possess computer skills, including but not limited to Company desktop applications as well as software and programming applicationsused to configure, program and test specific equipment installations. The knowledge, skills, and abilities required for this job are of a level comparable to those normally acquired through journeyman lineman experience and demonstrated ability to apply the principles of electrical theory.

TROUBLEMAN: Responsible for troubleshooting and performing routine inspections and minor repairs of the electric distribution system. Must have knowledge of: Equipment, tools, techniques, and methods employed in the construction, installation, maintenance and repair of distribution overhead and underground line facilities; overhead and underground circuitry and switching; and SCE's Accident Prevention Manual. The knowledge, skills, and abilities required for this job are of a level comparable with those normally acquiredthrough a high school education, supplemented by technical study and extensive training and experienceas a journeyman, patrolman, or lineman.

<u>Training and plans to improve worker qualifications:</u>

SCE will continue to refine its training program and worker qualifications based on lessons learned and feedback from field employees. We will continue to provide training to existing field personnel and those that are onboarded prior to every wildfire season. As it relates to wildfire and PSPS, SCE has implemented several training courses to educate and train field workers on proper practices and procedures. These training efforts are described in Table SCE 5-13.

Table SCE 5-13

List of Instructor Led and Web-Based Transmission and Distribution Wildfire and PSPS-Related Training Courses in 2021

Course Title	Course Description
PSPS Training	The purpose of this workshop is to provide an overview of the overall PSPS protocol including: 1) Roles and responsibilities 2) Communications process 3) Internal and external types of notifications 4) A detailed timeline of events and 5) How to access the pertinent information during a PSPS activation
PSPS 2021 Patrolling& Live Field Observation (LFO) Training	Training on PSPS patrolling and live field observations protocols, and any updates since prior year
PSPS Patrolling & LiveField Observation (LFO) Refresher: Contractor Orientation (Train the Trainer)	Orientation with contractor supervisors on PSPS patrolling and live field observations protocols, and any updates since prior year; contractor supervisors trained their own field crews and submitted rosters to SCE
Protection from Wildfire Smoke	This course is to teach how to protect workers when working in areas where there may be exposure to wildfire smoke. Teaches where to acquire the Air Quality Index, the health effects from wildfire smoke and how to obtain medical treatment if needed. Also teaches how to select, use and maintain proper respirator protection.
Wildfire Smoke Respirator (PAPR)	This course provides usage and maintenance procedures and requirements for Powered Air Purifying Respirator (PAPR) respirators.
Technology Integration – Grid Resiliency	Provides initial training on pilots or new equipment technologies being deployed across HFRA.
SOB 322 Refresher Training	SOB 322 that outlines the operational protocols for overhead distribution, sub-transmission, and transmission equipment within HFRA.

6 METRICS AND UNDERLYING DATA

Instructions: Section to be populated from Quarterly Reports. Tables to be populated are listed below for reference.

NOTE: Report updates to projected metrics that are now actuals (e.g., projected 2021 spend will be replaced with actual unless otherwise noted). If an actual is substantially different from the projected (>10% difference), highlight the corresponding metric in light green.

6.1 RECENT PERFORMANCE ON PROGRESS METRICS, LAST 7 YEARS

Table 1 of Attachment 3: Recent performance on progress metrics, last 7 years

Instructions for Table 1 of Attachment 3:

In the attached spreadsheet document, report performance on the following metrics within the utility's service territory over the past seven years as needed to correct previously reported data. Where the utility does not collect its own data on a given metric, each utility is required to work with the relevant state agencies to collect the relevant information for its service territory, and clearly identify the owner and dataset used to provide the response in the "Comments" column.

Table 1 provides a seven-year history (2015-2021), where applicable, of Progress Metrics as defined by the Guidelines. Updates to current and previous findings are in red font. As noted in the Q4 2021 Quarterly Data Report (QDR), many of these updates are a result of the new format requested for Table 2 (see below). The comment section for each metric in the table provides details of the source and data that was used or explanations for why certain data is not available.

Metric Type 1 asks for inspection counts for different inspection category types for transmission and distribution in circuit miles. SCE accounts for completed inspections by noting the counts of assets inspected (structures) instead of noting by circuit miles. Thus, in order to present completed inspections in the requested format, SCE uses a calculated average span length multiplied by the number of structures inspected. Additionally, rows have been added at the bottom of the table to provide additional detail on inspection data collected as part of SCE's detailed inspection programs. The drivers and program specifics can be found in Sections 7.3.4.9.1 for Distribution and 7.3.4.11.1 for Transmission.

Metric Type 2 asks for the number of spans inspected for vegetation compliance. SCE accounts for completed vegetation compliance inspections by circuit miles. Thus, in order to present completed vegetation compliance inspections in the requested format, SCE divided the recorded circuit miles inspected by the calculated average span length. Additionally, OEIS requests the number of spans inspected where at least some vegetation was found in non-compliant condition. SCE does not record vegetation management non-compliance by specific spans. Therefore, SCE is unable to provide how many findings are on each span and the number SCE presents is limited to the counts of findings.

Metric Type 3, customer outreach metrics, requires information not accounted for or maintained by SCE as SCE has no jurisdiction over evacuation orders. Previously, SCE diligently requested and followed up with local governments and law enforcement and was only able to obtain information from one county. Even then, the information provided included high-level estimations of evacuation counts estimated by the local government and law enforcement entity for a very limited set of fires. Because of this, SCE is unable to obtain the requested data, analyze it, and report on evacuation related requirements in this table. SCE anticipates this to be a recurring challenge going forward.

See Table 1 in Appendix 9.9 "Recent performance on progress metrics, last 7 years" for more detail.

6.2 RECENT PERFORMANCE ON OUTCOME METRICS, ANNUAL AND NORMALIZED FOR WEATHER, LAST 7 YEARS

Table 2 of Attachment 3: Recent performance on outcome metrics, last 7 years

Instructions for Table 2 of Attachment 3:

In the attached spreadsheet document, report performance on the following metrics within the utility's service territory over the past seven years as needed to correct previously reported data. Risk events and utility-related ignitions are normalized by wind warning status (RFW & HWW). Where the utility does not collect its own data on a given metric, the utility is required to work with the relevant state agencies to collect the relevant information for its service territory, and clearly identify the owner and dataset used to provide the response in "Comments" column.

Provide a list of all types of findings and number of findings per type, in total and in number of findings per circuit mile.

Table 2 provides a seven-year history (2015-2021), where applicable, of Outcome Metrics, which SCE has incorporated via the new format of Table 2 per the 2022 WMP Guidelines to provide the requested Wind Warning Status and HFTD Tier for this risk event data. As tracked, though, SCE's risk event data does not inherently contain Wind Warning Status and HFTD Tier. Thus, while SCE has worked to provide the data in the requested format, there are some instances of wire downs and outages where SCE cannot reasonably ascertain the Wind Warning Status and/or HFTD Tier. For these instances, an "Unknown" row has been inserted into Table 2. Additionally, as noted in the Q4 2021 QDR, this has in some cases resulted in modifications to prior reported periods, which may also impact Table 1 for metrics that appear in both tables. Updates to current and previous findings are in red font. Comments are included in the table to provide additional details about the data provided or indicate if the data is not available or not applicable for the past seven years. The information provided in conjunction with the "utility-ignited" wildfire statistics should not be construed as an admission of any wrongdoing orliability by SCE. SCE further notes that the damages metrics provided may be tracked by other agencies and thus, SCE does not guarantee the accuracy of such information. Additionally, in many instances, thecause of wildfires is still under investigation and even where an Authority Having Jurisdiction (AHJ) has issued a report on the cause, SCE may dispute the conclusions of such a report.

See Table 2 in Appendix 9.9 "Recent performance on outcome metrics, annual and normalized for last 7 years" for more detail.

6.3 DESCRIPTION OF ADDITIONAL METRICS

Table 3 of Attachment 3: List and description of additional metrics, last 7 years

Instructions for Table 3 of Attachment 3:

In addition to the metrics specified above, list and describe all other metrics the utility uses to evaluate wildfire mitigation performance, the utility's performance on those metrics over the last seven years, the units reported, the assumptions that underlie the use of those metrics, and how the performance reported could be validated by third parties outside the utility, such as analysts or academic researchers. Identified metrics must be of enough detail and scope to effectively inform the performance (i.e., reduction in ignition probability or wildfire consequence) of each preventive strategy and program.

Background

Metrics and underlying data are critical components for WMP development, execution, and evaluation, but we continue to emphasize that the near-term focus should be on efficient implementation of our planned activities, while the assessment of whether the activities are having the desired and expected impact on risk reduction should be measured over a longer time horizon. A clear distinction is necessary between metrics that monitor compliance with approved WMPs and those that evaluate effectiveness of these approved plans and inform future WMP updates.

As in the past three WMP submissions, we provide annual Program Targets for each WMP activity which establish goals to evaluate compliance. As stated in previous filings and submittals, tracking Program Targets for approved WMPs is the best means of determining progress and assessing WMP compliance in the near-term.

In addition, SCE has proposed five outcome-based metrics for the potential evaluation of the effectiveness of the portfolio of its wildfire mitigation activities. These outcome-based metrics are:

1. CPUC reportable ignitions in HFRA (total and by key drivers including CFO, wire-to-wire contact, TCCIs, and EFF)
2. Faults in HFRA (total and by the key drivers mentioned above)
3. Wire-down incidents in HFRA
4. Number of impacted customers and average duration of PSPS events
5. Timeliness and accuracy of PSPS notifications

SCE proposed these outcome-based metrics because WMP activities are ultimately designed to reduce wildfire ignitions associated with its electrical infrastructure and reduce the impact of PSPS de-energization events to customers. Faults and wire-down events are also key metrics as they are leading indicators of potential ignitions. Importantly, these metrics are within the reasonable control of utilities when appropriately normalized for weather and other exogenous factors. Other metrics such as safety incidents, acres burned or structures destroyed, though important to understand and drive California's fire mitigation efforts, are impacted by events and circumstances largely outside of the utility's control such as climate change, fire suppression efforts and fire response. Therefore, these are not appropriate WMP effectiveness metrics.

Description of Proposed Additional Metrics

CPUC Reportable Ignitions in HFRA, Faults in HFRA and Wire Downs incidents in HFRA

SCE is monitoring the number of faults at the circuit level and ignitions and wire-down events at the structure level and by key driver (CFO, EFF, and other) both before and after the deployment of select WMP wildfire activities. By observing the key drivers of these events down to the circuit or individual structure level, SCE is building the capability to better evaluate the effectiveness of wildfire activities that were deployed to mitigate those specific drivers, as well as help align future deployment of mitigations to targeting specific drivers identified at those locations.

Large variations in weather events, including temperature, rainfall, fuel moisture and wind, can heavily impact outcome-based metrics including faults, wire-down events and ignitions, and can often skew direct comparisons of these metrics year over year. At this time, SCE does not incorporate weather normalization into its WMP ignition forecasts due to the complexity of determining the causal relationship between aberrant weather and ignition probability and fire spread.

Number of impacted customers during and average duration of PSPS events

As more sectionalization equipment, covered conductor, and other grid hardening activities are deployed, de-energization thresholds can be raised reducing the number of circuits and circuit segments that will need to be de-energized during extreme weather conditions. Improved weather and fire modeling capabilities along with enhanced operational protocols can also help us reduce the frequency and duration of PSPS events. However, to assess the effectiveness of the WMP activities in reducing the frequency and scope of PSPS de-energizations, the total number of customers affected or the duration of outages during any period need to be normalized for the intensity of weather events, how widespread the weather events were, and the duration of the events as these can influence the number of circuits or circuit segments that have to be de-energized.

Lessons Learned and Advancements Made in 2021

Due to the factors described above, quantifying effectiveness metrics is a complex process that requires various data, assumptions, and time. In 2021, SCE shared initial perspectives on potential quantification methods for each of the WMP activities impacting the five outcome-based metrics.[73] Additionally, SCE shared plans to build, test, and refine methods to develop threshold values for effectiveness of each of the WMP initiatives. In this 2022 update, SCE affirms the need for a sufficient volume of work to be

[73] Table G5-SCE5-1 of SCE's 2021 WMP Update Supplemental Filing on February 26, 2021

deployed and a sufficient amount of time to pass with the mitigations in service before an accurate measure of the pre- and post-deployment change in effectiveness can be meaningfully evaluated. SCE continues to develop these methods and offers insights based on the work we performed in 2021.

Lessons learned / Initial findings from 2021 for the five outcome-based metrics

- **CPUC reportable ignitions in HFRA and Faults in HFRA**: Faults occur at a much greater frequency than ignitions or wire down events, which can make fault data more conducive to performing quantitative analyses, particularly those involving trends and causation over time. Based on historical data sets, faults occur on the order of approximately 75 times more frequently than ignitions. Analysis of fault data can also be beneficial as ignition events are almost always preceded by a fault event, whereas wire down events only occasionally precede ignition events. Conversely, use of fault data can be limited by the resolution at which it is captured. Fault data is attributed to an entire circuit, unlike ignitions which can almost always be attributed to a single pole or span of conductor. Since WMP activities can be deployed on certain portions of circuits, this lack of resolution can hamper efforts to draw correlations between rates of faults and wildfire mitigation efforts.

- **Wire Down Events in HFRA:** Similar to faults, wire down events occur at a greater frequency than ignitions – about 10 times as frequent. Additionally, unlike faults, wire down events can be attributed to individual spans or poles. One consideration for use of wire down event data is that wire down events precede—and thus a leading indicator for—only a fraction of ignition events (such as contact from vegetation and mechanical failures of conductors or connectors).

- **PSPS:** Number of impacted customers and average duration of PSPS events, and Timeliness and accuracy of PSPS notifications. SCE measures the effectiveness of these two metrics at the portfolio level. As with the other effectiveness metrics, improvements to these metrics result from the collective contributions of several activities, such as systems improvements, communication channel enhancements, grid hardening mitigations, and other factors that affect situational awareness. It is more difficult, however, to directly correlate improvements from these metrics to one specific WMP mitigation activity versus another. SCE discusses the challenges with attributing the impacts of the effectiveness metrics to individual activities further below. SCE is also further evaluating metrics such as CMI that may enable a more meaningful approximation for specific activities. For example, SCE can approximate the reduction in customers impacted and average duration impacted during a PSPS event through the implementation of grid hardening and sectionalizing devices.

General Observations and Challenges in Quantifying Effectiveness Metrics

- **Evaluating Enabling Activities:** As SCE has discussed in Chapter 4, not all WMP activities directly impact the probability or consequences of wildfire and/or PSPS risk. Some activities enable SCE to execute on other activity(ies) that do directly impact wildfire and/or PSPS risk, and other activities are supportive and foundational to serving customer needs, such as providing notifications to customers prior to, during, and after a PSPS event. SCE continues to evaluate ways in which enabling activities can be quantitatively evaluated under this effectiveness metrics framework.

- **Determination of Thresholds:** SCE is considering factors and methods to determine the extent to which a mitigation, or a portfolio of mitigations, is effective or ineffective. These factors include risk reduction, risk tolerance, cost, time, etc. These factors may inform a determination of whether a mitigation or set of mitigations is effective or ineffective.

- **Attribution of Effectiveness to each WMP Activity:** SCE proposed the five effectiveness metrics to be measured at the portfolio level. Many WMP activities can address similar risk drivers and allocating risk reduction benefits is very difficult and may not be as meaningful as understanding the combined risk reduction benefits of multiple mitigations. We are not yet aware of a comprehensive and accurate way to identify ignitions that were prevented by wildfire mitigations and determine which mitigation(s) is responsible for avoiding that ignition. Further, if multiple mitigations are involved, it can be subjective in allocating the risk reduction benefits to one mitigation over another.

- **Normalization:** Normalizing effectiveness metrics data remains a challenge given historical data sets that are available. Normalization will enable performance comparisons over time and help to understand the impact that various exogenous factors can have on each metric. As fire science and weather data capabilities are enhanced, there may be opportunities to leverage that data to identify methods to control for the fluctuations resulting from exogenous factors and the relationship to risk events.

- **Advancement Through Working Groups:** SCE is actively participating in the Covered Conductor Effectiveness joint-utility working group and the Joint-IOU Enhanced Vegetation Clearing Work group. Both groups have plans or are already in the process of establishing consistent criteria and measurements for evaluating the mitigation effectiveness of the respective work. SCE very much appreciates the active engagement from the other utilities, OEIS, and other stakeholders to establish these working groups and is hopeful in their potential to advance the topic of mitigation effectiveness. We will continue to actively participate in those efforts and apply the learnings and outcomes from them to our continued evaluation of mitigation effectiveness. Section 9.8 covers the progress or plans of these working groups in more detail.

While SCE continues to evaluate the best methods to develop and measure effectiveness metrics for its wildfire mitigation portfolio, there are indicators that can signal the directional effectiveness of wildfire mitigation programs that SCE is also tracking. For example, Figure SCE 6-1 helps to characterize the effects that four mitigation programs are having on various wildfire mitigation metrics.[74]

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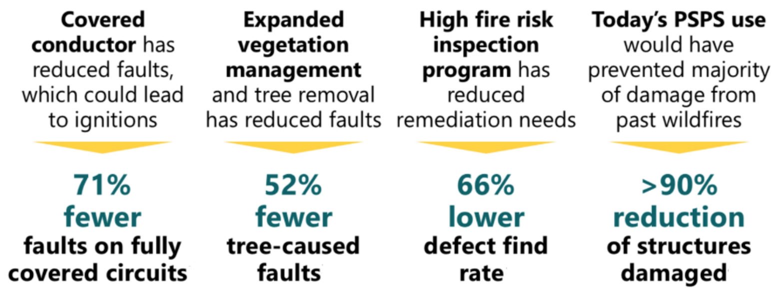
[74] **Covered Conductor**: Measured by faults covered conductor is expected to mitigate per 100 circuit miles on fully covered circuits as compared to bare circuits in 2021 in HFRA.
Expanded Vegetation Management: Measured by average monthly TCCIs in HFRA in 2020–2021 as compared to the average from 2015–2019
HFRI Inspection Program: Measured as Total Defect Find Rate (percentage of inspections) in 2021 as compared to 2019 (inception of program) for structures inspected every year

Figure SCE 6-1

Mitigation Effectiveness Examples



See Table 3 in Appendix 9.9 "List and description of additional metrics" for more detail on the metrics and units SCE uses to evaluate performance within each of these outcome-based metrics, including historical performance.

6.4 DETAILED INFORMATION SUPPORTING OUTCOME METRICS

Table 4 of Attachment 3: Fatalities due to utility wildfire mitigation initiatives, last 7 years

Instructions for Table 4 of Attachment 3:

In the attached spreadsheet document, report numbers of fatalities attributed to any utility wildfire mitigation initiatives, as listed in the utility's previous or current WMP filings or otherwise, according to the type of activity in column one, and by the victim's relationship to the utility (i.e., full-time employee, contractor, of member of the general public), for each of the last seven years as needed to correct previously reported data. For fatalities caused by initiatives beyond these categories, add rows to specify accordingly. The relationship to the utility statuses of full-time employee, contractor, and member of public are mutually exclusive, such that no individual can be counted in more than one category, nor can any individual fatality be attributed to more than one initiative.

Table 4 provides a seven-year history (2015-2021), where applicable, of fatalities associated with utility wildfire mitigation initiatives as defined by the Guidelines. The comment section for each metric in the table provides details of the source and data that was used or explanations for why certain data was not available.

See Table 4 in Appendix 9.9 "Fatalities due to utility wildfire mitigation initiatives, last 7 years" for more detail.

PSPS: Measured as structures damaged or destroyed in wildfires greater than 1,000 acres associated with SCE's infrastructure during 2015–2020, using red flag warning days as a proxy for PSPS conditions. Please note, however, that a red flag warning, alone, would not necessarily result in a decision to implement a PSPS

Table 5 of Attachment 3: OSHA-reportable injuries due to utility wildfire mitigation initiatives, last 7 years

Instructions for Table 5 of Attachment 3:

In the attached spreadsheet document, report numbers of OSHA-reportable injuries attributed to any utility wildfire mitigation initiatives, as listed in the utility's previous or current WMP filings or otherwise, according to the type of activity in column one, and by the victim's relationship to the utility (i.e., full-time employee, contractor, of member of the general public), for each of the last seven years as needed to correct previously reported data. For members of the public, all injuries that meet OSHA-reportable standards of severity (i.e., injury or illness resulting in loss of consciousness or requiring medical treatment beyond first aid) must be included, even if those incidents are not reported to OSHA due to the identity of the victims.

For Occupational Safety and Health Administration (OSHA)-reportable injuries caused by initiatives beyond these categories, add rows to specify accordingly. The victim identities listed are mutually exclusive, such that no individual victim can be counted as more than one identity, nor can any individual OSHA-reportable injury be attributed to more than one activity.

Table 5 provides a seven-year history (2015-2021), where applicable, of OSHA-reportable injuries associated with utilitywildfire mitigation initiatives as defined by the Guidelines. SCE does not use OSHA-reportable contractor and public incidents, as there is no direct employment relationship and no requirement to report to OSHA.However, SCE does monitor CPUC-reportable incidents, which have similar thresholds for identification and reporting (i.e., fatality or personal injury rising to the level of in-patient hospitalization, and in connection with utility assets). To provide a more complete data set, SCE provides data in Table 5 relatedto the "Contractor" and "Member of the Public" columns that correspond to CPUC-reportable incidents.

See Table 5 in Appendix 9.9 "OSHA-reportable injuries due to utility wildfire mitigation initiatives, last 7 years" for more detail.

6.5 MAPPING RECENT, MODELLED, AND BASELINE CONDITIONS

> *The utility must provide underlying data for recent conditions (over the last five years) of the utility's service territory in a downloadable shapefile GIS format, following the spatial reporting schema[75]. All data is reported quarterly, this is a placeholder for quarterly spatial data.*

In the Q4 2021 QDR, SCE made significant improvements to its GIS data submission via the inclusion of aging data for multiple assets and PSPS polygon shape data. In this 2022 WMP Update, SCE has also provided multiple new GIS layers per the 2022 WMP Guidelines. In addition, SCE has made progress on

[75] https://energysafety.ca.gov/wp-content/uploads/energy-safety-gis-data-reporting-standard_version2.1_09072021_final.pdf

the WiSDM project to enhance and improve overall data maturity levels in accordance with the Utility Wildfire Mitigation Maturity model. SCE's WiSDM project is expected to go live in Q1 2023.

6.6 RECENT WEATHER PATTERNS, LAST 7 YEARS

Table 6 of Attachment 3: Weather patterns, last 7 years

Instructions for Table 6 of Attachment 3:

In the attached spreadsheet document, report weather measurements based upon the duration and scope of NWS Red Flag Warnings, High wind warnings and upon proprietary Fire Potential Index (or other similar fire risk potential measure if used) for each year. Calculate and report 5-year historical average as needed to correct previously reported data.

Table 6 provides a seven-year history (2015-2021), where applicable, of weather patterns as defined by the Guidelines. The comment section for each metric in the table provides details of the source and data that was used or explanations for why certain data is not available.

The first row in Table 6 is populated with historical data on RFW by circuit mile days per year. The RFW circuit-mile days are based on all overhead distribution and transmission circuits that traverse through the NWS FWZ from a historical database of RFW events from the NWS. The overhead lengths of distribution and transmission circuits are calculated within each FWZ polygon (area divided geospatially into over approximately 1,000 space areas). All circuit lengths within that FWZ polygon are then multiplied by the number of days (or fraction of days) that a particular polygon had an RFW in effect.

The Guidelines require that SCE use RFW circuit mile days per year data to normalize data required in other tables. SCE recommends that OEIS consider using the National Fire Danger Rating System (NFDRS), which all fire agencies use to determine daily fire danger risk, instead of RFW data. NFDRS is a system that allows fire managers to estimate today's or tomorrow's fire danger for a given area. It combines existing and expected states of selected fire danger factors into one or more qualitative or numeric indices that reflect an area'sprotection needs. Fire danger ratings are typically reflective of the general conditions over an extended area, often tens of thousands of acres, where a possible wildfire could start. Fire danger ratings describe conditions that reflect the potential, over a large area, for a fire to ignite, spread and require suppressionaction.

See Table 6 in Appendix 9.9 "Weather patterns" for more detail.

6.7 RECENT AND PROJECTED DRIVERS OF OUTAGES AND IGNITION PROBABILITY

Table 7.1 of Attachment 3: Key recent and projected drivers of outages, last 7 years and projections

Instructions for Table 7.1 and Table 7.2 of Attachment 3:

In the attached spreadsheet document, report recent drivers of outages according to whether or not risk events of that type are tracked, the number of incidents per year (e.g., all instances of animal contact regardless of whether they caused an outage, an ignition, or neither), the rate at which those incidents (e.g., object contact, equipment failure, etc.) cause an ignition in the column, and the number of ignitions that those incidents caused by category, for each of last seven years as needed to correct previously-reported data. Calculate and include 5-year historical averages. This requirement applies to all utilities, not only those required to submit annual ignition data. Any utility that does not have complete 2021 ignition data compiled by the WMP deadline is required to indicate in the 2021 columns that said information is incomplete. (Table 7.2) Similar to Table 7.1, but for ignition probability by line type and HFTD status, according to if ignitions are tracked.

Table 7.1 provides a seven-year history (2015-2021), where applicable, which SCE has incorporated via the new format of Table 7.1 per the 2022 WMP Update Guidelines, as well as two years of projections. As noted in the Q4 2021 QDR, in some cases this has resulted in modifications to prior reported periods. Updates to current and previous findings are in red font.

To calculate the recent drivers of risk events, SCE utilized the following data sources:

- SCE's Outage Management System (OMS) and Outage Data and Reliability Metrics (ODRM) interface
- Wire-down data to determine if the conductor failure led to a wire-down event
- Repair work records from SCE's asset data in systems, applications & products (SAP) to identify failures

For the purposes of this table, transmission lines refer to all lines at or above 65 kV, and distribution lines refer to all lines below 65 kV. Transmission faults and wire-downs are typically on transmission lines 65 kV and above but may include some lower voltages (from an operational perspective, SCE also treats its 55 kV lines as transmission).

To populate wire-down data for each driver, SCE has previously used its wire-down database containing repair orders. As noted in the Q4 2021 QDR submission, SCE reviewed prior period transmission wire down data and provided a retroactive update and also performed a broader deep dive on failure data which identified two datasets that were not previously included in its wire down reporting. This resulted in the inclusion of additional wire down events, the vast majority of which occurred from 2016-2018 on distribution secondaries and service lines in the Non-HFTD. SCE again notes that these additional events did not impact its POI models, which rely on outage and ignition data, not wire down data. Nonetheless, given the potential associated risk, SCE has initiated a dedicated effort aimed at secondary conductor inspection and remediation, as outlined in this 2022 WMP Update. These updates also impact total wire down data in Tables 2 and 3.

To populate outage data for each driver, SCE used ODRM outage cause codes. ODRM database records and catalogs outage impacts and causes, determined by the cooperation of field, operations, and engineering employees.

For forecasts, SCE first created a baseline forecast for wire-down and outages based on timeseries forecasting. Time-series forecasting uses historical patterns to create a forecast and can capture variation over smaller periods compared to other forecasting methods. Then, the baseline forecast is subjected to the same methodologies used for RSEs, whereby SCE estimated the mitigation effectiveness of programs by risk drivers and determined the risk reduction, given the exposure and scope of the program, to incorporate the effects of SCE's various wildfire programs into the forecasts.

Updates to current and previous findings are in red font.

See Table 7.1 in Appendix 9.9 "Key recent and projected drivers of risk events" for more detail.

Table 7.2 of Attachment 3: Key recent and projected drivers of ignition probability by Line type and HFTD status, last 7 years and projections

Table 7.2 provides a seven-year history (2015-2021), where applicable, as well as two years of projections of key recent and projected drivers of ignitions by HFTD tier, which SCE has incorporated via the new format of Table 7.2 per the 2022 WMP Update Guidelines. Updates to current findings and the new "System" subtotals are in red font.

For the purposes of this table, transmission lines refer to all lines at or above 65 kV, and distribution lines refer to all lines below 65kV (however, from an operational perspective, SCE also treats its 55 kV lines as transmission).

To populate the ignitions per year for each driver, SCE used CPUC reportable data filed for 2015 through 2021. The CPUC reportable data contains date and time, latitude and longitude, voltage, location, suspected initiating event, and driver and sub-driver (e.g., animal contact, balloon contact, and transformer failure) categories. SCE mapped the suspected initiating event to the driver and sub-driver categories for 2015 through 2021.

For forecasts, SCE first created a baseline forecast for ignitions based on time-series forecasting. Time-series forecasting uses historic patterns to create a forecast and can capture variation over smaller periods compared to other forecasting methods. Then the baseline forecast was subjected to the same methodologies used for RSEs, whereby SCE estimated the mitigation effectiveness of programs by risk drivers and determined the risk reduction given the exposure and scope of the program to incorporate the effects of SCE's various wildfire programs into the forecasts.

See Table 7.2 of Appendix 9.9 "Key recent and projected drivers of ignition probability by line type and HFTD status" for more detail.

6.8 BASELINE STATE OF EQUIPMENT AND WILDFIRE AND PSPS EVENT RISK REDUCTION PLANS

6.8.1 Current baseline state of service territory and utility equipment

Table 8 of Attachment 3: State of service territory and utility equipment

Instructions for Table 8 of Attachment 3:

In the attached spreadsheet document, provide summary data for the current baseline state of HFTD and non-HFTD service territory in terms of circuit miles; overhead transmission lines, overhead distribution lines, substations, weather stations, and critical facilities located within the territory; and customers by type, located in urban versus rural versus highly rural areas and including the subset within the Wildland-Urban Interface (WUI) as needed to correct previously reported data.

The totals of the cells for each category of information (e.g., "circuit miles (including WUI and non-WUI)" would be equal to the overall service territory total (e.g., total circuit miles). For example, the total of number of customers in urban, rural, and highly rural areas of HFTD plus those in urban, rural, and highly rural areas of non-HFTD would equal the total number of customers of the entire service territory.

Table 8 provides a seven-year history (2015-2021), where applicable, of state of service area and utility equipment as defined by the Guidelines. The comment section for each metric in the table provides details of the sourceand data that was used or explanations for why certain data is not available.

Table 8 lists the current baseline state of SCE's service area in terms of overhead circuit miles for distribution and transmission lines, substations (only in-service, not including third-party owned), and critical facilities. The table also lists the number of customers in WUI zones and by HFRA tier/zone. HFTD Zone 1 cells only reflect those portions of Zone 1 that do not overlap with HFTD Tier 2 or Tier 3 areas, which are an extremely small portion of SCE's territory. Zone 1 areas that are wholly contained within Tier 2 and Tier 3 areas are reflected in those respective tiers. The WUI area delineation is based on a GIS layer published by the University of Wisconsin-Madison.

It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous yearssince the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available.

Previously, SCE has noted that it does not record all customers that are designated as AFN customers and as such, data provided for the AFN population only included SCE customers enrolled in MBL and/or Low-Income (i.e., enrolled in the CARE/FERA) programs. However, SCE has been engaged in efforts to incorporate additional AFN categories and has done so for its 2021 data included in this 2022 WMP Update submission.

See Table 8 of Appendix 9.9 “State of service area and utility equipment” for more detail.

6.8.2 Additions, removal, and upgrade of utility equipment by end of 3-year plan term

Table 9 of Attachment 3: Location of actual and planned utility equipment additions or removal year over year

Instructions for Table 9 of Attachment 3:

In the attached spreadsheet document, input summary information of plans and actuals for additions or removals of utility equipment as needed to correct previously-reported data. Report net additions using positive numbers and net removals and undergrounding using negative numbers for circuit miles and numbers of substations. Report changes planned or actualized for that year – for example, if 10 net overhead circuit miles are added in 2020, then report “10” for 2020. If 20 net overhead circuit miles are planned for addition by 2022, with 15 being added by 2021 and 5 more added by 2022, then report “15” for 2021 and “5” for 2022. Do <u>not</u> report cumulative change across years. In this case, do <u>not</u> report “20” for 2022, but instead the number planned to be added for just that year, which is “5”.

Table 9 provides a seven-year history (2015-2021), where applicable, as well as projections for 2022 of the location of actual and planned utility equipment additions or removal, year over year, as defined by the Guidelines. The comment section for each metric in the table provides details of the source and data that was used or explanations for why certain data is not available.

SCE does not routinely track planned additions or removals by population density or WUI. While SCE has a number of planned distribution projects over the next few years, the projects are not far enough along in the project lifecycle to have a complete list of affected structures (new or existing), circuit path/route geometries, and/or geospatial coordinates.

Therefore, SCE is unable to map the distribution projects in GIS and subdivide as requested. The planned work with a well-developed scope and geospatial properties are typically major, longer lifecycle transmission and substation projects that have detailed engineering and/or a Certificate of Public Convenience and Necessity or Permit To Construct from the Commission. Therefore, the only planned work that SCE has included here are (1) transmission projects that have known, planned geospatial geometries (circuit path/route) that can be uploaded to GIS tools and then divided by population density, WUI, and HFTD Tier/Zone and (2) known, planned substation projects (of which SCE has one in this three-year cycle). Additionally, SCE plans to install at least 150 weather stations and will strive to install up to 175 weather stations in 2022, but site/structure locations have not yet been determined and SCE is therefore unable to provide the locational attributes as requested.

SCE is also seeking to improve its processes associated with this WMP requirement.

The WUI area delineation is based on a GIS layer published by the University of Wisconsin-Madison.

See Table 9 of Appendix 9.9 “Location of actual and planned utility equipment additions or removal year over year” for more detail.

Table 10 of Attachment 3: Location of actual and planned utility infrastructure upgrades year over year

Instructions for Table 10 of Attachment 3:

Referring to the program targets discussed above, report plans and actuals for hardening upgrades in detail in the attached spreadsheet document. Report in terms of number of circuit miles or stations to be upgraded for each year, assuming complete implementation of wildfire mitigation activities, for HFTD and non-HFTD service territory for circuit miles of overhead transmission lines, circuit miles of overhead distribution lines, circuit miles of overhead transmission lines located in Wildland-Urban Interface (WUI), circuit miles of overhead distribution lines in WUI, number of substations, number of substations in WUI, number of weather stations and number of weather stations in WUI as needed to correct previously reported data.

If updating previously-reported data, separately include a list of the hardening initiatives included in the calculations for the table.

Transmission lines refer to all lines at or above 65kV, and distribution lines refer to all lines below 65kV.

Table 10 provides a seven-year history (2015-2021), where applicable, as well as projections for 2022 of the location of actual and planned utility infrastructure upgrades year over year as defined by the Guidelines. The comment section for each metric in the table provides details of the source and data that was used or explanations for why certain data is not available.

SCE does not routinely track planned upgrades by population density or WUI but has endeavored to provide this data where feasible.

SCE is also seeking to improve its processes associated with this WMP requirement.

The WUI area delineation is based on a GIS layer published by the University of Wisconsin-Madison.

See Table 10 of Appendix 9.9 "Location of actual and planned utility infrastructure upgrades year over year" for more detail.

6.8.3 Additional Data Tables Required per the 2022 WMP Guidelines

Table 11 of Attachment 3: Recent use of PSPS and other PSPS Metrics

For a description of Table 11 "Recent use of PSPS and other PSPS metrics," please see Section 8.5. For the table itself, please see Table 11 of Appendix 9.9.

Table 12 of Attachment 3: Mitigation initiative financials

Instructions for Table 12 of Attachment 3:

Report actual and projected WMP expenditure, as well as the risk-spend-efficiency (RSE), for each initiative by HFTD tier (territory-wide, non-HFTD, HFTD zone 1, HFTD tier 2, HFTD tier 3) in Table 12 of Attachment 3.

In Table 12, SCE provides various scope, cost, and risk information for the WMP initiatives. Pursuant to the 2022 WMP Guidelines, as part of this, SCE provides estimates for the scope and costs of these initiatives in 2023. As SCE has not yet developed a detailed and comprehensive 2023 wildfire mitigation portfolio, SCE notes that these estimates are necessarily preliminary and subject to change and should be considered directional in nature. These estimates will be updated and included as part of SCE's forthcoming 2023-2025 WMP.

SCE also notes that the activity structure as presented here in the 2022 WMP Update has introduced a few new activities and/or resulted in some minor activity grouping changes from its prior WMP submissions.

Regarding the Territory and HFTD split requested per the 2022 WMP Update Guidelines, SCE has taken three approaches.

1. Wildfire activities – SCE deploys its wildfire activity spend to mitigate risk in the HFTD. Accordingly, spend for wildfire activities is shown as entirely within HFTD (i.e., Territory spend = HFTD spend).
2. Vegetation management to achieve clearances around electric lines and equipment – SCE is complying with the 2022 WMP Update Guidelines by setting forth these costs broken down by HFTD and Non-HFTD. SCE notes, however, that this estimate reflects SCE's attempt to reasonably allocate these costs across its service area pursuant to respective tree counts and trim cadences in the HFTD and Non-HFTD areas, respectively. From an operational perspective, though, the same vegetation management contract crews often work in both HFTD and Non-HFTD areas, sometimes on the same days, making it difficult to precisely calculate the costs incurred in different areas. SCE further notes that from a regulatory cost recovery perspective, the CPUC's SCE 2021 General Rate Case Final Decision (D.21-08-036) authorized a Vegetation Management Balancing Account (VMBA) that does not differentiate between HFTD and Non-HFTD areas. Accordingly, SCE records all vegetation management line clearance costs in the VMBA, irrespective of where the trims take place.
3. Non-wildfire activities –SCE does not track the HFTD vs. Non-HFTD split of its non-wildfire activities. Accordingly, all spend for these activities is simply shown in the Territory column, though this is not to imply that no spend occurs in the HFTD areas.

7 MITIGATION INITIATIVES

7.1 WILDFIRE MITIGATION STRATEGY

Describe organization-wide wildfire mitigation strategy and goals for each of the following time periods, highlighting changes since the prior WMP report:

1. *By June 1 of current year*
2. *By September 1 of current year*
3. *Before the next Annual WMP Update*
4. *Within the next 3 years*
5. *Within the next 10 years*

The description of utility wildfire mitigation strategy must:

A. *Discuss the utility's approach to determining how to manage wildfire risk (in terms of ignition probability and estimated wildfire consequence) as distinct from managing risks to safety and/or reliability. Describe how this determination is made both for (1) the types of activities needed and (2) the extent of those activities needed to mitigate these two different groups of risks. Describe to what degree the activities needed to manage wildfire risk may be incremental to those needed to address safety and/or reliability risks.*

B. *Discuss how risk modeling outcomes are used to inform decision-making processes and used to prioritize mitigation activities. Provide detailed descriptions including clear evaluation criteria[76] and visual aids (such as flow charts or decision trees). Provide an appendix (including use of relevant visual aids) with specific examples demonstrating how risk modeling outcomes are used in prioritizing circuit segments and selecting mitigation measures.*

C. *Include a summary of achievements of major investments and implementation of wildfire mitigation initiatives over the past year, lessons learned, changed circumstances for the 2020-22 WMP plan cycle, and corresponding adjustment in priorities for the coming year. Organize summaries of initiatives by the wildfire mitigation categories listed in Section 7.3.*

D. *List and describe all challenges associated with limited resources and how these challenges are expectedto evolve over the next 3 years.*

E. *Outline how the utility expects new technologies and innovations to impact the utility's strategy and implementation approach over the next 3 years, including the utility's program for integrating new technologies into the utility's grid. Include utility research listed above in Section 4.4.*

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[76] "Evaluation criteria" should include all points of considerations including any thresholds and weights that may affect the outcome of their decision, as well as a descriptor of how it is evaluated (i.e. given a risk score, using SME expertise to determine that score, using a formula).

F. Provide a GIS layer[77] showing wildfire risk (e.g., MAVF); data should be as granular as possible.

G. Provide GIS layers[78] for the following grid hardening initiatives: covered conductor installation;[79] undergrounding of electrical lines and/or equipment and removal of electrical lines. Features must have the following attributes: state of hardening, type of hardening where known (i.e., undergrounding, covered conductors, or removal), and expected completion date. Provide as much detail as possible (circuit segment, circuit-level, etc.). The layers must include the following:

a. Hardening planned for 2022
b. Hardening planned for 2023
c. Hardening planned for 2024

H. Provide static (either in text or in an appendix), high-level maps of the areas where the utility will be prioritizing Grid Design and System Harding initiatives for 2022, 2023, and by 2032.

I. Provide a GIS layer for planned Asset Management and Inspections in 2022. Features must include the following attributes: type, timing, and prioritization of asset inspection. Inspection types must follow the same types described in Section 7.3.4, Asset Management and Inspections, and as applicable, should not be limited to patrols and detailed inspections.

J. Provide a GIS layer illustrating where enhanced clearances (12 feet or more) were achieved in 2020 and 2021 and where the utility plans to achieve enhanced clearances in 2022. Feature attributes must include clearance distance greater than or equal to 12 feet, if such data is available, either in ranges or as discrete integers (e.g., 12-15 feet, 15-20 feet, etc. OR 12, 13, 14, 15, etc.).

SCE's wildfire mitigation strategy integrates a combination of immediate-term activities and longer-term efforts to prudently advance our mitigation of wildfire and PSPS risk. Section 5.2 provides an overview of the overarching objectives that drive SCE's WMP approach. Section 5.3 then provides the near-term program targets and objectives for each wildfire mitigation initiative. Finally, Section 7.1.3 outlines SCE's near-term and longer-term wildfire strategies and goals over the next 10 years for each of the ten OEIS-defined WMP categories and Section 7.1.2.1 outlines updates associated with SCE's Integrated Grid Hardening Strategy and analysis.

7.1.1 Approach to Managing Wildfire Risk as Distinct from Risks to Safety and Reliability (2022 WMP Guidelines Reference 7.1.A)

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[77] GIS data that has corresponding feature classes in the most current version of Energy Safety GIS Data Reporting Standard will utilize the format for submission. GIS data that does not have corresponding feature classes shall be submitted in an Environmental Systems Research Institute (ESRI) compliant geodatabase (GDB) and include a data dictionary as part of the metadata.

[78] Energy Safety acknowledges potential security concerns regarding aggregating and presenting critical electrical infrastructure in map form. Utilities may provide maps or GIS layers required by these Guidelines as confidential attachments when necessary.

[79] For a definition of "covered conductor installation" see Section 9.1

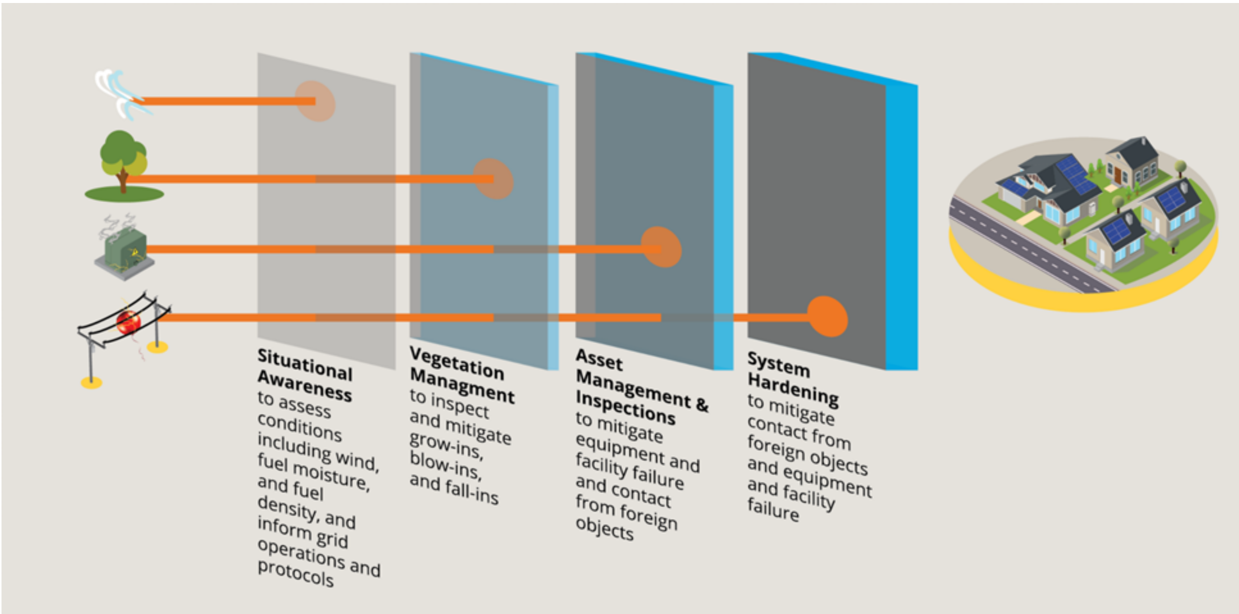
As discussed in Chapter 4, SCE's approach to identifying and analyzing risk is generally consistent for enterprise- wide key risks. Wildfire risk is one of the key safety risks, and currently represents a significant one. To determine the types of mitigation activities needed, SCE follows the bow-tie framework to determine risk drivers, factors that drive the probability of a risk event, and risk consequences, such as safety, reliability and financial.). This is followed by identifying mitigation activities that reduce either the probability or the consequence of the risk event and evaluating the effectiveness of each of the mitigations. This general approach is followed for key risks, including wildfire risk. The key safety risks are discussed in the RAMP report, and the mitigation activities for the key safety and reliability risks are included in SCE's GRC forecasts. Once mitigation alternatives are identified, SCE examines whether any of them are ongoing activities, and evaluates whether the ongoing activities will adequately mitigate the new risk. These steps are followed before recommending incremental work.

For example, analysis of ignition events in SCE's HFRA showed that distribution overhead conductor failure due to contact, foreign object or wire-to-wire contact, or other faults are material drivers of ignition events in SCE's service territory. SCE engineers developed several options such as replacing the bare conductor with heavier wire, undergrounding and replacing bare conductor with covered conductor. The first option was an existing activity, such as the overhead conductor program (OCP) to reduce the risk energized wire-down events and safety consequences associated with human contact. Based on comparison of the three alternatives, SCE determined that covered conductor installation represented the optimal solution for the majority of situations, due to its ability to balance is risk reduction, cost, and feasibility to implement in an expedient manner.

Similarly, SCE's risk analysis of faults that could potentially lead to ignition showed that traditional compliance-driven detailed inspections of overhead structures and equipment (to mitigate safety and reliability risks) needed to be augmented in terms of scope, frequency, and approach to target ignition risks. For operational and cost efficiencies, SCE has combined the compliance-based overhead detailed inspections with the HFRI inspections. In order to address the variety of wildfire and PSPS risk drivers in its HFRA, SCE leverages a suite of mitigation activities. The multi-layered diagram in Figure SCE 7-1 illustrates how SCE aims to protect against these various drivers via a portfolio of mitigations.

Figure SCE 7-1

SCE's Multi-Layered Approach to Wildfire and PSPS Risk Mitigation



Each of the wildfire mitigation activities proposed in this WMP update (such as SH-1, IN-1.1, etc.) are wildfire mitigation activities that are driven specifically to mitigate wildfire risks and are incremental to activities that SCE already undertakes to reduce other reliability and safety risks. The WMP includes several activities such as intrusive pole inspections, pole loading assessments, etc., that can provide wildfire risk reduction benefits, however, they were not initially undertaken to reduce wildfire risks directly, and hence are not considered wildfire mitigation activities.

7.1.2 How Risk Modeling Outcomes Are Used to Inform Decision-Making Processes and Used to Prioritize Mitigation Activities (2022 WMP Guidelines Reference 7.1.B)

Below in Figure 7-2, SCE provides a detailed flowchart of our risk-informed decision-making process as generally used to select and deploy SCE initiatives that mitigate wildfire and PSPS risks. The flowchart illustrates SCE's general approach to risk-informed decision-making when assessing and selecting wildfire and PSPS mitigations and prioritizing deployment for selected activities. We also provide a detailed narrative explanation of various entries in, and aspects of, the flowchart. For ease of reading and reference, we provide a "zoom in" of the particular portion of the flowchart when we are explaining it in narrative form.

The flowchart and detailed narrative set forth below were previously provided as part of SCE's June 3, 2021 Revised 2021 WMP Update, specifically in response to OEIS's Critical Issue SCE-02.[80] In its Final Action Statement, OEIS found that SCE's response for Critical Issue SCE-02 "adequately addressed all parts of this critical issue" and that SCE's work product "brings clarity to the decision-making process by illustrating factors such as 'risk reduced' and 'RSE' are weighted more heavily than 'operational feasibility' and 'compliance requirement.'"[81]

Broadly speaking, the process can be broken down into four major stages, as outlined in the flowchart: First, we evaluate or reassess, and then prioritize, wildfire and PSPS risks. Second, we identify the choice of mitigations to address the risk. In other words, we pinpoint the various mitigation alternatives. Third, we evaluate the mitigations and then select the appropriate one(s) from among the alternatives, using decision-making factors. Fourth, we prudently scope and deploy the chosen mitigation(s). We then continue to monitor deployments in light of relevant conditions or circumstances, and we strive to improve through lessons learned, metrics information, and feedback from our customers, regulators, and other stakeholders.

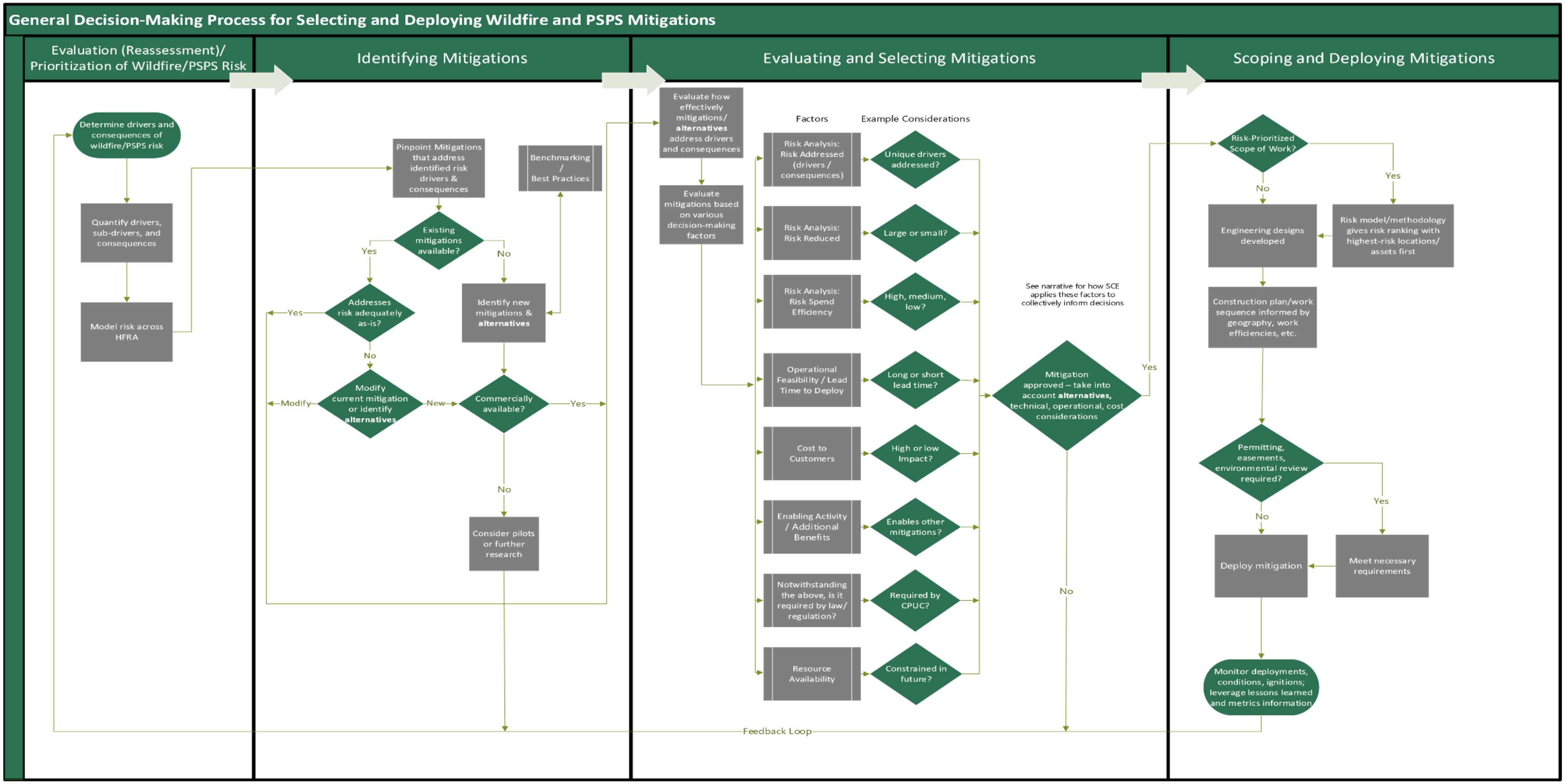
Application of this process for each wildfire mitigation activity may vary, because SCE is continually in the process of improving how risk-informed decision-making is utilized across the enterprise. Applicability may also vary depending on the unique characteristics of the mitigation activities. While specific processes and steps continue to evolve as we build out our asset management capabilities, the flowchart generally captures the key elements of the process. With each cycle, SCE's overall risk-informed decision-making process generally is maturing in the level of quantitative analysis performed, granularity of analysis, and consistent application across the enterprise.

[80] SCE's full response with regard to Critical Issue SCE-02 is found in Appendix 9.9 of SCE's Revised 2021 WMP Update, which can be retrieved from SCE's WMP webpage (https://www.sce.com/safety/wildfire-mitigation). Within the document, please refer to SCE's response to Critical Issue SCE-02.

[81] Please see OEIS Final Action Statement, pp. 87, 89.

Figure SCE 7-2

General Decision Making-Process Flowchart

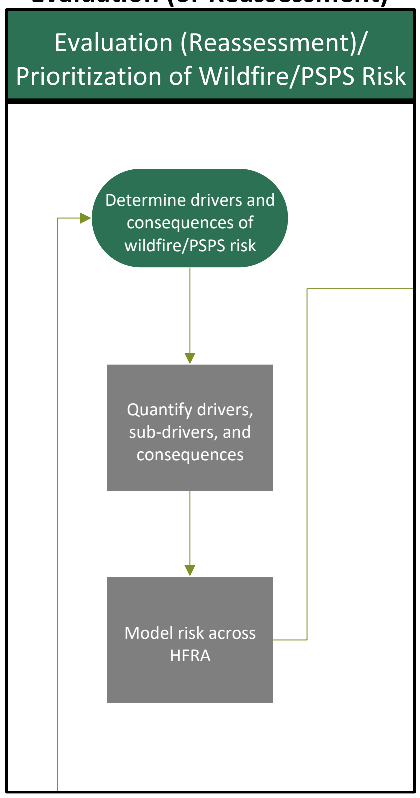


Below, SCE outlines in greater detail the specific steps and key considerations in the decision-making process.

1. Evaluation (or Reassessment) and Prioritization of Wildfire/PSPS Risks

Figure SCE 7-3

Evaluation (or Reassessment)



The selection of wildfire and PSPS risk mitigations starts with evaluating or reassessing the particular issue at hand, and the risks that underpin the issue. SCE has invested considerable resources to build its capabilities for identifying the drivers and consequences of wildfire and PSPS risk and examining how that risk is distributed across SCE's HFRA. The flowchart outlines, in basic terms, general steps embedded in SCE's process for identifying and evaluating wildfire risk:

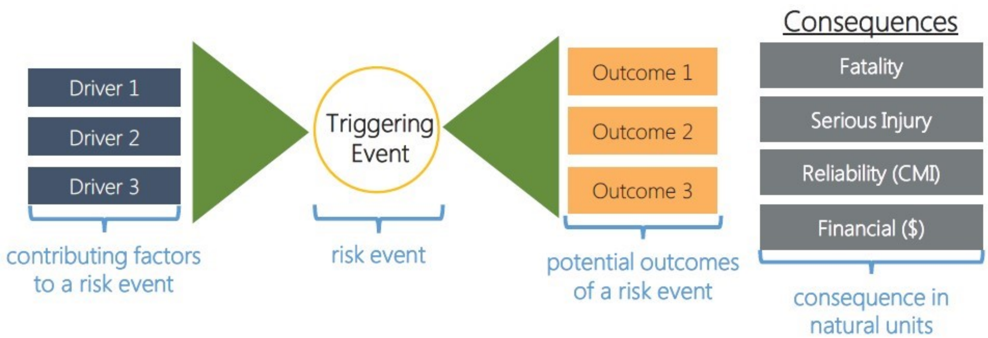
- Determining drivers (and sub-drivers) and consequences of wildfire risk;
- Quantifying drivers, sub-drivers, consequences, and overall risk as appropriate; and
- Modeling this risk across SCE's HFRA.

Determine drivers (and sub-drivers) and consequences of wildfire risk

As we discussed in detail in Chapter 4 of SCE's 2022 WMP Update, SCE's WRRM framework leverages the risk bowtie approach to organize drivers, triggering events, and consequences. SCE applies the risk bowtie approach to enable us to consistently and systematically identify threats and characterize sources of risk. The risk bowtie is shown below in Figure SCE 7-4.

Figure SCE 7-4

SCE Risk Bowtie



Quantify drivers, sub-drivers, consequences, and overall risk as appropriate

The outputs of WRRM are used to estimate risk reduction and calculate RSEs in order to help make decisions about wildfire/PSPS mitigation activities and to inform the prioritization of deploying mitigations.

The triggering event at the center of the wildfire bowtie is an ignition in SCE's HFRA. On the left-hand side of the bowtie, historical ignition and fault analysis determined that potential ignitions are primarily driven by equipment failure, contact from objects (such as vegetation or mylar balloons), and wire-to-wire contact (during periods of high winds). SCE leverages ML models to estimate the POI by driver for a given set of assets in HFRA.

The consequences of these ignition events are estimated on the right-hand side of the bowtie, using the Technosylva consequence model (starting in late 2020). The model estimates the potential spread of a fire over a given time, as well as the corresponding impact of a fire in natural units - structures, acres, and population.

The risk bowtie for PSPS risk evaluates the drivers and probabilities of PSPS activations. Here, SCE uses data points such as the historical back-cast of wind and weather conditions in conjunction with PSPS de-energization protocols to estimate the annual frequency and duration of de-energization events. The consequences of these PSPS events are estimated on the right-hand side of the bowtie, based on the potential safety, reliability, and financial impacts to customers.

Model this risk across SCE's HFRA

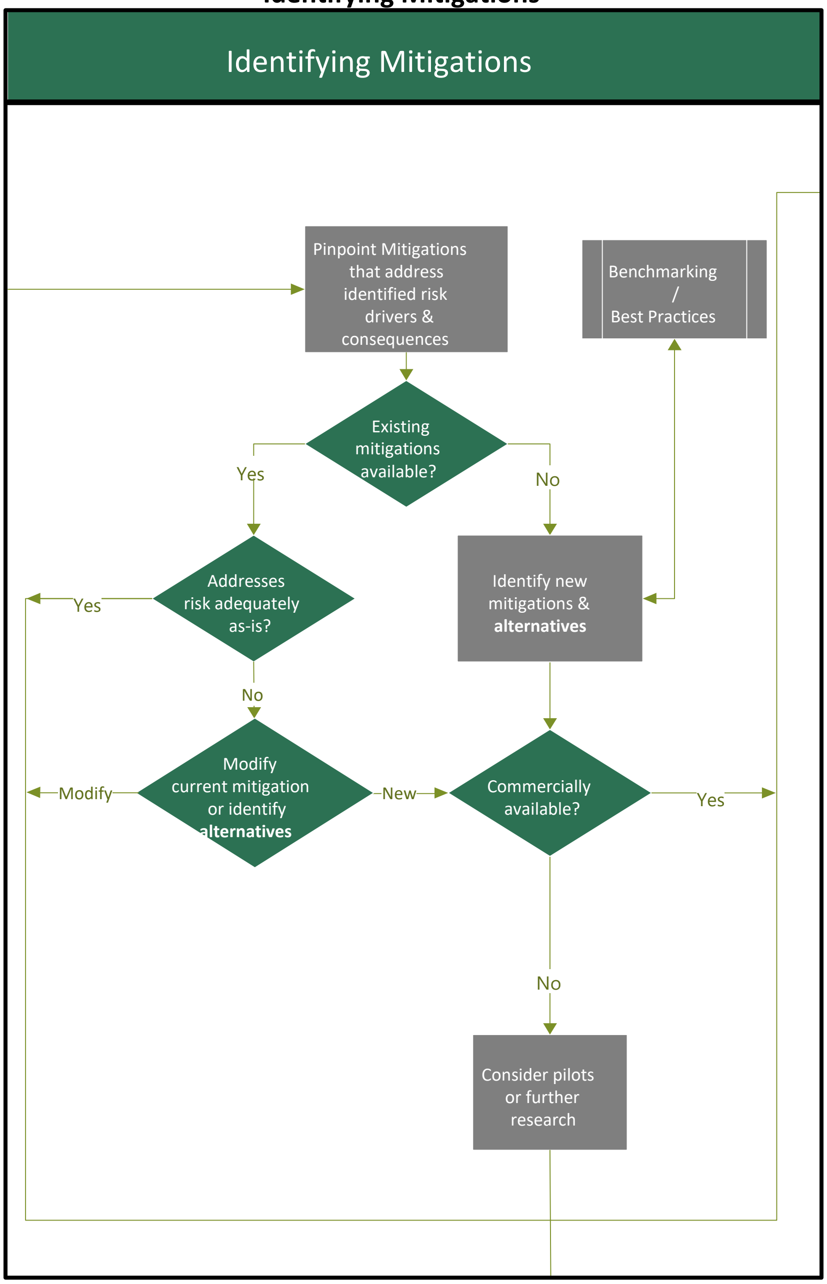
Wildfire and PSPS consequences are then translated into MARS units to calculate RSEs for mitigation activities and compare the relative risk of wildfire ignitions/PSPS events to that of other risk events. The outputs of the various models are aggregated into a unified WRRM output. The output of individual models and/or the entirety of the model output can be used to inform risk-related decision-making.

Through SCE's risk modeling framework, we have developed an improved understanding of the drivers and consequences of wildfire/PSPS risks. In addition, this framework gives visibility to where wildfire/PSPS risk is highest when looking across SCE's HFRA. This information is foundational to identifying, evaluating, and prioritizing mitigation initiatives to address these risks.

2. Identifying Mitigations

Figure SCE 7-5

Identifying Mitigations



The second step in the process is to identify candidate initiatives to mitigate wildfire/PSPS risk. Here, we focus on potential options to reduce the risks that we evaluated or reassessed, and then prioritized, in the first step. These potential options come in the form of existing, modified, or new initiatives. Mitigation options reduce either the frequency, consequence, or both, of wildfire and/or PSPS risk, resulting in overall risk reduction.

The flowchart outlines certain key steps and decision branches in this process that center around identifying mitigation activities that can address risk drivers and consequences. The flowchart considers these potential options in four general categories, as described below:

- Existing mitigations that already help to reduce risk

In some cases, the work that SCE performs to maintain and upgrade its overhead systems in HFRA already provides certain risk reduction benefits. In such cases, these activities would be identified for continued implementation as prudent for purposes of reducing wildfire risk. One example is line clearance activities to reduce the probability of faults or ignitions from vegetation making contact with energized equipment.

- Existing mitigations that, when modified, can further reduce risk

In other cases, existing mitigation activities may support wildfire risk reduction, but if appropriately modified, could provide even greater risk reduction benefits. This modification can take several forms:

1. The scope of the activity could be modified. An example is expanding the scope of assets and asset conditions that are evaluated as part of an inspection program.
2. The scale of the activity could be increased to cover a wider area of SCE's HFRA.
3. The frequency of an activity could be modified. An example would be to increase how frequently critical or higher-risk assets or areas are inspected.
4. New technology could be incorporated to make the activity more effective or efficient at identifying and mitigating risk. As an example, incorporating Artificial Intelligence/Machine Learning (AI/ML) models to help detect asset defects and identify hazards as part of the Aerial Inspection processes could result in decreased time for problem identification, with increased confidence in risk/issue detection.

- New mitigations that are commercially ready to deploy to reduce risk

SCE also identifies new risk mitigation options. These new options can be identified through, among other actions, benchmarking with other utilities; studying and adopting emergent best practices; obtaining guidance from engineering and technical industry committees; studying emerging technology demonstrations; and assessing pilot studies that produce successful or otherwise useful results. SCE's portfolio of wildfire mitigation initiatives has benefitted greatly from identifying and adding new initiatives that were not previously deployed in SCE's service area. Our covered conductor program is an example of one such mitigation.

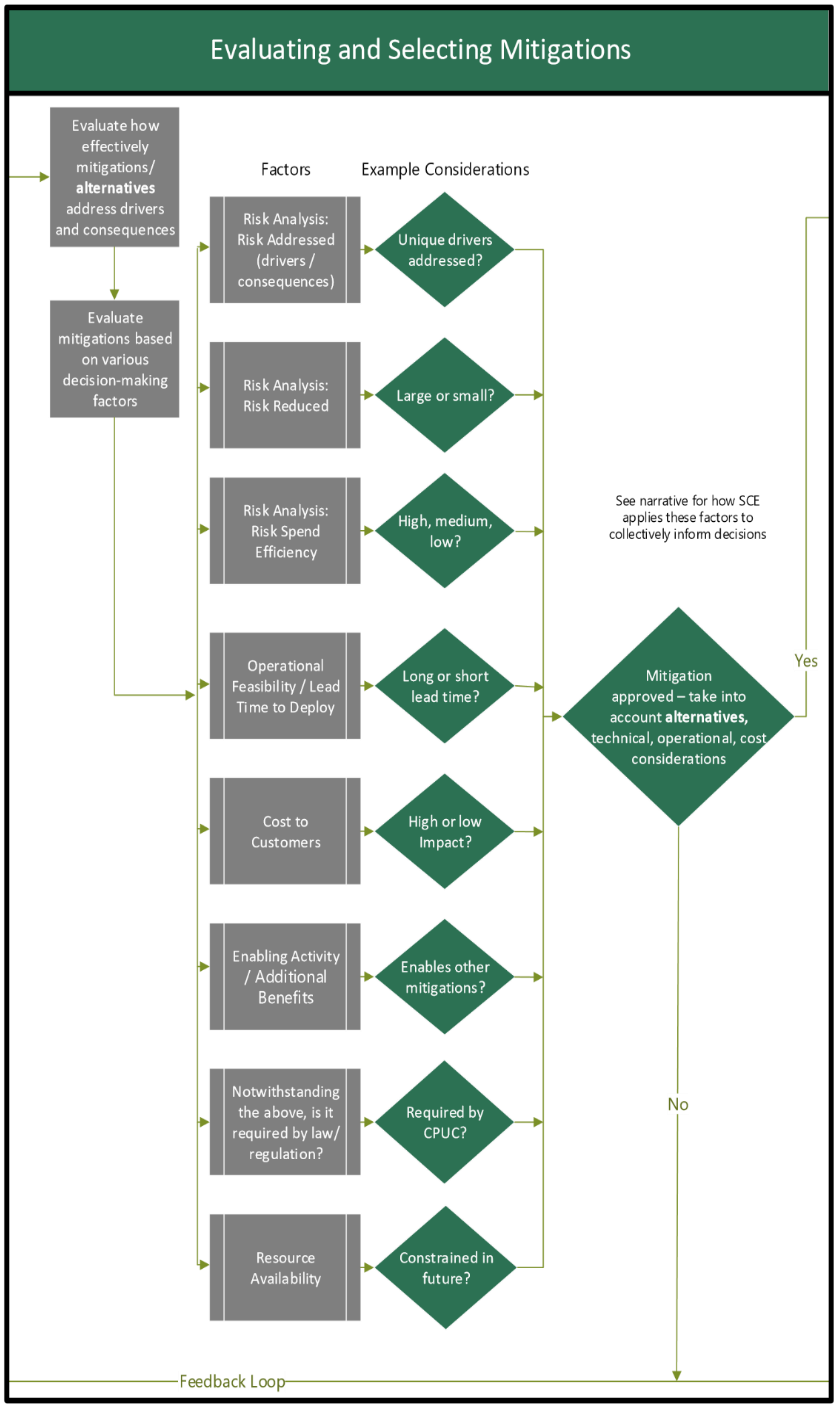
- New mitigations that should be piloted and further evaluated for potential future deployment

In some cases, concepts emerge that have promising wildfire or PSPS risk reduction benefits but have not yet been fully studied or evaluated through a reliable pilot or demonstration. Since these options are not commercially ready to be deployed on SCE's system, SCE will typically engage in further consideration of these options through a pilot project, demonstration effort, or smaller-scale field testing or pilot deployment. Technological maturity is an important criterion when we are identifying and assessing mitigations. EFD is an example of a mitigation that is being studied and further evaluated.

3. Evaluating and Selecting Mitigations

Figure SCE 7-6

Evaluating and Selecting Mitigations



After we have identified our options for possible selection, those options must then be prudently evaluated. This usually starts with an estimation of how effective each option can be in reducing the various wildfire and/or PSPS risk drivers and consequences. This analysis is performed by SMEs, who utilize engineering data, historical performance data, benchmarking information, research studies, results from demonstrations or field tests, and other sources of information.

SCE is focused on efficiently reducing wildfire and PSPS risk as quickly as reasonably possible, prioritizing mitigations to areas of our system that present the highest risk, and doing so in a manner that appropriately minimizes customer cost and service impacts. Therefore, the selection of wildfire initiatives must necessarily consider several factors in the decision-making process. Such factors include the risk profile for HFRA in SCE's service area, the risk profile of assets that have the potential to cause ignitions, how each activity impacts the frequency and/or impact of wildfires, the potential speed of deployment, costs, RSE scores, resource constraints, material or technology availability and other factors that may relate to a given initiative.

Figure SCE 7-7 below provides additional details concerning the key factors shown in the flowchart above that are commonly considered as part of SCE's decision-making process when selecting wildfire mitigation initiatives. The figure also illustrates how SCE generally evaluates each factor when making decisions.

Figure SCE 7-7

Decision-Making Factors Considered

		Features that can dissuade initiative selection	Features that can encourage initiative selection
Critical Factors that drive initiative selection	Risk Analysis - Risk Drivers and Consequences Addressed - Risk Reduced - RSE	Risk drivers and consequences not adequately addressed; Low magnitude of risk reduction; Low RSE	Many risk drivers and consequences addressed or only initiative to address specific risk-driver(s); High magnitude of wildfire and/or PSPS risk reduction; High RSE
	Operational Feasibility / Lead Time to Deployment	Limited or constrained ability to execute; Longer lead time than alternatives	No operational constraints; Shorter lead time than alternatives
Additional Critical Factors that supplement initiative selection decision	Cost to Customers	Higher cost impacts	Lower cost impacts
	Enabling Activity / Add'l Benefits	Does not enable other initiatives; Limited or no non-wildfire benefits (e.g. reliability)	Additional non-wildfire benefits; Necessary for the successful deployment of other initiatives
Overarching Factors that can drive absolute "Go/No-Go" selection decisions themselves	Compliance Requirements / Regulatory Guidance	N/A (Does not factor into selection)	Meet compliance requirements, aligns with regulatory guidance
	Resource Availability	Resource constraints prevent near-term implementation	Resources fully available to plan and execute work

SCE carefully considers each factor both individually and in the aggregate in order to make sound and informed decisions. A given factor may not have a uniform level of importance or impact in all situations. As an example, if an initiative is required pursuant to a regulation, standard, code, or other authority, then meeting and adhering to compliance requirements would naturally be a decisive factor in SCE's ultimate determination. Similarly, if an initiative is under consideration but SCE would be unable to sufficiently staff it with requisite resources, then the "Resource Availability" factor will more heavily influence our decision-making because it may be infeasible to execute the initiative in a timely manner. The influence of resource constraints in assessing a particular potential mitigation can be very different if the resource constraints would simply lead to a short delay in building out the mitigation, versus if the resource constraints could lead to a material inability to complete the mitigation in an acceptable time frame, or fully complete it at all.

Below, SCE describes each decision-making factor in greater detail.

- **Risk Analysis/Factors**: Risk is a primary consideration when selecting mitigation initiatives. Decisions incorporate one or more of the following risk factors:

- **Risk Drivers and Consequences Addressed:** There are many drivers to wildfire risk (see Tables 7.1 and 7.2 of SCE's WMP Quarterly Data Reports for examples). It is necessary to have a portfolio of initiatives that collectively and sufficiently addresses the breadth of risk drivers. In some cases, an initiative such as covered conductor will address numerous risk drivers. In other cases, initiatives may more narrowly – but importantly – address one risk driver that none of the other initiatives address. For example, SCE's C-Hooks Replacement initiative (SH-13) was included in SCE's 2021 WMP Update to address a very specific potential risk driver associated with potential failure of a specific piece of hardware in HFRA that was previously not addressed in our wildfire mitigation plan. In some cases, a mitigation initiative addresses a key driver that is already addressed to some degree by other initiatives, but the configuration is beneficial because the multiple initiatives work together to address the driver better than any single mitigation initiative. For example, though covered conductor addresses vegetation making contact with wires, line clearance and HTMP activities are also necessary to reduce heavy branches or trees from falling into lines that covered conductor may not be able to withstand. Moreover, vegetation management activities can be deployed more rapidly than covered conductor installation, and therefore can help reduce risk across HFRA in advance of covered conductor being installed. Finally, initiatives are also considered based on their ability to mitigate risk consequences. As an example, SCE deploys CRCs to enable the charging of portable mobile devices and distribute water and snacks. CRCs also provide access to air-conditioned facilities and restrooms, among other services, during a PSPS event. The CRCs do not prevent PSPS events. Instead, they help alleviate the consequences of a PSPS event.

- **Risk Reduction:** SCE aims to expeditiously reduce as much risk as possible in terms of our electrical lines and equipment being involved in an ignition that can lead to a wildfire. As SCE evaluates wildfire initiatives, the magnitude of risk reduction is a central consideration, with a preference toward those initiatives that can provide higher risk reduction.

- **Risk Spend Efficiency:** RSEs help SCE evaluate the relative cost-effectiveness of potential initiatives; this in turn provides insight concerning prudently allocating resources, funding, and efforts to efficiently mitigate wildfire risk. That said, it would not be in the best interest of our customers or the communities we serve if SCE were to carry out a comprehensive wildfire risk mitigation plan based solely on RSEs. An RSE does not take into account certain operational realities, such as resource constraints, compliance issues, or service disruptions. Relying solely on RSEs could lead to significant parts of the system and potentially significant risk issues being left unaddressed. Indeed, the Commission's Safety and Enforcement Division (SED) noted that focusing solely on RSEs in selecting mitigations could be "suboptimal from an aggregate risk portfolio standpoint."[82] SED acknowledged that "mitigations are usually selected based on the highest RSE score unless there may be some identified resource constraints, compliance constraints, or operational constraints that may favor another candidate measure with a lower RSE."[83] SCE agrees with this characterization. An initiative with a relatively higher RSE is generally favorable to one with a relatively lower RSE. However, when an initiative has a relatively lower RSE, it could still be selected if, for example, it is easier to deploy quickly (e.g., critical care battery backup program to MBL customers affected by PSPS), addresses a particular risk driver that other mitigations do not (e.g., C-hook replacement and aerial inspections), or reduces overall risk even if it costs more (e.g., targeted undergrounding).

- **Operational Feasibility / Lead Time to Deployment**: An important feature of the selection process is obtaining an early understanding of the feasibility of implementing an initiative, and the time required to plan, design and ultimately deploy the initiative. Since SCE is focused on reducing wildfire risk as quickly as reasonably possible, our preference leans toward initiatives that can be deployed more quickly in order to protect public safety. However, SCE carefully considers certain initiatives that may have longer lead times but that are necessary to provide substantial long-term risk reduction.

- **Cost to Customers**: While the primary focus of our WMP is to reduce wildfire and PSPS risk at an appropriately urgent pace for the safety of our customers, cost is a factor in the decision-making process. In addition to RSEs that assess the risk reduction benefits of each initiative against its costs, the total cost associated with any initiative also needs to be considered to account for customer affordability and funding constraints.

- **Enabling Activity / Technology / Additional Benefits**: As noted in Chapter 4 of SCE's 2022 WMP Update, initiatives can be selected that do not directly reduce wildfire or PSPS risk, but rather *enable* other initiatives to reduce risk, or to do so more efficiently. For example, SCE included our fuel sampling, where SCE takes semi real-time measurements of vegetation moisture at 15 sites across its service area. SCE's decisions regarding de-energization consider information about the areas that are impacted by wildfire risk, such as fuel conditions. Although models can be used to estimate fuel dryness, results from fuels sampling can be used to assess vegetation

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[82] California Public Utilities Commission, Risk and Safety Aspects of Risk Assessment and Mitigation Phase Report of Pacific Gas and Electric Company, Investigation 17-11-003 (March 30, 2018), page 18.
[83] *Id.*

dryness in near real-time, help inform models, and serve as an input for fire spread and fire potential calculations. In our decision-making process, SCE will also consider indirect but worthwhile benefits that initiatives may provide. Such indirect benefits may include improved system reliability, faster service restoration, improved communications with customers, etc. While valuable, these secondary benefits may be less influential in the wildfire risk reduction decision-making process compared to the other factors.

- **Compliance Requirement / Regulatory Guidance**: In most circumstances, activities necessary to comply with local, state, or federal laws or regulations will be selected irrespective of other factors. In other words, compliance needs may weigh in favor of selecting the initiative even if other factors seem to weigh against selecting the initiative, particularly if the initiative represents the only prudent or feasible way to comply with the applicable law(s) or regulations(s). In addition, SCE takes into account Commission or other regulatory guidance and decisions when we are selecting wildfire mitigation activities and scope.

- **Resource Availability**: With increasing work to maintain and operate the grid while upgrading it to mitigate safety and resiliency risks, there are increasing constraints associated with specialized resources such as planners, designers, engineers, field crews, etc. The scope of such resource constraints can be internal, across the state, and even nationwide at times. If requisite resources are not available, the potential initiative could be temporarily deferred or de-scoped.

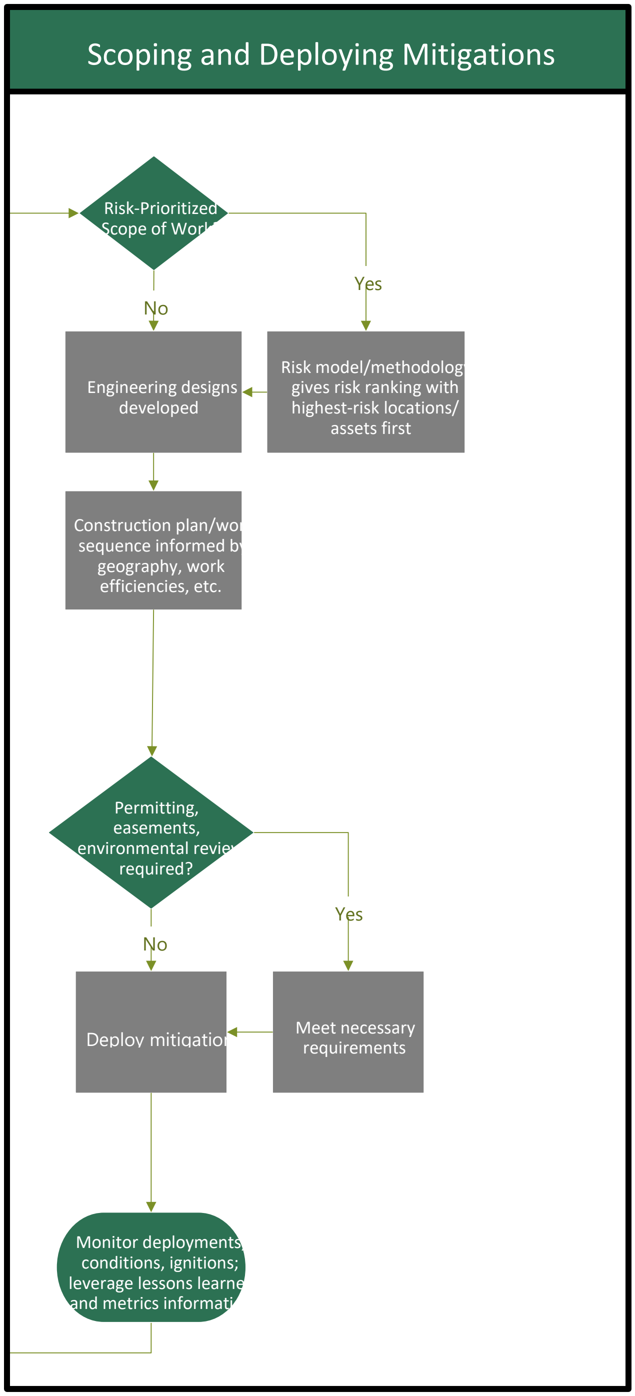
Mitigation Selection & Approval

In developing the portfolio of activities that constitute our wildfire mitigation plan, we consider the factors discussed above as we decide how much, when, and where to implement each selected mitigation measure. Decisions on selecting initiatives are ultimately made by senior management, through SCE's corporate governance and risk management processes, as discussed above. As part of the risk management process, the factors we outlined earlier help management assess the technical, operational, resource, financial, and regulatory considerations of each wildfire risk mitigation initiative, and of our proposed wildfire mitigation plan overall. Importantly, SCE uses these efforts to evaluate, as a general matter, how sufficiently the overall portfolio of mitigations addresses the drivers and consequences of wildfire and PSPS risk. These factors, such as RSE scores, can aid in this evaluation and further validate and/or focus our decisions on mitigation selection when mitigations are evaluated in aggregate. Part 2 of SCE's responses to Critical Issue SCE-02 from SCE's Revised 2021 WMP Update illustrate how the various factors described above were used in practice to select specific wildfire mitigation activities.

4. Scoping and Deploying Mitigations

Figure SCE 7-8

Scoping & Deploying Mitigations



Once mitigations are selected, SCE prioritizes the scope of work, plans and designs the work, and then undertakes the work. This section of the flowchart is germane to how SCE uses risk-informed prioritization to help scope work, and how that scope of work is refined as it advances through the planning, design, and execution process.

SCE's WMP activities predominantly deploy work to SCE's HFRA. However, wildfire and PSPS risk are not uniform across our entire HFRA. Therefore, in most cases, SCE uses risk analysis to prioritize where to allocate resource and funding first. SCE's risk models prioritize deployment to those areas where the initiative will be most effective at reducing the greatest risk. Each WMP initiative may be prioritized differently in light of the specific driver(s), sub-driver(s), or consequence(s) that it is designed to address. While SCE's risk models continue to evolve, as demonstrated by SCE's Integrated Grid Hardening Strategy described below in Section 7.1.2.1, the approach remains the same: prioritize work to reduce wildfire risk as expeditiously as possible.

SCE also relies on subject matter expertise and qualitative enterprise-level risk tools to help make risk-informed decisions when quantitative methods are not mature or applicable. The risk bowtie, fault tree analysis, decision trees, failure modes and effects analysis (FMEA), and probabilistic risk assessment (PRA) are some examples of methods that are used.

After work is prioritized, it must be planned, designed, and implemented. The specific steps for grid related work vary for different types of initiatives. However, the general steps remain as follows: work is planned; it goes through detailed engineering and technical design; it is packaged with other work where applicable to gain work efficiencies and reduce the number of outages to customers; all necessary permitting, environmental assessments and customer approvals as required are obtained; and then assets are inspected, remediated, replaced or installed onto SCE's system or the customer site. The process is different for non-grid work such as customer and technology programs because there are different resources, stakeholders, and requirements involved.

Summary of SCE's Risk-Informed Decision-Making Framework

SCE has an ERM organization that centralizes oversight and guidance on key and emerging risks across the Company. Specifically, ERM's role is to identify the most critical risks facing the entire enterprise, validate that appropriate mitigation measures have been initiated, monitor the status of the risks and the mitigation measures, and communicate ERM's findings concerning key and emerging risks to SCE's senior management and Board of Directors. Wildfire and PSPS risks are two of the most critical risks utilizing this ERM approach.

ERM works closely with each operating unit (OU) through a "hub-and-spoke" structure to manage risk across the Company. ERM establishes SCE's common risk management framework. ERM also facilitates cross-OU collaboration in developing and maintaining consistent and coherent risk management tools and systems. The OUs provide data, analysis, and guidance on the risks identified within each OU. This helps ERM prioritize and manage the key risks across the Company. Throughout the year, ERM meets with senior leaders to review and discuss enterprise- and operational-level risks and mitigation plans.

SCE's risk-informed decision-making framework is built on the foundation we described in SCE's S-MAP Application.[84] In the succeeding years, SCE has taken measured and prudent steps to enhance our risk management capabilities. SCE has benefitted from actively participating in the WMP, S-MAP, and RAMP processes,[85] and collaborating with OEIS, the Commission's SED, the Public Advocates Office, intervenors, and other California utilities in a host of risk-related proceedings and forums. In risk-oriented proceedings, the Commission has repeatedly noted that risk analysis and risk-informed decision-making is an evolving arena.[86] SCE continues to mature our processes to identify, review, and approve new or modified wildfire initiatives in a manner that supports an increasingly consistent assessment framework that helps ensure the proposed wildfire mitigations provide for measurable risk buy-down for purposes of eliminating or reducing wildfire and PSPS risks and can be successfully placed into an executable plan.

7.1.2.1 Response to SCE Action Statement SCE-21-06, 2021 WMP Key Areas for Improvement

The following is one of the Key Areas for Improvement as provided by OEIS in the Final Action Statement on SCE's 2021 WMP.

SCE's Integrated Grid Hardening Strategy

Since the devastating California wildfires that occurred in the last half of 2017, SCE has been enhancing its approach to reducing the risk of ignitions associated with utility equipment. Over the last several years, it has become apparent that the magnitude of wildfire risk associated with significant portions of SCE's service areas is unacceptable and continuing to grow. Accelerating climate change, with associated extreme weather events and pervasive drought, as well as the continued expansion and migration of Californians into the wildland-urban interface, has made it imperative that SCE do everything within its reasonable control to mitigate the risk of catastrophic wildfires associated with its overhead lines; historically, these assets are linked to the majority of ignitions and ignition risk associated with SCE's utility equipment. Given finite resources and other constraints, SCE uses a risk-prioritization methodology that deploys mitigations in the riskiest parts of its service area, as defined by the Commission's HFTD maps, first. From a relative risk perspective, it is appropriate to prioritize work in the very riskiest areas using the most effective and expeditious mitigations. Recent wildfires, however, have demonstrated that the level of absolute risk across California and the West may require actions beyond the utilities' short- and medium-term risk mitigation plans, which are the appropriate focus of this annual WMP. For example, burning for months in 2021, the Dixie Fire became the largest single wildfire in California history, burning almost a million acres – an area larger than the state of Rhode Island – and across the crest of the Sierra Nevada mountains. On December 30, 2021, an unprecedented wildfire broke out in suburban Boulder, Colorado, in an area that would likely not be designated as HFRA in California, spreading with devastating speed and destroying more than 1,000 structures. Both of these events demonstrate that the level of absolute wildfire risk on the system – even in non-HFRA – is beyond what can be mitigated and addressed in this WMP.

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[84] A.15-05-002, SCE's Safety Model Assessment Proceeding application, submitted May 2015.

[85] ERM serves as the lead organization for SCE in RAMP, S-MAP, and other risk-related proceedings.

[86] *See, e.g.*, D.16-08-018, Finding of Fact 35 ("There is no optimization of portfolio of risk mitigation activities, but this will take several more years of evolving utility models, data collection, and assessments.").

To expeditiously reduce ignition risk, SCE deploys mitigations that, together, address ignition risk drivers for its overhead distribution lines. From 2018 to 2021, the installation of covered conductor across HFRA has served as one of SCE's primary mitigation activities to expeditiously and materially reduce ignition risk associated with overhead distribution lines. The order of installation has been informed by the best reasonably available risk model at the time when each segment was initially planned, as well as operational considerations. The scope was grounded in the CPUC's HFTD definition for elevated or extreme wildfire risk for our service area.

SCE has further refined its grid hardening approach based on guidance from the OEIS and the Commission in the 2021 WMP Update and the 2021 GRC, respectively, as well as benchmarking with other utilities and updated risk analyses using more sophisticated tools and improved data sets acquired over the past few years. Below, SCE describes how, moving forward, it will determine:

a) the portions of its overhead distribution system in HFRA where the consequences of an ignition to public safety are most significant and require that SCE mitigate as many significant risk drivers as reasonably possible and

b) which mitigations to deploy in each of those locations to achieve that objective.

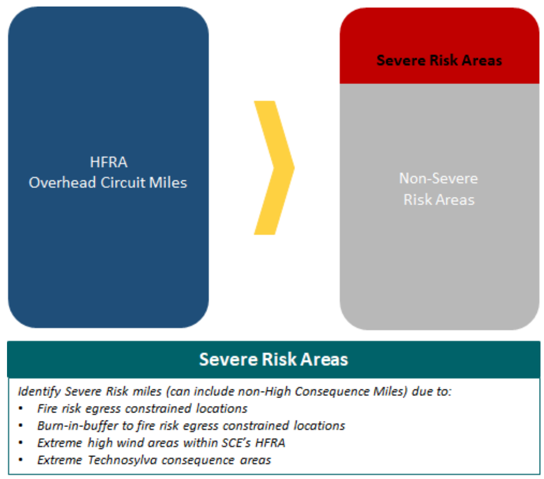
As further explained below, under this refined risk-reduction strategy, SCE is likely to pursue a suite of grid hardening measures in addition to – and sometimes in lieu of – covered conductor. Such measures may include the targeted undergrounding of overhead lines and using other technologies such as REFCL.

I. Severe Risk Areas

The Commission has already defined all areas in HFTD as inherently being at elevated or extreme risk of wildfire; SCE has determined a subset of those regions are "Severe Risk Areas" as they have attributes that further elevate the risk levels to populations residing, working in, or visiting these locations. The criteria for locations to be categorized as Severe Risk Areas is summarized in Figure SCE 7-9 below.

Figure SCE 7-9

Severe Risk Area Criteria



The steps for determining Severe Risk Areas are the following:

1. Divide SCE's HFRA into equally sized polygons
2. Identify egress-constrained locations
3. Determine locations that have experienced high fire frequency historically
4. Overlay the egress-constrained locations with historical high fire frequency locations to determine Fire Risk Egress Constrained Areas
5. Add a burn-in buffer to Fire Risk Egress Constrained Areas
6. Identify incremental locations with extreme high wind areas within SCE's HFRA
7. Identify incremental locations with extreme Technosylva consequence in terms of acres burned within SCE's HFRA.
8. Categorize the overhead distribution miles in the locations identified in steps 4, 5, 6 and 7 as Severe Risk Miles.

These steps are described in detail below:

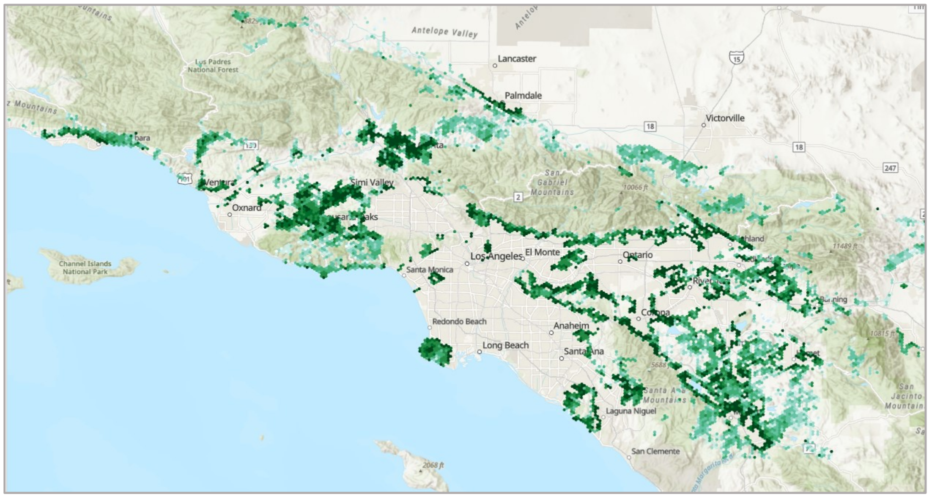
Figure SCE 7-10

Step 1: Polygon Assignment

SCE divided its service area into hexagons, approximately 214 acres in size. SCE used hexagons because the distance from the center of a hexagon to all adjacent hexagons is the same distance and it enabled SCE to compare variables across similar-sized polygons.

Figure SCE 7-11

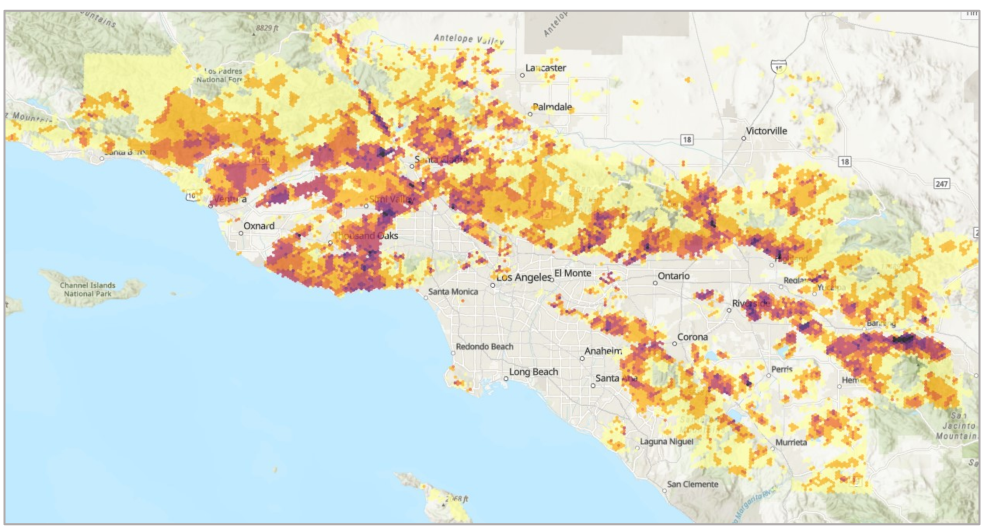
Step 2: Identify Egress-Constrained Areas



SCE determined hexagons in its HFRA that have substantial road availability concerns, using a ratio of roads to the population in each hexagon. A lower score indicates 0.5 or less miles of roads available per person in a given hexagon, meaning a potential egress concern should everyone in the polygon need to evacuate the area simultaneously.

Figure SCE 7-12

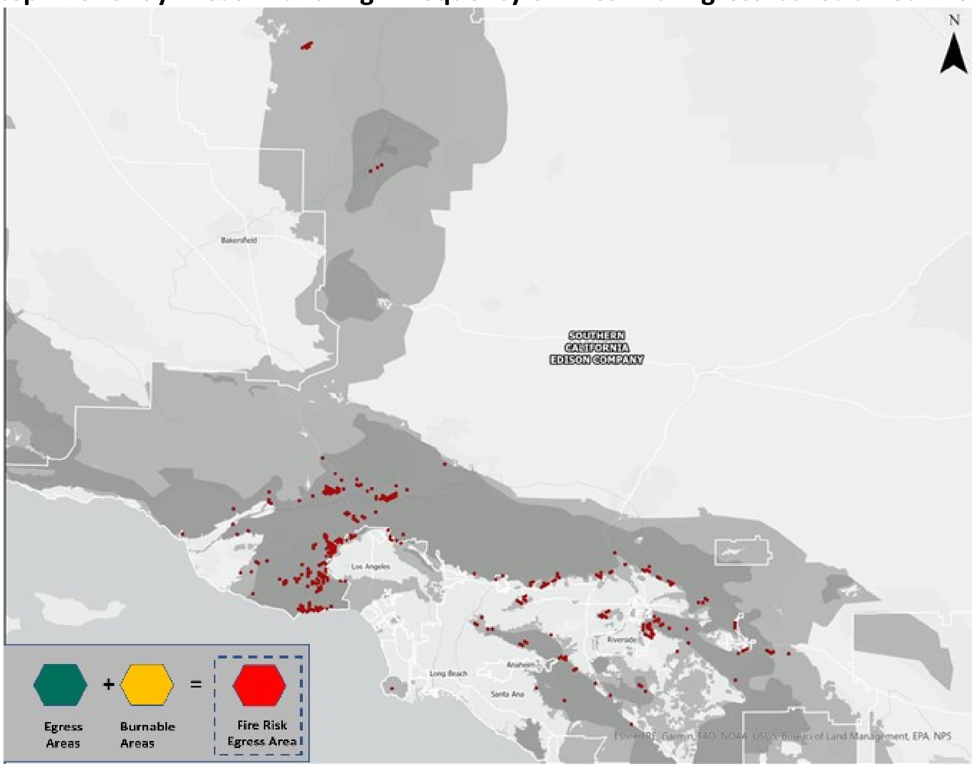
Step 3: Identify Areas with a High Frequency of Fires



SCE determined hexagons in its HFRA that have a high frequency of historical fires, using fire scars, from 1970 to 2020. A higher score indicates a higher likelihood that a given hexagon will burn, meaning fires either originated from or travel into these hexagons.

Figure SCE 7-13

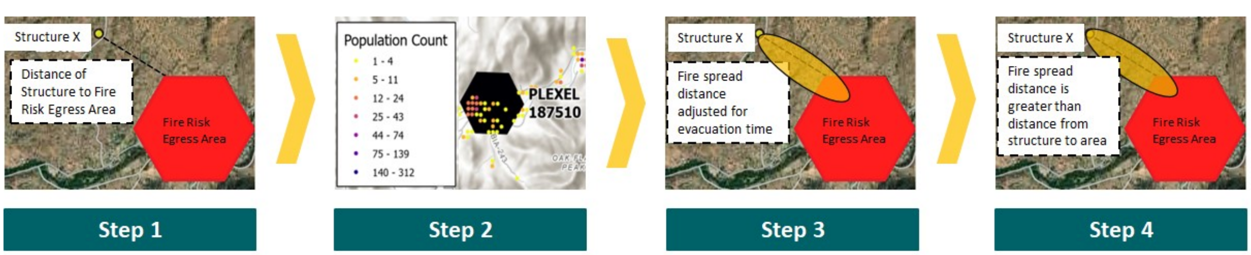
Step 4: Overlay Areas with a High Frequency of Fires with Egress-Constrained Areas



SCE then overlaid the egress-constrained areas from Step 2 with regions that have a high historical fire frequency from Step 3. SCE flagged hexagons with both limited road availability and a high burn frequency as potential Fire Risk Egress Constrained Areas. SCE has approximately 50 circuit miles of overhead distribution lines in these polygons.

Figure SCE 7-14

Step 5: Delineate Burn in Buffer



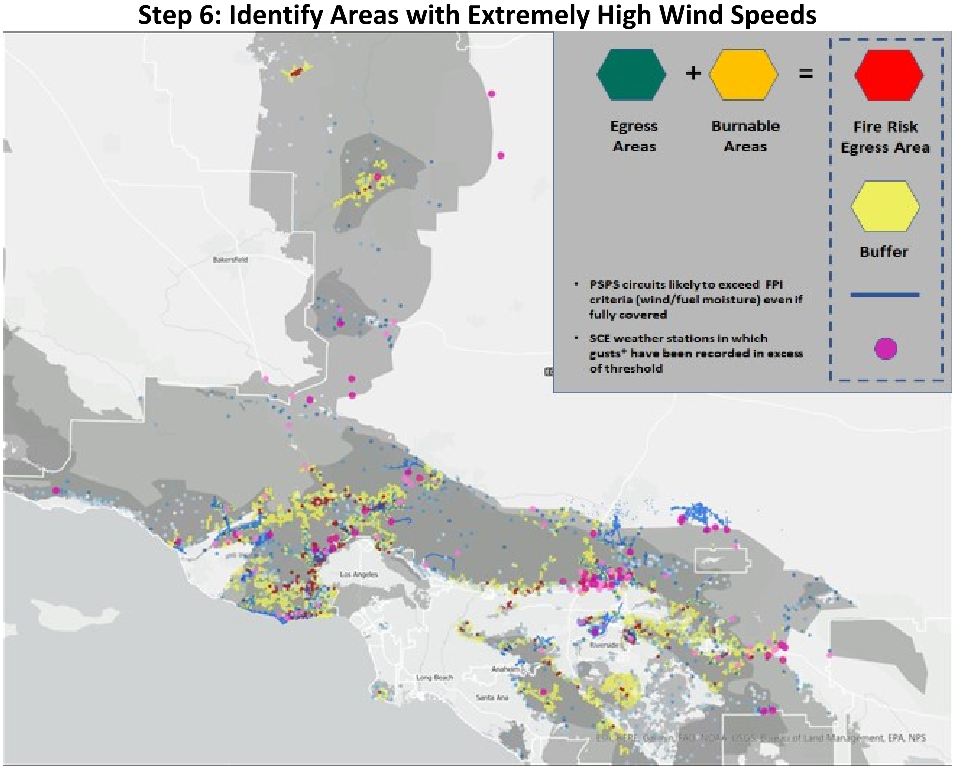
Utilizing Technosylva data, SCE determined which of SCE's overhead structures could result in fires burning into Fire Risk Egress Constrained Areas. SCE performed a calculation to identify which structures could potentially result in a fire trapping the public. Below are the steps to calculate the "Burn in Buffer"

1. Identify all structures within 25 miles of a Fire Risk Egress Constrained Area
2. Calculate the time needed for the population to exit the polygon using population size, travel speed, and distance to safety
3. Taking into account terrain and other factors, calculate the distance the fire could travel from each SCE distribution overhead structure within 25 miles, in the time needed to evacuate the Fire Risk Egress Constrained Area
4. Flag the structure as a potential burn in buffer structure if the fire originating there could enter the Fire Risk Egress Constrained Area
5. Determine if the fire will actually burn into a Fire Risk Egress Constrained Area, when accounting for wind direction, topography, and physical barriers (e.g., lakes)

SCE has approximately 975 circuit miles of overhead distribution lines, incremental to the miles in the previous steps, in these buffers.

Figure SCE 7-15

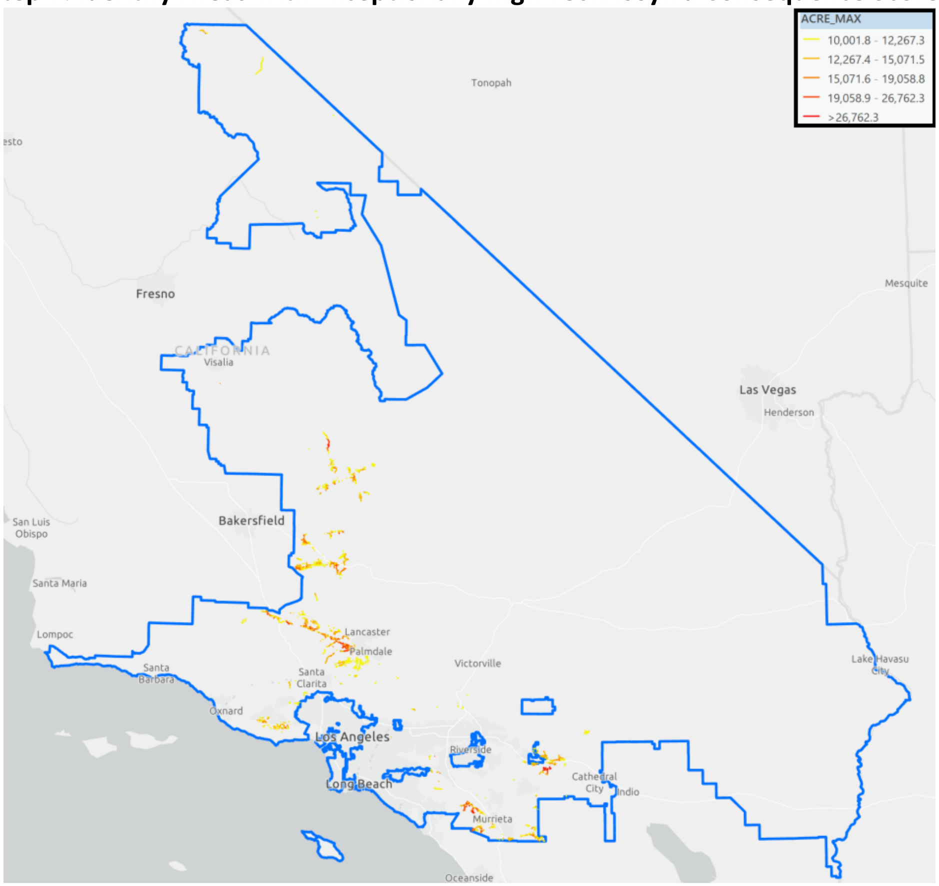
Step 6: Identify Areas with Extremely High Wind Speeds



SCE examined historical wind data from 2017 to determine which areas have experienced high sustained wind speeds above 40 mph and wind gusts above 58 mph (current PSPS de-energization threshold for fully covered isolatable conductor segments).[87] SCE has approximately 250 circuit miles of overhead distribution lines, incremental to the miles in the previous steps, in these areas.

Figure SCE 7-16

Step 7: Identify Areas with Exceptionally High Technosylva Consequence Scores



SCE identified segments in its HFRA that have an exceptionally high standard consequence in acres burned at eight (8) hours. SCE used the threshold of 10,000 acres burned in the first 8 hours. Fires that burn over 10,000 acres in the first 8 hours on average burn over 100,000 acres.

SCE has approximately 650 circuit miles of overhead distribution lines, incremental to the miles in the previous steps, in these areas.

As SCE's risk modeling abilities evolve, we may consider other factors in the determination of Severe Risk Areas.

II. <u>High Consequence Segments</u>

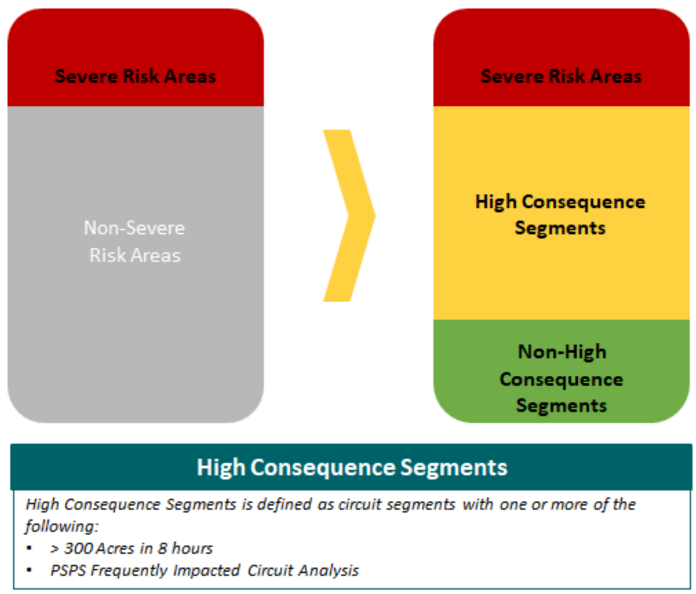
In addition to Severe Risk Areas, SCE has identified where a wildfire can propagate over large areas in a relatively short period of time and/or have the potential to be frequently impacted by PSPS. SCE has categorized these as "High Consequence Segments." SCE determined an ignition that can become a 300-

[87] This may change as SCE modifies thresholds based on further analyses and data over time.

acre-or-greater sized fire[88] within the first eight hours has a high probability of eventually becoming very large, thereby posing significant risks to life, health and property. In addition, SCE conducted an analysis that identified circuits that have experienced or are expected to experience high customer minutes of interruption from PSPS de-energizations absent appropriate grid hardening. SCE has included those circuits within the High Consequence Segments category.

Figure SCE 7-17

High Consequence Segments Criteria



A. <u>300-Acre Consequence Threshold</u>

Although Technosylva fire-spread projections rely on an assumed eight-hour burn duration after ignition, the real-world implications of a fire of that size in that time frame may be far more dire. SCE's analysis shows the following:

- Our analysis of California fires between 2015 to 2019 indicates that number of acres burned is a reasonable and reliable correlated proxy for buildings destroyed.

[88] CAL FIRE uses the 300-acre threshold for large fires in its annual fire report. The National Wildland Coordinating Group defines a "large fire" as any wildland fire in timber 100 acres or greater and any grassland/rangeland fire 300 acres or greater.

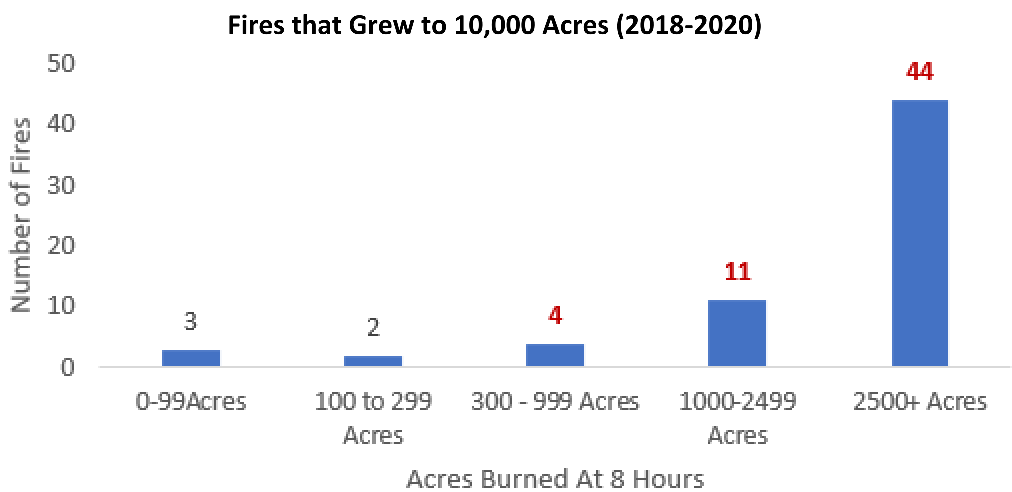
Table SCE 7-1

California Fires 2015 – 2019 (Size & Buildings Destroyed)

Final Fire Size (Acres)	Average Buildings Destroyed
300-1k	~2
1k-5k	~7
5k-10k	~15
10k-50k	~200
50k+	~1250

- A fire of 10,000 acres or more, destroys approximately 200 buildings, on average
- As summarized in Figure SCE 7-18 below, of the 64 fires in California between 2018 to 2020 that ultimately grew to greater than 10,000 acres, 59 (i.e., 92%) had spread to at least 300 acres in the first eight hours.

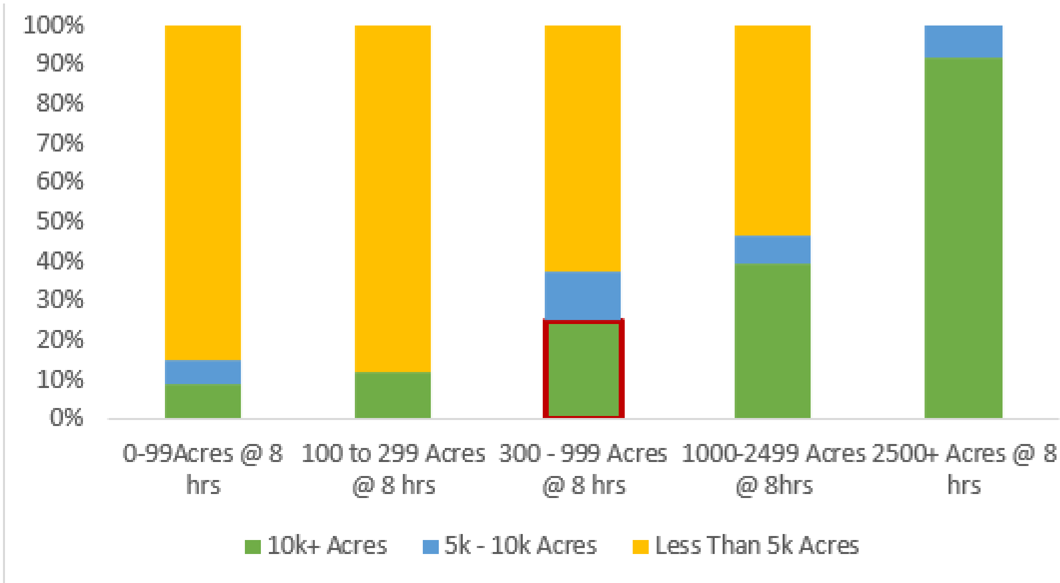
Figure SCE 7-18



- Of the fires that were only 300-999 acres in size after approximately eight hours post ignition, 25% grew to over 10,000 acres or more.

Figure SCE 7-19

Fire Size at 8 Hours, Relative to Final Fire Size



For all historical fires in SCE's service area that were greater than 10,000 acres, the closest Technosylva consequence point had an expected fire spread of 300 acres or more within eight hours post ignition.

B. Unhardened Circuits Not in Severe Risk Area at Risk of PSPS

Using five-years of backcast weather data and actual PSPS de-energizations, SCE analyzed its circuits and determined which ones are at the highest risk of a future PSPS de-energization. These circuits are then targeted for additional hardening. See SCE's description of its initiative SH-7 in section 7.3.3.8.1 for further discussion.

III. Mitigation Options

The suite of options SCE evaluated and selected from include:

- Installing covered conductor combined with fire-resistant poles installation, asset inspections, FC settings for CB relays, along with vegetation management activities (as necessary) including HTMP, pole brushing, and line clearing. SCE refers to this suite as CC++. In some circumstances, covered conductor may be substituted with spacer cable or aerial bundled cable.[89]
- Undergrounding
- Installing REFCL combined with asset inspections, FC settings for CB relays, along with vegetation management activities (as necessary) including HTMP, pole brushing, and line clearing. SCE refers to this suite as REFCL++.

[89] Spacer and aerial bundled cables are insulated cables supported by a separate, non-electrified steel cable which lends them greater strength, but are also more expensive than CC.

- Installing covered conductor and REFCL combined with fire-resistant poles installation, asset inspections, FC settings for CB relays, along with vegetation management activities (as necessary) including HTMP, pole brushing, and line clearing. SCE refers to this suite as CC/REFCL ++.

In selecting a mitigation or suite of mitigations, SCE considers their expected efficacy in addressing ignition risk drivers associated with overhead conductors, cost effectiveness, and operational considerations such as how quickly the mitigations can be deployed, mitigation deployment feasibility based on terrain, etc. Table SCE 7-2 below summarizes these considerations for the various alternatives.

Table SCE 7-2

Efficacy of Mitigation Suites

Attribute	CC[90]	CC++	Undergrounding	REFCL++[91]	CC/REFCL++
Approximate Average lifetime cost/mile[92]	\$0.5M-\$0.6M	\$1.3M-\$1.4M	\$1.6M-\$5.6M[93]	\$0.8 M-\$1.8M	\$1.3M-\$2.4M
Deployment Speed[94]	16-24+ months	16-24+ months	25-48+ months	18-36+ months	18-36+ months
Phase-to-phase incandescent particle ignition[95] mitigation	High	High	High	Low	High
Phase-to-ground incandescent particle ignition[96] mitigation	High	High	High	High	High
Distribution Wire-down ignition mitigation	Medium	High	High	Medium	High
Equipment Failure mitigation	Low	Medium	High	High	High

As explained in further detail in Section 9.8 of SCE's 2022 WMP Update, SCE's experience in the past three years with covered conductor, consistent with numerous utilities with longer histories of covered conductor installation, have validated its effectiveness in preventing ignitions, especially those resulting from contact from objects. Given its mitigation potency and the relative lower cost and faster speed of deployment when compared to alternatives such as undergrounding, SCE has historically chosen covered conductor as a significant part of its overall wildfire mitigation strategy. However, covered conductor

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[90] CC by itself is not among the mitigation options SCE considers but initial capital deployment cost is included here for reference.

[91] Preliminary determination of costs and effectiveness, subject to change pending further experience.

[92] Approximate per mile estimates for mitigation options SCE considers include initial capital deployment plus net present value of lifetime inspections, maintenance, remediation, and vegetation management costs, which will vary depending on location and operational considerations.

[93] Based on current analysis, SCE estimates that less than 10% of miles being considered for undergrounding will be on the low-end of this range.

[94] Typical deployment timelines based on historical installations and projections. Actual timelines can vary further due to local conditions.

[95] Examples include conductor to conductor contact, balloon coming between two phase wires.

[96] Examples include tree to conductor contact, animal contact between phase wires and pole.

cannot mitigate all significant ignition risk drivers from overhead equipment on its own, such as those related to failure from pole top equipment. For example, covered conductor by itself does little to mitigate ignitions resulting from a transformer failure. As such, SCE complements covered conductor with a portfolio of mitigations that addresses the other significant risk drivers. In the above example of the risk of transformer failure, SCE mitigates that risk by including detailed asset inspections, pole brushing, and fire-resistant poles in CC++.

Undergrounding is an extremely effective mitigation and, by itself, reduces all ignition risk drivers to a greater extent than any other single mitigation or suite of mitigations. It also virtually eliminates the need for PSPS and materially reduces the need for ongoing vegetation management. However, it is often more expensive, takes longer to deploy (and therefore does not mitigate risk as fast as other alternatives), and can be significantly more difficult to implement than other mitigation measures in certain terrains. Further, undergrounding lines often requires re-routing that results in more circuit miles constructed than if the structures were left overhead. It is also more challenging to find fault locations underground, resulting in longer restoration times if there is an outage. Finally, ignitions can still occur from undergrounded facilities and accompanying above-ground pad-mounted equipment. For prospective locations, SCE will examine the feasibility of undergrounding, taking into account cost, constructability, permitting, and time.

While REFCL is a promising new technology that is expected to be effective in reducing ground faults from a single phase, it does not prevent ignitions from phase-to-phase faults (e.g., a balloon or branch contacting two phases) nor multiple simultaneous ground faults (e.g., a heavy tree or damaged pole bringing down all three phases). There can also be wide cost variability of installing REFCL at different locations on SCE's system. Accordingly, SCE is currently not selecting REFCL++ to address High Consequence Segments on its own. However, given its mitigation profile, REFCL is likely an effective supplement to CC++ and SCE is preparing to deploy REFCL in several locations to assess its performance in conjunction with covered conductor, which is part of this 2022 WMP Update. In certain locations and under certain circumstances, CC++ and REFCL deployed together could come close to the effectiveness of undergrounding and at a lower cost and faster implementation timeline.

A. Mitigation Selection for Severe Risk Areas

For Severe Risk Locations, the threat to lives and property is elevated to such an extent that SCE has determined that for public safety reasons it is prudent to not just significantly reduce ignition risk expeditiously but minimize it in the long term to the extent practicable. Therefore, undergrounding is preferred unless covered conductor has already been installed or specific terrains necessitate installing alternatives such as covered conductor along with supplementary mitigations. For example, mountainous regions with winding rights-of-way and rocky soil may not be conducive to undergrounding. In those situations, SCE would examine alternatives such as covered conductor paired with REFCL. On the other hand, undergrounding may be more feasible in flat areas with silty clay soil, making that the preferred option. As all options have implementation times of multiple months, we will continue to use initiatives such as vegetation management, FC settings, asset inspections, and, as a tool of last resort, PSPS to mitigate the risk of ignitions while the selected initiative is designed, permitted, and constructed.

B. Mitigation Selection for High Consequence Segments

For High Consequence Segments, our strategy focuses on mitigating the majority of significant ignition risk drivers. Given the challenges with undergrounding and REFCL, SCE has selected CC++ for most of the High Consequence Segments that are still unmitigated, as it addresses all significant ignition risk drivers associated with overhead conductor, reduces more risk per dollar spent, and is faster and easier to deploy. Undergrounding will be chosen in select locations where it can be performed at a more comparable lifecycle cost and timeline.

C. Mitigation Selection for Non-High Consequence Segments

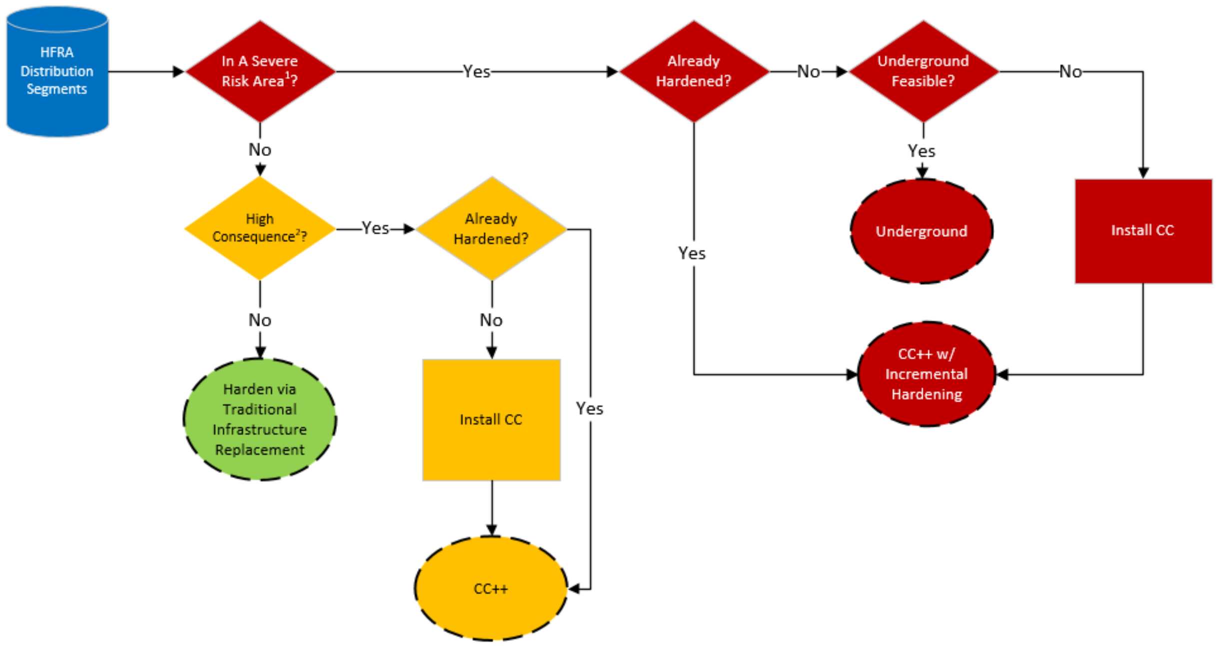
For its overhead distribution lines that are not High Consequence Segments, SCE will replace retired or damaged bare wires with covered conductor pursuant to its standards in HFRA. SCE will continue wildfire mitigation initiatives such as asset inspections, FC settings, and vegetation management that have relatively low incremental costs or are dictated by compliance requirements or local conditions. Although SCE is not currently targeting proactive hardening of these lines (with the exception of where it may be operationally efficient to do so), SCE will regularly re-evaluate risks in these locations based on climate change impacts, refined risk methodologies and modeling, and/or more accurate information.

IV. Projected Results and Prioritization

By utilizing the grid hardening approach described above, SCE is striking a balance between substantially mitigating the risk of significant fires from its overhead distribution facilities and addressing areas with special considerations, affordability, and expediency in implementation of mitigations. SCE has established the overall framework and in 2022 will continue to refine and implement the process described above (and illustrated in Figure SCE 7-20 below).

Figure SCE 7-20

Grid Hardening Framework



[1] Segment in area that meets criteria described in section I (e.g. Fire Risk Egress Constrained Area, Extreme High Wind Area, etc.)
[2] Segment that meets 300 acre consequence threshold or at risk of PSPS not in Severe Risk Area
[3] Segment that is not in a Severe Risk Area or does not meet High Consequence criteria; will replace retired or damaged bare wires with covered conductor pursuant to its standards in HFRA

SCE will rank all segments that SCE's methodology determines requiring hardening using the following variables:

- Egress concern
- Fire Consequence
- PSPS Criteria
- Probability of Ignition
- Pre-existing mitigations

SCE will then prioritize deployment of the selected mitigations based on this ranking. SCE generally requires a minimum of 16 months to design, permit, and construct covered conductor installations and even longer for undergrounding (usually 25-48 months but can be longer).[97] As such, the covered

[97] SCE interacts and engages with a host of local, State and federal Land Management, Air, Water and Natural Resources agencies, including the Forest Service, Bureau of Land Management, Caltrans, California Coastal Commission, Air Resources Boards, Department of Water Resources, State and Regional Water Boards, and California Department of Fish and Wildlife, for access authorizations, permitting, environmental clearances and

conductor installation and undergrounding projects for 2022 and much of 2023 are far along in their lifecycle process. Stopping these projects altogether would be impractical not only because of resources and costs already expended, but more because of the delays it would cause in reducing wildfire risks. Therefore, SCE will deploy 1,100-1,250 miles of covered conductor and 11-13 miles of undergrounding in 2022, most of which were scoped using earlier iterations of SCE's risk buy-down methodologies. However, 83% of these are also identified as segments in Severe Risk Areas or High Consequence Segments. For the remaining miles SCE will continue to look for potential adjustments based on the latest refined analysis if it is operationally feasible, economically efficient, and does not compromise expedited risk reduction.

Table SCE 7-3

Distribution Grid Hardening Analysis Results

Category	Currently Hardened	Currently Unhardened		Total
		In-Flight CC Scope	Not Currently Scoped	
Severe Risk Areas Miles • Egress Areas • Burn-in-Buffer • Exceptionally High Standard Consequence Areas • Extreme High Wind Areas	725	500	700	**1,925**
High Consequence Segments Miles • 300 Acres at 8 hours[98]	1,700	1,350	2,025	**5,075**
Other HFRA Miles	475	550	1,675	**2,700**
Total	**2,900**	**2,400**	**4,400**	**9,700**

<u>Note:</u> Circuit miles in the table are approximates and represent existing distribution overhead lines; additional circuit miles required for installation or rerouting not included.

In Table SCE 7-3 above, SCE displays how this strategy categorizes the circuit miles of overhead distribution overhead lines in its HFRA. SCE emphasizes that these results are from a specific point in time and may change as factors such as climate change alter conditions across HFRA.

There are approximately 1,925 Severe Risk Area miles, of which approximately 1,225 are scoped for, or have installed, CC++. Of those 1,225 miles, SCE will assess whether CC++ can be supplemented with REFCL or other initiatives to bring the overall mitigation effectiveness close to undergrounding. For the in-flight miles, if undergrounding is feasible, SCE will examine which covered conductor projects can be reasonably

approvals to conduct grid hardening and other wildfire mitigation activities. Utilities and the State, in general, would greatly benefit from a greater coordination and collaboration between Agencies and the utilities to focus on streamlining and standardizing processes and expediting this urgent grid hardening work. SCE details the timelines for these efforts in Appendix Sections 9.3 and 9.4."

[98] Segments of 10,000 Acres or more at 8 hours are included as part of the Exceptionally High Standard Consequence Areas in the Severe Risk Areas Miles row

and cost-effectively halted to allow the installation of undergrounding instead. For the remaining 700 miles SCE will consider the feasibility of undergrounding, as well as the other alternatives discussed above.

For High Consequence Segments, SCE has covered or scoped to cover approximately 3,050 miles and will implement the full CC++ suite for those miles. SCE will scope CC++ for the remaining 2,025 miles over the next several years.

There are approximately 2,700 remaining HFRA circuit miles that are neither High Consequence Segments nor in Severe Risk Areas. Of those, 475 miles have been hardened and 550 miles are scoped to be hardened with CC++. These miles were scoped for operational reasons, constitute replacement work due to storm restoration or retirement of aging bare wire pursuant to SCE's current construction standards in HFRA, and/or were deployed pursuant to previous iterations of SCE's risk prioritization methodologies. For the 550 miles of CC++ that are still in-flight in this category, SCE will examine which miles can be reasonably and cost-effectively halted.

7.1.3 Summary of Achievements of Major Investments and Implementation of Wildfire Mitigation Initiatives (2022 WMP Guidelines Reference 7.1.C)

SCE's 2022 WMP update builds on the successes of our WMP implementation to date, incorporates the lessons we learned during WMP deployment and reflects the continued progress we made in our analytical, engineering and process maturity prior to and during the first two years of the 2020-2022 period. Throughout this WMP update, SCE presents its portfolio of wildfire and PSPS mitigation strategies, including the costs, prior performance, anticipated deployment in 2022, near- and long-term strategies, and lessons learned that have informed our approach going forward. Please refer to the following areas of this WMP for summary information at the wildfire mitigation category and/or activity level:

- SCE's Executive Summary provides a portfolio and category-by-category (as listed in Section 7.3) summary of achievements of major investments and achievements of key wildfire mitigation initiatives over the past year. In addition, Table 5.3- 1 provides historical performance and specific 2022 targets for the WMP activities within these wildfire mitigation categories. Recorded and forecast costs for the mitigations within each WMP category can be found in Table 12.

- Table 4-1 presents lessons learned across the wildfire mitigation categories.

- Each WMP activity within each of the wildfire mitigation categories represented in Section 7.3 discuss key efforts and strategies performed in 2021, and those that will be performed over the course of 2022. Notable changes in circumstance and/or strategy are noted within those narratives and reflected in the priorities for the current year.

- Further, Table SCE 7-4 outlines the specific near-term strategies and priorities for 2022 for each wildfire mitigation category

Wildfire Mitigation Strategy and Goals

Wildfire Mitigation Strategy and Goals Over the Remaining 2020-2022 WMP Period (By June 1, 2022, September 1, 2022, and before the next WMP Period)

SCE is including the near-term goals that cover June 1, 2022; September 1, 2022; and before the next WMP filing in the following tables. The lessons learned described in Section 4.1 cover the details of how SCE is changing its WMP going forward, with key highlights included in each of the category-specifics within Table SCE 7-4, and the summary of major investments and implementation of wildfire mitigation initiatives achieved over the past year are included in Section 5.3.

Each of the near-term goals are part of SCE's long-term Wildfire Mitigation Strategy and contribute to building foundational capabilities, communicating with stakeholders, hardening the grid, or reducing the risk of ignition or worker and public safety.

SCE Near-Term Wildfire Strategy and Goals

Table SCE 7-4

Near-Term Strategy by WMP Category

Category	Near-Term Strategy	By June 1, 2022	By September 1, 2022	Before Next WMP Update
Risk Assessment & Mapping	Efforts are focused on refining the probabilities of EFF and CFO across all electrical topologies.		Update inputs and assumptions to the WRRM including fuels, wind and weather scenarios. Segment analysis and integration with other population risks.	Enhance the mitigation effectiveness estimate methodologies used in RSE quantifications for wildfire mitigations.
Situational Awareness & Forecasting	Efforts are focused on increasing data collection (through additional weather station deployment, HD camera deployment and other data sources, e.g., ML and artificial intelligence) and augmenting weather modeling and fire propagation capabilities.	Continue to evaluate fuel samples, fire spread modeling and FPI 2.0 for Fire Science (SA-8) and ML modeling performance for Weather and Fuels Modeling (SA-3) Install 4 HD cameras (SA-10). Install approximately 50 weather stations (SA-1).	Equip 500 weather station locations with ML capabilities. Develop live fuel models for different species (SA-3). Continue to evaluate fuel samples, fire spread modeling and FPI 2.0 for Fire Science (SA-8). Install 14 HD cameras (SA-10). Install approximately 90 weather stations (SA-1).	SCE will evaluate findings from prior DFA installations to inform future DFA activity. Install approximately 150 weather stations (SA-1).

Category	Near-Term Strategy	By June 1, 2022	By September 1, 2022	Before Next WMP Update
Grid Design & System Hardening	Execute SCE's system hardening portfolio of activities to improve wildfire-related public safety and reduce impacts from PSPS. Align annual execution and resource plan to ensure achievement of the 2022 system hardening program targets. Expand use of undergrounding in targeted areas. Develop secondary conductor mitigation strategy to complement existing system hardening portfolio.	Ensure timely completion of internal plans for system hardening portfolio. If behind plan, develop get-well strategies to get back on track to meet program targets by year end.	Ensure timely completion of internal plans for system hardening portfolio. If behind plan, develop get-well strategies to get back on track to meet program targets by year end. Complete all system hardening prioritized locations of activities that reduce impacts from PSPS.	Complete execution of 2022 program targets and develop lessons learned to inform 2023 plan and execution.
Asset Management & Inspections	Expand the use of risk modeling in scoping and planning, to augment SCE's risk-informed asset management approach, as described in the discussion around grid hardening in SCE's WMP.	Complete 50% of distribution and transmission HFRA scope (excluding Area of Concern scope). Complete 80% of distribution infrared inspections. Completion of transmission infrared and corona inspections is subject to operating conditions.	Complete 90% of distribution and transmission HFRA scope (excluding Area of Concern scope). Complete 100% of distribution infrared inspections. Completion of transmission infrared and corona inspections is subject to operating conditions.	Complete any added area of concern inspections identified after the start of wildfire season. Complete all 2021 program targets and develop lessons learned to inform 2022 plan and execution.
Vegetation Management & Inspections	Focus on execution of key vegetation management activities, including the introduction of new work management tools and enhanced vegetation risk modeling.	SCE will have completed ~40% of the Hazard Tree Management Assessments. SCE will have completed ~40% of the Expanded Pole Brushing activity goal. SCE will have completed 50% of this year's Expanded Clearances for Legacy facilities compliance target. SCE will have completed ~40% of the Dead and Dying Tree inspections. SCE will have completed ~40% of the Line Clearing inspections in HFRA.	SCE will have completed ~70% of the Hazard Tree Management Assessments. SCE will have completed ~70% of the Expanded Pole Brushing activity goal. SCE will have completed ~83% of this year's Expanded Clearances for Legacy facilities compliance goal. SCE will have completed ~70% of the Dead and Dying Tree inspections. SCE will have completed ~70% of the Line Clearing inspections in HFRA.	100% completion for the following activities: • Hazard Tree Management Assessments • Expanded Pole Brushing • Expanded Clearances for Legacy facilities • Dead and Dying Tree inspections • Line Clearing inspections in HFRA Implement the vegetation management work management tool for the Hazard Tree Program (HTP), which includes HTMP and Dead and Dying Tree removal, and for Routine Line Clearing.

Category	Near-Term Strategy	By June 1, 2022	By September 1, 2022	Before Next WMP Update
Grid Operations & Protocols	Continue to augment foundational systems to leverage higher quality data about the grid and integrate risk modeling. Continued review of Customer Care programs performance and refinement.	Refine FC setting strategy to reduce fault energy which may reduce wildfire risk while maintaining reliability by providing coordination with downstream protective devices. Continue marketing Customer Care programs to eligible customers.	Operationalize the Palantir Foundry platform for use in the 2022 PSPS fire season. Continue to identify new eligible customers to offer Customer Care programs and continue to enhance the incentive offering programs.	Expand use of UAS and enhance UAS protocols to help assess a circuit's readiness to return to service.
Data Governance	Expand SCE's cloud Big Data platform to manage remote sensing data for additional wildfire mitigation initiatives and enable an AI Platform for SCE's data scientists. Establish a centralized data repository that consolidates data from disparate enterprise systems to enable wildfire data analytics, real-time sharing of data, and efficient reporting.	Integration Aerial Inspections imagery data management. Enable remote sensing data solutions for 360-inspection model. Baseline OEIS datasets and data sources. Wildfire data portal design completion. Continue staggered consolidation of wildfire safety datasets into centralized data platform.	Enable long-term remote sensing data solutions for Long Span inspections. Enable SCE's enterprise Artificial Intelligence platform for model training, tuning, serving, monitoring, and management. Continue staggered consolidation of additional wildfire safety datasets into centralized data platform. Initiate implementation of foundational elements for Data Portal.	Initiate solution analysis and design for LiDAR data management. Complete consolidation of wildfire safety datasets required for QDR. Continue additional capability implementation for Data Portal.
Resource Allocation Methodology	Continued use of risk analysis and operational considerations to prioritize deployment of employee and financial resources.	N/A	N/A	Allow comparison of multiple mitigations that may substitute for one another or complementeach other. Evaluate ongoing OCM support needs.
Emergency Planning & Preparedness	Maintain a comprehensive all hazards planning and preparedness program and a robust and highly skilled field workforce (both employees and contractors) to provide effective emergency response and restore service during and after a major event.	N/A	To have all PSPS IMT and Task Force members fully trained and qualified or requalified by mid-year.	Have all other IMT and IST members trained by end of the year. Technically qualify 50 UAS Operators that have passed the FAA 107 exam.
Stakeholder Cooperation & Community Engagement	Establish stakeholder networks and partnerships to better understand customer, community and stakeholder-specific needs and develop tailored solutions.	Launch marketing campaign to raise PSPS and wildfire mitigation awareness.	Sign MOU with local fire authorities to aid in aerial suppression support. Host at least nine community meetings to raise PSPS and wildfire mitigation awareness and hear customer concerns.	Conduct at least wildfire mitigation/PSPS related surveys.

Wildfire Mitigation Strategy and Goals Over Future WMP Periods

SCE's long-term wildfire mitigation roadmap for each of the Maturity Model's 10 categories is included in its response to Guidance 12 and updated in Section 7.3. Within each category, SCE defines the objectives that support achieving the goals outlined for all utilities in Section 5.1 to Section 5.3.

SCE's achievements and key activities in this current WMP period are articulated for each category in the tables below. The table covers both the key initiatives driving progress to-date, as well as potential priorities for future WMP cycles that will drive maturity growth, based on the existing capability maturity model. The progress planned in three years is not directionally different from the 10-year plan, but the focus will shift to implementation, re-evaluation and continuous improvement with each passing cycle. Therefore, SCE combined within the next three years (i.e., 2022-2024) and within 10 years (i.e., 2022-2031) timeframes in its response in the table.

Action SCE-9 in WSD's evaluation of SCE's First WMP Quarterly Report asks SCE to define the terms "continue" and "increase" as used in SCE's response to Guidance 12. If SCE forecasts that a current scope and approach for a particular activity would remain unchanged, SCE called it a continuation. For example, covered conductor deployment is a continuation over the course of the 2020-2022 period, as the scope and pace of covered conductor deployment over this time period is relatively constant. On the other hand, when SCE expects the scope, approach (e.g., granularity of analysis), or some other aspect to be enhanced, SCE termed that as an "increase." For example, we expectto "increase" the granularity at which we can perform weather modeling as we have access to more datato support those calculations. In either case, the quantification of deployment is captured in SCE's program targets for existing efforts, Table 5.3- 1, where the inclusion of an activity across multiple years, or into future WMPs, is indicative of a "continuation." For these activities, SCE will use these forecasts tounderstand progress. Please note, that these targets are subject to change as part of Change Orders or in future WMP updates or WMPs based on emergent information and further refinement in risk analysis and alternative evaluation. For "increases", it was generally more used to capture the benefits that result fromexecuting on an initiative. Table 5.3- 1will provide a quantitative capture of the deployment activity, but the qualitative benefits from the deployment, which is more appropriately aligned with "increases", will be captured in the corresponding narrative for that initiative. It is anticipated that much of the benefit will be captured in subsequent capability maturity model survey responses as the "increases" will yield maturity advancements.

Table SCE 7-5

Category Near- and Long-Term Strategy and Goals – Grid Design & System Hardening

	Within Three Years (2022-2024)	**Within 10 Years (2022-2031)**
Objective/Goal:	Execute key proven hardening activities to improve wildfire-related public safety and to reduce the need for PSPS.	Minimize and mitigate wildfire risk by developing and deploying resilient grid designs, standards, and architectures.
Strategy:	*Progress expected through:*	*Potential future focus:*

<table>
<tr><th></th><th>Within Three Years
(2022-2024)</th><th>Within 10 Years
(2022-2031)</th></tr>
<tr><td></td><td>• Completing execution of initial grid hardening strategy developed from 2018-2021, which includes reducing the greatest amount of wildfire risk in the shortest amount of time coupled with targeted PSPS reduction strategies.
• Developing longer term integrated grid hardening strategy that complements the initial strategy with results of new technologies (e.g., REFCL, EFD), targeted undergrounding; secondary conductor mitigations; determining locations for targeted undergrounding will use variables not utilized by the WRRM (e.g., egress, tree canopy and density, high wind locations).
• Add third-party testing of hardening solutions/activities.
• Further develop transmission grid hardening strategy.
• Begin scoping and design of longer-term integrated grid hardening strategy initiatives.
Key Initiatives:
• Covered Conductor
• Targeted undergrounding
• C-Hooks (complete in 2022)
• LSI
• REFCL
• Microgrids
• Secondaries</td><td>• Execute longer term integrated grid hardening strategy
• Continue to assess the impacts of climate change in SCE’s service areas
• Refine strategy based on the latest risk profile / analysis to deploy the most effective hardening solutions
• Evaluate complementary aspects of mitigations to increase overall effectiveness across HFRA
• Execute updated Transmission hardening system strategy.
• Add independent audits of innovative solutions (validate is in maturity model)</td></tr>
</table>

Table SCE 7-6

Category Near- and Long-Term Strategy and Goals – Grid Operations & Protocols

	Within Three Years (2022-2024)	Within 10 Years (2022-2031)
Objective/Goal:	Continue to augment foundational systems to leverage higher quality data about the grid and integrate risk modeling.	Significantly reduce the number, scale, duration, and impact of PSPS activations through increased automation coupled with operational flexibility enabled by grid design and adoption of DERs.
Strategy:	*Progress expected through:* • Improvements in average downtime; and more automation in restoration processes. *Key Initiatives:* • Evaluate effectiveness of microgrids and determine the feasibility. Support the facilitation of commercialization of microgrids. • Review/assess emerging distributed sensor systems to improve situational awareness to inform operations. • Begin implementation of an Advance Distribution Management System (ADMS) that may improve average downtime and improved operational capabilities. • Evolve grid operations processes and protocols to maximize the ignition risk reduction, safety, and reliability benefits of a hardened grid, including the proliferation of covered conductor, targeted undergrounding, and other advanced technologies currently being explored (e.g. REFCL, Open Phase Detection). • As the Field Area Network is further developed, identify synergies and opportunity areas that enable the improvement of	*Potential future focus:* • Implementing new distributed sensing systems and associated protocols for better situational awareness to improve operational effectiveness and decision making. • Adding incremental automation to reduce average downtime. • Continue to implement an ADMS that may improve average downtime and improved operational capabilities.

	Within Three Years (2022-2024)	Within 10 Years (2022-2031)
	grid operation processes and protocols to reduce risk, improve reliability, and reduce PSPS duration and scope. • Battery Backup Programs – Continue to identify new eligible customers to offer programs to.	

Table SCE 7-7

Category Near- and Long-Term Strategy and Goals – Asset Management & Inspections

	Within Three Years (2022-2024)	Within 10 Years (2022-2031)
Objective/Goal:	Expand the use of risk modeling in scoping and planning, to augment SCE's risk informed asset management approach, as described in the discussion around Grid Hardening in SCE's WMP.	Further advance our effectiveness in targeting specific assets that require inspection or maintenance through a defined timeframe, leveraging new technologies that facilitate a near real time data-driven, risk-informed asset management approach.
Strategy:	*Progress expected through:* • Adding predictive analysis to inform scheduling; refining inspection checklists dynamically to asset-specificdetails. • Further integration with SCE's Integrated Grid Hardening Strategy *Key Initiatives:* • Inspections and Remediations • Inspection Work ManagementTools	*Progress expected through:* • Adding predictive analysis to inform scheduling; refining inspection checklists dynamically to asset-specific details. *Key Initiatives:* • Inspections and Remediations • Inspection Work Management Tools

Table SCE 7-8

Category Near- and Long-Term Strategy and Goals – Vegetation Management & Inspections

	Within Three Years (2022-2024)	**Within 10 Years (2022-2031)**
Objective/Goal:	The incorporation of data informed decision making, and modern technology will provide adaptability and agility in day-to-day operations. SCE strives to achieve regulatory compliance, continual workforce development opportunities, greater data integrity, timeliness, reduction of customer impacts, cost effectiveness and reduced safety risks. We use best-in-class practices to prevent wildfires and protect environmental resources to ensure sustainable long-term methodologies within SCE's area.	Comprehensive vegetation management programs that further integrate data, new technologies, analytics, risk-informed program, design and deployment to mitigate wildfire risks. SCE will focus on developing more robust IVM utilizing a broader array of treatment strategies to achieve compliance and mitigate fire risks.
Strategy:	*Progress expected through:* • Focus on execution of key vegetation management activities, including the introduction of new work management tools and enhanced vegetation risk modeling (e.g., TRI). Improved inspection and remediation practices. • Further integrate with SCE's Integrated Grid Hardening Strategy *Key Initiatives:* • Vegetation Management Work Management Tool • HTMP • Joint IOU Plan to Study the Effectiveness of Enhanced Clearances	*Progress expected through:* • Focus on the introduction of new technologies to continue to support improved inspection and remediation practices. *Key Initiatives:* • IVM- tree growth regulators, planting, grazing, herbicides, wildfire restoration, etc., in order to achieve long-term trimming and removal reductions • Achieve semi-automated inspections and auditing through incorporation of enhanced technologies • Develop predictive modeling, incorporating additional data inputs, as identified over time

Table SCE 7-9

Category Near- and Long-Term Strategy and Goals – Data Governance

	Within Three Years (2022-2024)	Within 10 Years (2022-2031)
Objective/Goal:	Establish a comprehensive asset data governance framework with clear roles and responsibilities of how data is to be managed, enhancing our data collection and data centralization capability using cloud, platform-centric architecture that consolidates data from disparate enterprise systems supporting automated publication to the WMP publication portal.	Enhance SCE's information management framework to further ensure data integrity and support widespread usage of data across planning, grid design, operations, and maintenance through the identification of additional asset and operational data we need to collect, the development of rigorous data governance processes, and integrated, real-time access.
Strategy:	*Progress expected through:* • Deploy centralized data repository; building integration with disparate data sources; and design for external portal assisting with data submissions. *Key Initiatives:* • Wildfire Safety Data Mart and Data Management (WiSDM / Ezy)	*Potential future focus:* • Add real-time interfaces for sharing data • Add a self-service portal for data accessibility • Add big data analytics to enable growth of capabilities in other areas

Table SCE 7-10

Category Near- and Long-Term Strategy and Goals – Situational Awareness and Forecasting

	Within Three Years (2022-2024)	Within 10 Years (2022-2031)
Objective/Goal:	Increased data collection (through additional weather station deployment and other data sources), augmenting weather modeling capabilities, and piloting emerging. Technologies to provide incipient fault awareness.	Embed situational awareness and forecasting into decision making processes across planning, grid design, operations, and maintenance through the development of additional data and model granularity and accessibility.

	Within Three Years (2022-2024)	Within 10 Years (2022-2031)
Strategy:	*Progress expected through:* • Higher resolution weather data; higher resolution forecasting; and improving fire detection capability. *Key Initiatives:* • Weather Stations • Next Generation Weather Modeling • Fire Spread Modeling	*Potential future focus:* • Add automated error checking and correction. • Develop earlier and more accurate forecasting capabilities • Incorporate physical impacts of weather to assets • Improve ability to detect fires

Table SCE 7-11

Category Near- and Long-Term Strategy and Goals – Risk Assessment and Mapping

	Within Three Years (2022-2024)	Within 10 Years (2022-2031)
Objective/Goal:	Efforts are focused on refining the probabilities of EFF and CFO across all electrical topologies.	Integrate how risk assessment and mapping informs asset management decisions across grid planning, design, operations, & maintenance functional areas by using a data-driven, asset component-level risk modeling methodology.
Strategy:	*Progress expected through:* • Higher resolution in ignition risk and consequence calculation; adding automation to processes; and advances in how we calculate risk. *Key Initiatives:* • Update mitigation effectiveness values based on lab and field testing • Update ML algorithms to leverage remotely sensed vegetation data • Integration with new Severe Risk Area framework as part of SCE's Integrated Grid Hardening Strategy • Incorporate weather data to account for forward looking climate scenarios	*Potential future focus:* • Add incremental automation. • Integrate with vegetation, weather, and asset data. • Perform sensitivity analysis • Perform independent validation.

Table SCE 7-12

Category Near- and Long-Term Strategy and Goals – Stakeholder Cooperation and Community Engagement

	Within Three Years (2022-2024)	Within 10 Years (2022-2031)
Objective/Goal:	Establish further stakeholder networks and partnerships to better understand customer, community and stakeholder-specific needs and develop tailored solutions.	Effective stakeholder communication through tailored approaches for outreach, engagement and information exchange with customers, communities and stakeholders based on various groups' unique needs.
Strategy:	*Progress expected through:* • Developed annual Access & Functional Needs customer plans. *Key Initiatives:* • Aerial Suppression • Customer Education- Community Meetings • Customer Education- Marketing Campaign	*Potential future focus:* • Incorporate process for adopting best practices (company-wide). • Monitor land-owner agreement with WMP initiatives. • Increase cooperation with fire suppression agencies. • Cultivate lower risk vegetative ecosystems.

Table SCE 7-13

Category Near- and Long-Term Strategy and Goals – Emergency Planning and Preparedness

	Within Three Years (2022-2024)	Within 10 Years (2022-2031)
Objective/Goal:	Maintain a comprehensive all hazards planning and preparedness program and a robust and highly skilled field workforce (both employees and contractors) to provide effective emergency response and restore service during and after a major event.	Best-in-class emergency planning and preparedness approach to enable customer resiliency through training, education, helpful programs, and delivery of tailored communications before, during, and following an event.
Strategy:	*Progress expected through:* Continuous assessment of threats and hazards while building strategies and solutions that improve emergency	*Potential future focus:* • Continue to focus on opportunities to improve restoration by exploring new tools and technologies that

	Within Three Years (2022-2024)	Within 10 Years (2022-2031)
	response capability and information sharing. *Key Initiatives:* • Emergency Responder Training	support the IMT and field staff with restoration efforts.

Table SCE 7-14

Category Near- and Long-Term Strategy and Goals – Resource Allocation Methodology

	Within Three Years (2022-2024)	Within 10 Years (2022-2031)
Objective/Goal:	Continued use of risk analysis and operational considerations to prioritize deployment of employee and financial resources.	Augment the risk analysis framework to allow comparative analysis of multiple mitigations that may substitute each other or complement each other at a granular level.
Strategy:	*Progress expected through:* • Improved granularity in mitigation risk projections; risk-informed portfolio decisions adding PSPS consequences; and costs for innovations. *Key Initiatives:* • Calculate RSE at more granular locations (will be including 2021-2022 scope) • Refine wildfire risk, PSPS risk, and combined risk scores for applicable WMP initiatives	*Potential future focus:* • Optimize mitigation deployment at the asset level based on quantitative factors (e.g., levelized cost, updated mitigation effectiveness values). • Optimize mitigation deployment at the asset level based on qualitative factors (e.g., speed of deployment, permitting, resource constraints, etc.).

7.1.4 Challenges associated with limited resources and how these challenges are expected to evolve over the next 3 years (2022 WMP Guidelines Reference 7.1.D)

Executing SCE's wildfire mitigation strategy is dependent on having sufficient qualified labor to perform the desired activities as described in the WMP. To date, the largest resource challenge remains in vegetation management, as SCE's ability to secure enough qualified resources has been challenged with the increasing need for their services across other areas inside and outside of California. This applies to both ISA-certified arborists and vegetation management pruning/removal/brushing crews. SCE will continue to evaluate resource requirements necessary to effectively perform work across its vegetation management programs and will continue to address those needs through a combination of internal and external staffing solutions. In 2023, SCE will continue to develop internal ISA certified arborists for SSP roles by mentoring SPs to become SSPs/ISA Certified Arborists. Longer term, SCE will also explore the benefit of ISA certification for line clearing inspectors and potential incentives for contractor companies and their individual employees for obtaining ISA certification.

Additionally, there are more general resource challenges in helping to ensure subject matter expertise is available across the 10 wildfire categories, as many of these areas are rapidly evolving and can require skill sets that may not be readily available currently within the utility. To the extent possible, SCE attempts to foresee emerging needs, such as SCE's identified AOC inspections as discussed in Sections 7.3.4.9.1 and 7.3.5.4 to secure the necessary resources.

Another factor that could potentially impact SCE resources is the ongoing presence of the COVID-19 virus, which was declared a pandemic by the World Health Organization in March 2020. SCE continues to closely monitor impacts of the pandemic on the availability of various wildfire resources. To date, SCE's resources have been able to keep up with wildfire mitigation activities, however the pandemic could put a strain on future resource availability. State and local restrictions could potentially further impact resource availability and the method to which wildfire work can be performed (e.g., social distancing requirements has limited vehicles to one person instead of two, requiring additional vehicles). SCE will adhere to all state and local restrictions as they arise and will notify OEIS if any mitigation activities are not on track through quarterly initiative reporting throughout 2022.

Material delays due to global supply chain issues are also an issue that SCE is monitoring that may have an impact to various mitigation initiatives in the future. SCE continues to explore options to source materials from various vendors where material delays could significantly impact SCE's abilities to achieve their goals.

Across all of these challenges, SCE expects that continued engagement with industry to support the need for, as well as type of, resources will help to alleviate resource constraints faced as SCE has continues to scale many activities to address the magnitude of risk presented by wildfire.

7.1.5 New Technologies and Innovations (2022 WMP Guidelines Reference 7.1.E)

Outline how the utility expects new technologies and innovations to impact the utility's strategy and implementation approach over the next 3 years, including the utility's program for integrating new technologies into the utility's grid. Include utility research listed above in Section 4.4.

This section provides information about the technologies SCE is exploring that, if successful, may be adopted to mitigate wildfire risk, improve resiliency of the SCE system, and advance SCE towards achieving its long-term objectives, as described in 4.4 Sections 7.1.1 through 7.1.3 above. Though the exact process of adoption at SCE may vary, projects generally follow a sequential flow consisting of evaluation (step 1), pilot (step 2), small scale deployment (step 3), and finally programmatic application as mitigations or for use in the normal course of business (step 4). The sections below describe the technology or innovation under consideration, how the technology may reduce ignition risk, SCE's progress on assessing the technology, SCE's plans for 2022 specifically, and how SCE will make the determination whether to adopt the technology. Since SCE has not yet determined whether a targeted or full-scale deployment of an activity should occur, it is premature to develop an RSE calculation at this stage. If the results of a technology or innovation pilot are favorable, SCE will estimate the risk reduction of the mitigation and perform the RSE calculation to help inform the decision on whether to deploy the activity more broadly.

The technologies below span a large range of approaches including improvements to inspection efficiencies, maintenance situational awareness, and system protective features. Some of these technologies represent unique mitigations while others supplement or improve deployment of existing mitigations. Particularly with technologies offering system protection and system monitoring, multiple technologies may be considered or adopted to achieve optimal results. Some mitigations focus on fault prevention, thereby avoiding a possible ignition and related customer outage, whereas others target reducing the potential of the fault (or electric system related condition) to result in an ignition. The layering of systems to lower or prevent ignitions is common across many of the wildfire mitigation advanced technology activities.

SCE continues to explore technological options and resiliency approaches for reducing ignition risks and the impacts of wildfires on SCE's customers and the electric system. For utility research not included in Alternate Technology and Innovations pilots please see Section 4.4. Below is the collection of Alternative Technology options and evaluations:

Meter Alarming for Downed Energized Conductor (MADEC)

- Activity description and drivers:

MADEC is a ML algorithm utilizing smart meter data to detect a subset of energized wire-downs and other high impedance faults/hazards and generates an alarm that allows an operator to act quickly and de-energize the circuit. MADEC is currently being used throughout SCE's service area. The MADEC system was designed for bare conductor but is being improved to work with bare and covered conductor.

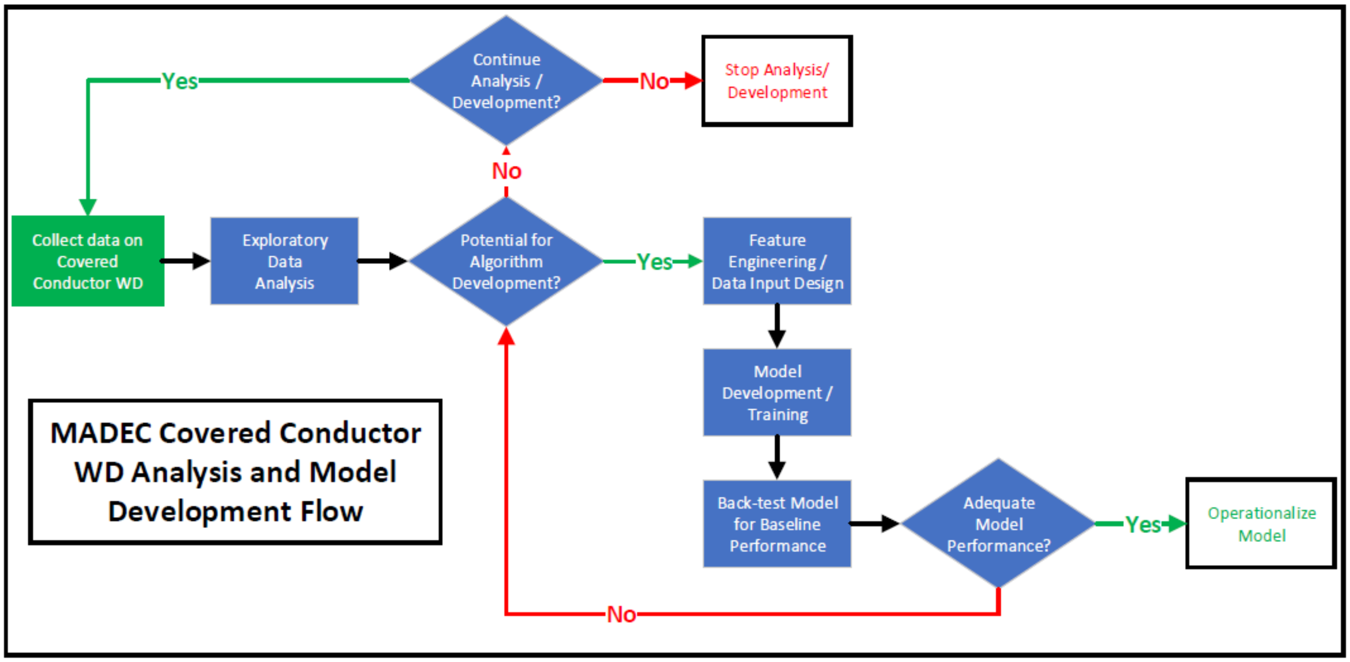
- How is the activity effective at reducing ignitions and how is effectiveness measured?

Detection and prevention of downed energized covered conductor is an important aspect of public safety and of wildfire risk reduction. The MADEC system can limit the total time a downed covered conductor stays energized after falling, providing potential reduction of ignition risk and public safety benefits. Covered conductor reduces the number of faults or failures compared to bare overhead conductors but does not eliminate them. It is unclear whether the MADEC algorithms developed for bare conductor will work for covered conductor, which necessitates the evaluation.

This pilot will be deemed successful if MADEC's ability to detect energized downed covered conductor is confirmed using sufficient sample data as more covered conductor is installed in the field, and actionable changes needed to make MADEC more effective are identified (i.e., distinct voltage signature patterns that are validated by actual field conditions). See Figure SCE 7-21 MADEC Flowchart, which illustrates the process for validating the data collected. SCE has experienced very few downed energized covered conductor events and algorithm improvements will require more field data on downed energized covered conductor before it can be determined whether an algorithm to detect them automatically can be implemented. Threshold values are not applicable.

Figure SCE 7-21

MADEC Flowchart



- 2021 Activities:

A ML algorithm requires data to build a model and teach the algorithm to generate an alarm. SCE identified and studied 16 downed covered conductor events in 2021; however, based on initial results it is unlikely that MADEC will be able to detect Covered Conductor wire down in its current configuration. Since there have been limited instances of downed covered conductor to date, not enough field data has been collected to determine if detection is possible.

- 2022 Planned Activities:

SCE will continue to collect data on downed wire for covered conductor in 2022.

Advanced Unmanned Aerial Systems Study (UAS)

- Activity description and drivers:

SCE developed the Advanced UAS demonstration project to study the feasibility, effectiveness, and efficiency of using drones in flying beyond visual line of sight (BVLOS) flights and to closely monitor a rapidly evolving regulatory environment in the UAS space. These missions provide aerial patrols of overhead lines associated with PSPS events and supplement traditional patrol methods—via truck, foot, and/or helicopter—to help identify ignition risks before fire weather conditions materialize (pre-patrol) and upon power restoration following an event (post-patrol). The project also can help expedite power restoration to mitigate the impact of outages on customers.

- How is the activity effective at reducing ignitions and how is effectiveness measured?:

As with other types of pre-event patrols, conducting pre-event aerial PSPS patrols of overhead lines to look for abnormal situations that could cause faults reduces the risk of ignitions. Once the event has concluded, aerial PSPS patrols can quickly survey overhead lines to help ensure that it is safe to restore power. Lastly, having an additional patrol method can expedite patrols and the restoration of power, with the goal of reducing the impact of PSPS outages on SCE's customers during larger scale events or when helicopters are limited in supply and/or may be needed for other emergency purposes.

2021 Activities:

In 2021, SCE further developed and equipped troublemen, senior patrolmen, and overhead inspectors on the use of UAS. Select SCE troublemen utilized company-issued UAS to conduct both visual line of sight (VLOS) and BVLOS demonstration flights on frequently-impacted circuits in HFRA. A key objective of these missions was the use of flight automation (e.g., pre-programming the flight path and camera operation) with the goal of reducing flight time, improving flight safety, and expediting power restoration. Automated flight plans can be developed for frequently impacted PSPS circuits to enable swift patrols of overhead line segments. Portions of these circuits that would otherwise be difficult to inspect on the ground due to terrain, can be accomplished with VLOS drones that allow the pilot to easily customize patrols based on the difficult to traverse portions of the circuit that are impacted by PSPS and can be readily shared with peers depending on who is on shift. Additionally, dividing long circuits into more manageable portions addresses ongoing technological challenges with BVLOS missions, such as maintaining safe and reliable command, control, and communication with the drone over long distances in very rugged and undulating terrain.

SCE is building internal capabilities with SCE employees and UAS equipment in order to implement UAS for VLOS in 2022. SCE continues to monitor the rapidly evolving UAS market, trade/commerce restrictions, regulatory requirements, and advanced communication requirements necessary for longer-range BVLOS missions. In parallel, SCE is testing new UAS equipment for SCE first responders that potentially could more safely, securely, and efficiently help reduce wildfire risk and the impact of PSPS on our customers.

2022 Planned Activities:

In 2022, SCE will continue to build internal UAS capabilities by equipping and training first responders on the use of UAS. In parallel, we will continue exploring flight automation and validating the application of UAS across a wide variety of FICs in HFRA and to better understand what additional resources, if any, will be needed to operationalize this approach. Additionally, SCE's Aircraft Operations is evaluating next generation drone platforms for our UAS pilots that are more capable, safe, and secure than our current model. Lastly, SCE anticipates significant changes to FAA Part 107 (regulations governing the use of small unmanned aircraft systems) in the coming years that will highly influence how SCE invests in and operates UAS. These aviation regulatory changes, including developing federal restrictions on the use of specified foreign-made UAS in the critical infrastructure sector, are expected to bring additional clarity and guidance around requirements for BVLOS operations. This will continue to inform SCE's UAS strategy moving forward.

Distribution Open Phase Detection (D-OPD)

Activity description and drivers.

A Distribution Open Phase Detection (D-OPD) scheme aims to detect one or more open phase (broken conductor) conditions on the distribution system. The scheme focuses on reducing ignition risk associated with wire-down incidents for both bare and covered conductor systems, by allowing the protection system to isolate a separated conductor before the wire contacts the ground. SCE's detection scheme leverages existing RSR installations at circuit tie-points and pairs these devices with new high-speed radio installations (point-to-point communications) to detect a separated conductor. Once detected, an alarm operation is rapidly deployed to an existing source RAR. The pilot effort also helps SCE understand the potential for additional circuit outages related to the increased sensitivity of this protection system.

- How is the activity effective at reducing ignitions and how is effectiveness measured?

If successful at detecting open phase conditions and isolating lines prior to the lines contacting ground, the D-OPD system is expected to reduce ignition probability. The success rate for detecting open phase conditions and isolating lines in the required time is still under review.

Evaluation includes:

1. Ability to identify and isolate an open phase condition within 1.2 seconds[99]
2. Reduction in number of energized wire-down events
3. System reliability impacts from false detections with an operational OPD scheme
4. Costs for broad scale deployment of OPD systems

- 2021 Activities**:**

In 2021, SCE continued monitoring the performance of existing units with D-OPD logic and identified two successful open phase events. SCE also found some performance limitations with the newly installed communication infrastructure and developed recommendations for future D-OPD plans to use Long-Term Evolution (LTE) communication technology to improve communication reliability and support the future

[99] Using the freefall equation, 1.2 seconds is the estimated time it would take for a Distribution conductor to hit the ground after separating.

deployment of a Field Area Network. This recommendation was made after determining that the reliability of the communication network could be improved.

- 2022 Planned Activities:

In 2022, SCE plans to continue monitoring the performance of existing units, perform lab testing on algorithms and capture learnings in an assessment report. SCE will also install D-OPD logic at two additional locations using LTE communication technology (which is expected to mimic the future capabilities of SCE's Field Area Network).

<u>Asset Defect Detection Using Machine Learning Object Detection</u>

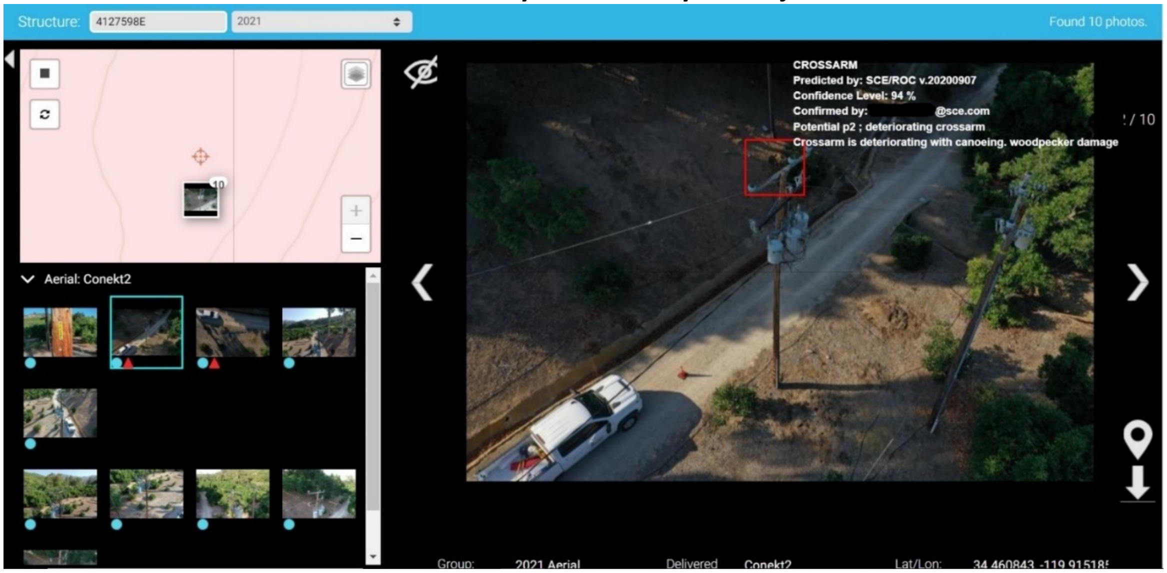
Activity description and drivers:

This pilot uses ML technology to automate certain time-intensive activities related to overhead asset inspection such as processing of imagery, with a goal to efficiently and effectively identify defects in overhead assets that could lead to wildfires. If successful, this initiative will enable faster processing of large amounts of image data than the current manual process and will identify potential problems for prioritized inspection/intervention.

A failure signature on an asset must be detected accurately and in time for maintenance before the defect becomes an ignition. This project will involve identifying assets that have a probability of defect. Inspectors supervising the output will then prioritize those assets for human inspection/intervention based on the information received from the output regarding risk of failure and type of defect. To achieve acceptable levels of accuracy for the failure detection results, there will be extensive training of the algorithm and validation of the output by inspectors who are SMEs. Based on the findings from the ML algorithms, inspectors can create a mitigation plan to address the concerns ahead of a failure. Once the algorithm is trained and confidence levels are within an acceptable range, the ML algorithm can be incorporated into the existing inspection process to reduce time spent on the analysis of individual images. See Figure SCE 7-22 for an illustrative example of a crossarm defect that was correctly identified by ML object detection technology, as validated by an SCE inspector.

__Figure SCE 7-22__

Crossarm Defect Correctly Identified by ML Object Detection



How is the activity effective at reducing ignitions and how is effectiveness measured?

This initiative uses ML to identify assets and defects from inspection imagery in the field and potentially identifies defects prior to inspections, thereby reducing potential ignition risks.

The effectiveness metric for this pilot is the platform's ability to manage and access incoming inspection data streams and ability to detect defects accurately. SCE targets a performance that is equal to or better than the manual performance of a person doing the same work on the device. Over time, SCE will continue improving the accuracy of the model by providing feedback to train the model.

2021 Activities:

SCE completed ML algorithms for distribution cross-arms and poles in 2021. SCE completed initial development of ML algorithms for distribution insulators and transformers and expects to move into production by the end of Q1 2022. SCE also developed models for image quality and a platform to enable image tagging. The 2021 algorithm development work provided valuable input to capabilities needed in the image tagging platform and provided insight into image capture requirements to enable more accurate condition detections from the algorithms.

2022 Planned Activities:

In 2022, SCE seeks to accomplish the following tasks:

- Utilize new tagging platform for tagging of distribution and transmission asset defects for training and testing ML algorithms.
- Continue prioritizing and developing ML algorithms to identify defects on assets from images. Explore the addition of LiDAR and Satellite imagery to the ML algorithm for detection of vegetation encroachment

Early Fault Detection (EFD)

Activity description and drivers:

EFD technology detects high frequency radio emissions which can occur from arcing or partial discharge conditions on the electric system. These types of conditions can represent an incipient failure, such as severed strands on a conductor, vegetation contact, or tracking on insulators. EFD shows potential to monitor the overall health of the electric system which may inform operational decisions during high-risk conditions. The technology requires placement of paired sensors on poles approximately every three circuit miles on a distribution line, or placement further apart at higher circuit voltages. Each pair of sensors is able to “bi-angulate” the detection down to a specific location.

The purpose of this pilot project is to evaluate the effectiveness of EFD technology.

How is the activity effective at reducing ignitions and how is effectiveness measured?

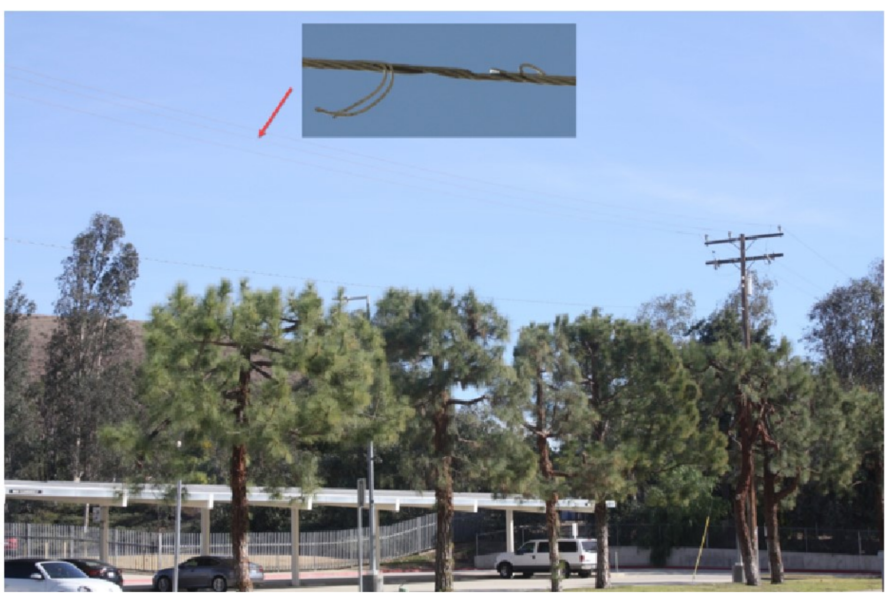
EFD sensors can continuously monitor lines and proactively detect undesirable, degraded or pre-failure system conditions. If successful, EFD’s ability to detect these conditions can translate into assessment of maintenance needs and timely remediations, thereby reducing the probability of faults and associated ignitions.

SCE is evaluating EFD’s effectiveness by testing the ability of the technology to accurately and expeditiously detect undesirable, degraded, or pre-failure system conditions.

The continuous monitoring capability of EFD inherently results in identifying findings more quickly than present processes. In fact, EFD can detect undesirable conditions not found with existing practices. See Figure SCE 7-23 which illustrates damage to a conductor detected by EFD technology.

Figure SCE 7-23

EFD Gun Shot Conductor Damage Detection Example



2021 Activities:

In 2021, SCE had a total installed population of approximately 123 units, including 100 on circuits previously equipped with DFA in order to compare and contrast their detection capabilities, 13 EFD units on sub-transmission circuits, and 10 units on circuits with previously identified issues through IR Scanning (to allow for technology comparison).

DFA and EFD technologies offer capabilities for situational awareness of incipient fault and undesirable conditions on the electric system, to then facilitate remediation repairs. DFA operates utilizing voltage and current waveforms, providing SCE access to high fidelity data not presently available on most SCE distribution circuits. EFD uses a completely different detection system targeting radio frequency signals produced by arcing and electrical discharges. SCE has not identified a detection common to both systems. The comparison of EFD with IR scanning is on-going and results of these comparisons will be shared when data is available.

Between October 2020 to end of 2021, SCE evaluated 10 instances where the EFD technology detected undesirable, degraded, or pre-failure system conditions where repairs have subsequently been completed. The conditions detected included damaged conductor (e.g., wire slap, gunshot), a failing primary surge arrester, vegetation grow-in, mylar balloon contact, and a failing transformer lead.

2022 Planned Activities:

In 2022, SCE will install an additional 50 units and strive to add up to 150 EFD units, expanding the scope of the pilot and validating next generation EFD equipment, which is expected to increase sampling rates and improve the signal-to-noise ratio in comparison to current EFD equipment. Installations will focus on testing the use of the new generation hardware, and further installations on sub-transmission system voltages. New installations in both Distribution and Transmission are expected to expand application capabilities for different line construction configurations, such as horizontal or vertical (phase-over-phase). SCE also intends to further explore different EFD detection capabilities, by completing staged testing to simulate vegetation grow-in and bridging of covered conductor phases. Finally, SCE will look for opportunities to compare EFD with DFA performance and EFD performance with IR scanning and X-ray scanning technologies, by installing a subset of the target 2022 EFD devices on the same circuits where issues were identified by IR scanning or X-Ray scanning inspection technologies. These comparative installation opportunities for EFD will help SCE to understand the overlap between the mentioned inspection efforts and the continuous monitoring sensor capabilities from EFD.

High Impedance Relays

Activity description and drivers:

High Impedance Relays utilize multiple protective elements to reduce wildfire ignition risks by detecting High Impedance (Hi-Z) conditions such as downed conductors or arcing events. In lab testing, SCE has demonstrated that the High Impedance Relay technology can detect Hi-Z conditions; however, SCE is still validating the technology's efficiency in the field in detecting actual Hi-Z events.

How is the activity effective at reducing ignitions and how is effectiveness measured?

Detection of Hi-Z conditions is an industry-wide challenge and SCE's traditional feeder protection elements are based on overcurrent, meaning the protection elements rely on fault magnitude to trigger the relay to operate. In a Hi-Z event, however, the fault magnitude is relatively small to non-existent. Therefore, protection schemes that can detect Hi-Z conditions can reduce the propagation of low magnitude fault conditions and therefore reduce ignition risk. Effectiveness assessment includes review of relay event data to determine if the relay alarmed correctly for Hi-Z events.

2021 Activities:

The Hi-Z relays were installed at 2 locations prior to 2021 and deployed at an additional 15 Distribution 12kV and 16kV locations in HFRA in 2021 to assess the effectiveness of detecting Hi-Z conditions. The locations were selected based on having voltage-sensors with minimum required current levels (i.e., ≥ 25 amps). The protection device model used, SEL651RA, has the Hi-Z elements that require voltage sensors and a minimum current. SCE also trained its crews on how to install the technology and continued to monitor performance of the Hi-Z scheme at previously installed locations. Based on the event analysis of the Hi-Z pilots, there was not enough sample data to determine if Hi-Z relays can detect correct or incorrect operations.

2022 Planned Activities:

In 2022, SCE plans to expand the existing pilot to an additional 20 locations in HFRA to assess the effectiveness of detecting Hi-Z conditions, with almost half deployed at Distribution locations with covered conductor. Increasing the number of locations at which Hi-Z relays are deployed is expected to provide additional data from potential Hi-Z events. SCE plans to conduct an analysis of its pilots at the end of 2022.

Satellite and Other Imaging Technology for Fire Spotting

Activity description and drivers:

Utilities and other stakeholders have some ability to detect and assess the threat and occurrence of fires in the service area today, through HD camera and weather station networks. This provides useful but not entirely complete data and situational awareness of fires. This activity aims to bolster our ability to detect and precisely assess wildfire ignitions and threats by consolidating data collected from satellite and other imaging technology and augmenting our existing practices.

How is the activity effective at reducing ignitions and how is effectiveness measured?

Satellite and other imaging technology can be used to help determine the point of ignition origin and perform threat assessments, among other information that can be derived from having an overhead or aerial view of the fires. SCE will use this technology to detect and follow changes in fire locations and the spread of a fire. SCE will communicate that information with stakeholders and SCE resources impacted by the area of threat. This technology will allow SCE to reduce the impact of wildfire, though quantifying the reduction will be difficult to ascertain.

2021 Activities:

In 2021, SCE developed an application and system that consolidates fire detection data from satellites and disseminates alerts to the Fire Management team via e-mail notification. SCE also began partnering with a university to improve the algorithm used to evaluate the data for fire detection.

2022 Planned Activities:

SCE is developing a user interface (UI) and an Application Programming Interface (API) that will allow SCE Fire analysts, Meteorologists, Fire Officers, SCE IMTs and others to visualize and observe fires using consolidated data from satellites, SCE's weather station network, HD camera network, and/or SCE's proprietary fire perimeter tool.[100] This will represent a vast improvement over current practices, which involves pulling alerts from different sources and comparing it with the grid before an assessment can be made. Additionally, SCE in 2022 is working to develop a map to be housed on sce.com that will display fire ignitions in SCE's service area from HD cameras and/or satellites.

7.1.6 Provide a GIS layer showing wildfire risk (e.g., MAVF); data should be as granular as possible (2022 WMP Guidelines Reference 7.1.F)

Please refer to the supplemental geospatial database submission for this GIS layer (see geodatabase titled "WMP_2022_GIS_Layers" and feature classes titled "WMP_2022_7_1_F_Distribution_CONFIDENTIAL, WMP_2022 _7_1_F_Subtransmission_CONFIDENTIAL, and WMP_2022 _7_1_F_Transmission_CONFIDENTIAL).

7.1.7 Provide GIS layers for the following grid hardening initiatives: covered conductor installation; undergrounding of electrical lines and/or equipment; and removal of electrical lines. Features must have the following attributes: state of hardening, type of hardening where known (i.e., undergrounding, covered conductors, or removal), and expected completion date. Provide as much detail as possible (circuit segment, circuit-level, etc.). The layers must include the following (2022 WMP Guidelines Reference 7.1.G):

a. Hardening planned for 2022

Please refer to the supplemental geospatial database submission for this GIS layer. SCE has provided GIS data for 2022 covered conductor and targeted undergrounding scope for which specific locations are currently available in GIS format (see geodatabase titled "WMP_2022_GIS_Layers" and feature classes

[100] The proprietary tool is a fire confirmation system that includes a website displaying information and pushes email notifications to SCE's fire management team, Watch Office and Technology program. SCE's fire management team will then review these emails and use SCE's HD camera network to confirm the location of the fires and notify local agencies as appropriate.

titled “WMP_2022 _7_1_G_CC_System_Hardening_2022_CONFIDENTIAL” and “WMP_2022 _7_1_G_TUG_System_Hardening_2022_CONFIDENTIAL”).

b. Hardening planned for 2023

Please refer to the supplemental geospatial database submission for this GIS layer. SCE has provided GIS data for 2023 covered conductor and targeted undergrounding scope for which specific locations are currently available in GIS format (see geodatabase titled “WMP_2022_GIS_Layers” and feature classes titled “WMP_2022 _7_1_G_CC_System_Hardening_2023_CONFIDENTIAL” and “WMP_2022 _7_1_G_TUG_System_Hardening_2023_CONFIDENTIAL”).

c. Hardening planned for 2024

SCE has not provided a GIS layer for 2024 covered conductor and targeted undergrounding scope as specific locations have not yet been identified sufficiently for GIS mapping purposes.

7.1.7.1 **Response to SCE Action Statement, 2021 WMP Other Issue to Address in 2022 WMP**

The following is one of the Additional Issues as provided by OEIS in the Final Action Statement on SCE’s 2021 WMP.

“Issue: (Requirement 14) SCE provided vague information regarding “where the electrical corporation considered undergrounding electrical distribution lines within those areas of its service territory identified to have the highest wildfire risk in a commission fire threat map.”
Remedy: Provide specific, locational information as requested in the Guidelines, including spatial data on underground distribution lines.”

SCE’s response to this Issue/Remedy is described below:

See geodatabase titled “WMP_2022_GIS_Layers” and feature classes titled “WMP_2022 _7_1_G_TUG_System_Hardening_2022_CONFIDENTIAL” and “WMP_2022 _7_1_G_TUG_System_Hardening_2023_CONFIDENTIAL” and Figures SCE 7-22 and SCE 7-23 for spatial data and corresponding maps for SCE’s targeted undergrounding scope in 2022 and 2023 for which specific locations are currently available in GIS format. A description on how SCE intends to scope future targeted undergrounding can be found in its Integrated Grid Hardening Strategy as discussed in Section 7.1.2.1.

7.1.8 Provide static, high-level maps of the areas where the utility will be prioritizing Grid Design and System Harding initiatives for 2022, 2023, and by 2032 (2022 WMP Guidelines Reference 7.1.H)

Please see Figure SCE 7-24 and Figure SCE 7-25 below for high-level maps depicting the areas where SCE will prioritize covered conductor and targeted undergrounding scope for 2022 and 2023, respectively, consistent with the GIS data as provided in response to Section 7.1.7 above.

Figure SCE 7-24

Covered Conductor and Targeted Undergrounding Scope – 2022

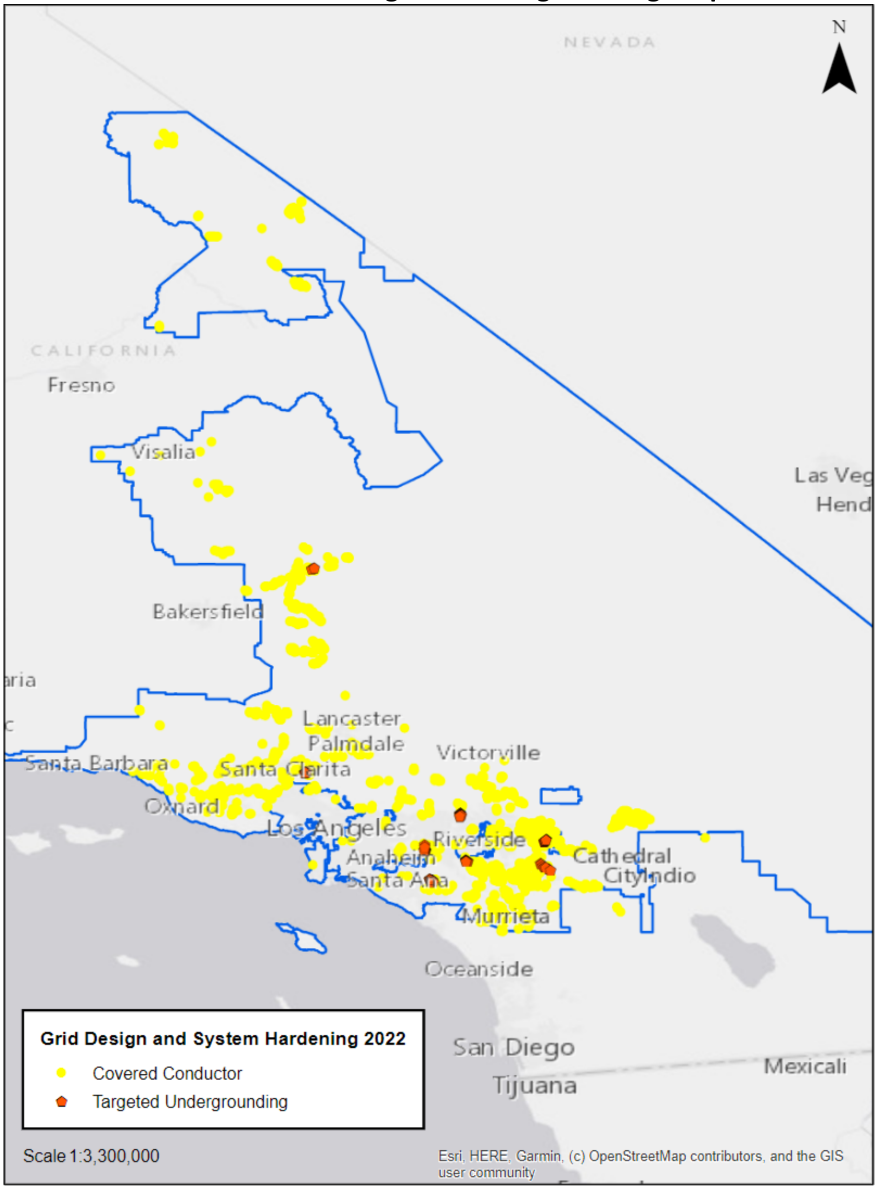
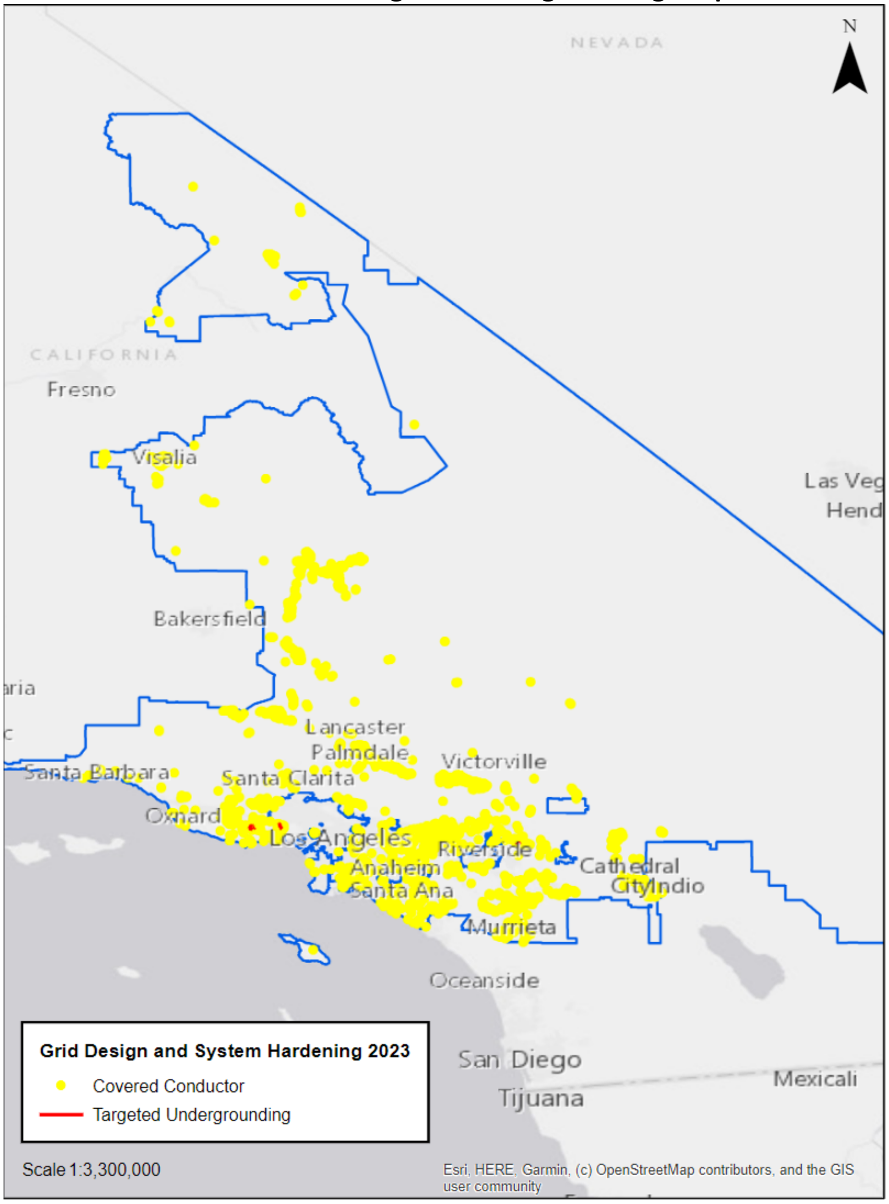


Figure SCE 7-25

Covered Conductor and Targeted Undergrounding Scope – 2023



Please see Figure SCE 4 3 in Section 4.2.1 for a high-level map depicting the High Consequence Segments where SCE will prioritize system hardening through 2032.

7.1.9 Provide a GIS layer for planned Asset Management and Inspections in 2022. Features must include the following attributes: type, timing, and prioritization of asset inspection. Inspection types must follow the same types described in Section 4.3.4, Asset Management and Inspections, and as applicable, should not be limited to patrols and detailed inspections (2022 WMP Guidelines Reference 7.1.I).

Please refer to the supplemental geospatial database submission for this GIS layer (see feature class titles below).

- WMP_2022_7_1_I_Transmission_Circuit_Patrol_Asset_Management_CONFIDENTIAL
- WMP_2022_7_1_I_Conductor_Sample_Target_Asset_Management_CONFIDENTIAL
- WMP_2022_7_1_I_Distribution_Infrared_Asset_Management_CONFIDENTIAL
- WMP_2022_7_1_I_Generation_Inspections_Asset_Management_CONFIDENTIAL
- WMP_2022_7_1_I_Grid_Patrol_Asset_Management_CONFIDENTIAL
- WMP_2022_7_1_I_IRD_Distribtuion_Aerial_Asset_Management_CONFIDENTIAL
- WMP_2022_7_1_I_IRD_Distribution_Ground_Asset_Management_CONFIDENTIAL
- WMP_2022_7_1_I_IRD_Transmission_Aerial_Asset_Management_CONFIDENTIAL
- WMP_2022_7_1_I_IRD_Transmission_Ground_Asset_Management_CONFIDENTIAL
- WMP_2022_7_1_I_Line_Vue_Target_Asset_Management_CONFIDENTIAL
- WMP_2022_7_1_I_Splice_Target_Asset_Management_CONFIDENTIAL
- WMP_2022_7_1_I_Substation_Inspections_Asset_Management_CONFIDENTIAL
- WMP_2022_7_1_I_Transmission_Infrared_Asset_Management_CONFIDENTIAL

7.1.10 Provide a GIS layer illustrating where enhanced clearances (12 feet or more) were achieved in 2020 and 2021, and where the utility plans to achieve enhanced clearances in 2022. Feature attributes must include clearance distance greater than or equal to 12 feet, if such data is available, either in ranges or as discrete integers (e.g., 12-15 feet, 15-20 feet, etc. OR 12, 13, 14, 15, etc.). (2022 WMP Guidelines Reference 7.1.J)

Please refer to the supplemental geospatial database submission for this GIS layer for work performed in 2020 and 2021 (see geodatabase titled "WMP_2022_GIS_Layers" and feature class titled "WMP_2022 _7_1_J_Enhanced_Clearances"). SCE notes that while it has not provided a GIS layer for 2022, it plans to maintain established clearances from previous years and expects to achieve additional expanded clearances at a slower rate on trees that have not yet achieved these clearances throughout the service territory in future years. These locations will be documented in SCE's work management system.

7.2 WILDFIRE MITIGATION PLAN IMPLEMENTATION (7.2.A-7.2.D)

Describe the processes and procedures the electrical corporation will use to do all the following:

> *A. Monitor and audit the implementation of the plan. Include what is being audited, who conducts the audits, what type of data is being collected, and how the data undergoes quality assurance and quality control.*

SCE exercises comprehensive and rigorous oversight of its WMP through programmatic processes that monitor and audit the implementation of the plan and the effectiveness of inspections. SCE utilizes a performance dashboard to track and analyze the progress on its wildfire mitigation activity goals. SCE collects data regularly from existing data repositories throughout the organization (e.g., number of weather stations and HD cameras installed, circuit miles of covered conductor deployed) and displays the data in the performance dashboard indicating implementation status as Complete, Ahead of Plan, On Track, At Risk, or Off Track. SCE SMEs assist with performing QC checks to validate the data. The performance dashboard is updated regularly and communicated to SCE senior leadership for awareness and review. Items that are Off Track or trending negatively, are specifically brought to the attention of senior management to discuss implementation risks, ways to improve performance, and/or plans to get back on schedule. The program targets, rationale for deviances and any corrective actions if needed undergo another round of review on a quarterly basis prior to reporting to Energy Safety.

SCE's Audit Services Department (ASD) assesses WMP implementation independent of the responsible operating unit. Audits are determined via a risk assessment informed by SCE's Board of Directors (Board), senior management and regulatory requirements. ASD has conducted risk-informed audits of SCE's system hardening and operations, inspection, maintenance, and vegetation management programs and WMP-related Compliance and Quality (C&Q) processes. These audits are conducted through desktop reviews and, in some instances, field inspections of assets to provide reasonable assurance that mitigations are deployed according to plan, that SCE facilities are appropriately inspected, and that identified conditions are timely remediated according to applicable requirements. ASD documents audit tasks and monitors corrective actions using industry standard auditing software in accordance with the International Standards for the Professional Practice of Internal Auditing.

The Board provides oversight for all aspects of SCE's business including safety, and Board committees have responsibility for oversight of specific areas. The Board's Safety and Operations Committee (Committee) is responsible primarily for safety oversight at SCE including its links to SCE's operational practices. The Committee oversees SCE's safety performance, culture, goals, risks (including wildfire) and significant safety-related incidents involving employees, contractors, or members of the public. The Committee members take an active role in overseeing SCE's safety and operational practices, including oversight of SCE's WMP and SCE's safety and operational goals.[101]

> *B. Identify any deficiencies in the plan or the plan's implementation and correct those deficiencies.*

As discussed above, SCE has implemented robust oversight of wildfire mitigation activities. Mitigation activity owners and SCE Performance Management monitor leading and lagging metrics to measure

[101] A description of the Committee's recommendations are reported in SCE's quarterly notification letters to Energy Safety pursuant to Public Utilities Code Section 8389(e)(7)[E14].

progress, review any concerns raised, issues identified through QA/QC processes and audits, and recommend appropriate corrective actions to the responsible organizations. The responsible organization for each mitigation activity is accountable for implementing these corrective actions. These organizations work with the Performance Management team to report progress and corrective actions to senior management.

In addition, SCE field crews (SCE and contract) executing work in HFRA are empowered to suggest improvement opportunities. Field crews and grid operations staff are closest to the work and play an instrumental role in implementing SCE's wildfire mitigation programs and ensuring that work is safely executed, data is captured correctly, concerns are reported, and work methods and analyses are continually improved. Key changes to wildfire mitigation activities in 2020 and 2021 are discussed in the Lessons Learned Section 4.1 in this WMP.

In 2020, the WSD identified various deficiencies in SCE's 2020 WMP submittal and issued a RCP for Class A deficiencies and a Quarterly Report for Class B deficiencies. SCE submitted a WMP RCP in July 2020 and Quarterly Reports for Class B Deficiencies beginning September 2020 to cure 2020 WMP deficiencies:

In August 2021, OEIS identified 14 Key Areas of Improvement for the SCE's 2021 WMP Update per the Final Action Statement.[102] SCE submitted the 2021 WMP Update Progress Report[103] on November 1, 2021, providing progress, or in some cases resolution, to those key areas of improvement. SCE's responses to the Progress Report items are summarized in Section 4.6, with references to the respective sections for SCE's ongoing progress.

If scope changes to wildfire programs are identified in 2022, SCE will notify the OEIS of the program changes via a Change Order report, as applicable.

> *C. Monitor and audit the effectiveness of inspections, including inspections performed by contractors, carried out under the plan and other applicable statutes and commission rules.*

SCE's has a C&Q group that develops QC and QA processes to help ensure that mitigation activities are proceeding as planned. C&Q performs testing and assessment of wildfire and non-wildfire activities to measure conformance and drive continuous improvement throughout the organization. In 2020 and 2021, distribution line/equipment inspections were performed by both SCE employees and contractors. The quality reviews are intended to monitor and check conformance of these programs include oversight of both SCE and contract employees. Section 7.3.4.15 QA/QC of Inspections further describes the monitoring and QA program for line/equipment inspections. As described in Section 7.3.4.15, this group performs field validations of inspections completed by SCE's T&D work crews under the WMP. SCE QC inspectors conduct the reviews by performing field inspections, essentially performing the same

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102 Final Action Statement on 2021 Wildfire Mitigation Plan Update – Southern California Edison, issued August 18, 2021, pp. 8-16.

103 https://www.sce.com/sites/default/files/AEM/Wildfire%20Mitigation%20Plan/2021/SCE%202021%20WMP%20Update%20Progress%20Report.pdf

inspection activity, and comparing the results. For 2022, C&Q currently plans to perform QC inspections of completed inspectionsfor approximately 5,000 transmission, distribution, and generation structures in HFRA. The QC inspectionscope will be based on risk-stratified sampling to assess the accuracy of the overhead inspections. Program risk rankings are in the process of being updated for 2022. Changes to program risk rankings could impact sample sizes for QC activities going forward.

SCE also determines the scope of the QC of its vegetation line clearing work using a TRI model. Within the model there are four risk categories ranging from highest to lowest risk. For more details on vegetation QC please see Section 7.3.5.13.

> *D. Ensure that across audits, initiatives, monitoring, and identifying deficiencies, the utility will report* in a format *that matches across WMPs, Quarterly Reports, Quarterly Advice Letters, and annual compliance assessment*.

SCE's reports, compliance filings, audits, etc. follow the section numbering, naming conventions (by WMP section, major program and/or initiative), and unique Activity Identifiers in its WMP. Since its first WMP, in 2019, SCE created unique Activity Identifiers to highlight its wildfire mitigation initiatives and goals and to provide easy reference for compliance filings and reports. Consistency in the use of WMP Activity Identifiers (e.g., SH-1) from the WMP to the Quarterly Reports, data request responses, Change Order Reports, and other compliance filings ensures SCE will report in formats consistently across all its wildfire-related submissions. SCE's Activity Identifiers are a key to consistent reporting especially given that every WMP since 2019 and including the 2022 WMP Update has had different requirements with different section numbers and headings. Every WMP provides opportunity to revisit planned activities, so it's natural for new activities to be added or activities to be removed as work is completed, re-evaluated or new efforts emerge. Changes of Activity Identifiers from WMP to WMP are documented in a mapping document (see Appendix 9.5). SCE also explains how it reports its wildfire mitigation Activity goals using units of measure, such as structures, circuit miles, etc., that are tied to business process documentation to demonstrate compliance. SCE follows Energy Safety templates and guidance in regulatory reporting. SCE's format for certain quarterly reports were adopted historically by the CPUC, and now Energy Safety, as a standard for all IOUs.

7.3 DETAILED WILDFIRE MITIGATION INITIATIVES

In this section, describe how specific wildfire and PSPS mitigation initiatives execute the strategy setout in Section 5. The initiatives are divided into 10 categories, with each providing a space for narrative descriptions of the utility's initiatives. The initiatives are organized by the following categories provided in this section:

1. *Risk assessment and mapping*
2. *Situational awareness and forecasting*
3. *Grid design and system hardening*
4. *Asset management and inspections*
5. *Vegetation management and inspections*
6. *Grid operations and protocols*
7. *Data governance*

8. *Resource allocation methodology*
9. *Emergency planning and preparedness*
10. *Stakeholder cooperation and community engagement*

It is not necessary for a utility to have every initiative listed under each category.

7.3.a Financial data on mitigation initiatives

Report actual and projected WMP expenditure, as well as the risk-spend-efficiency (RSE), for each initiative by HFTD tier (territory-wide, non-HFTD, HFTD zone 1, HFTD tier 2, HFTD tier 3) in Table 12 of Attachment 3.

For a description of Table 12 "Mitigation initiative financials," please see Section 6.8.3. For the table itself, please see Table 12 of Appendix 9.9.

7.3.b Detailed information on mitigation initiatives

Report detailed information for each initiative. For each initiative, organize details under the following headings:

1. Risk to be mitigated / problem to be addressed

2. Initiative selection ("why" engage in initiative) – include reference to and description of a risk informed analysis and/or risk model on empirical (or projected) impact of initiative in comparison to alternatives and demonstrate that outcomes of risk model are being prioritized

3. Region prioritization ("where" to engage initiative) – include reference to a risk informed analysis in allocation of initiative (e.g., veg clearance is done for trees tagged as "high-risk") and demonstrate that high-risk areas are being prioritized

4. Progress on initiative since the last WMP submission and plans, targets, and/or goals for the current year

5. Future improvements to initiative – include known future plans (beyond the current year) and new/novel strategies the utility may implement in the next 5 years (e.g., references to and strategies from pilot projects and research detailed in Section 4.4).

7.3.1 Risk assessment and mapping

For each item in this category, provide relevant maps within the report or appendices.

SCE's wildfire risk models have advanced significantly over the past three years. Detailed descriptions of these models can be found in Chapter 4. In addition, SCE discusses the risk analysis framework for its Integrated Grid Hardening Strategy in Section 7.1.2.1.

7.3.1.1 Risk Assessment and Mapping Initiatives

SCE's former risk assessment and mapping initiative (RA-1) focused on the development of the Technosylva WRRM geospatial viewer tool. This tool provides SCE with the capability to better analyze and visualize wildfire risk. In the following narrative, SCE combines the three Energy Safety initiatives under this Risk Assessment and Mapping section:

- **Initiative 7.3.1.1:** A summarized risk map showing the overall ignition probability and estimated wildfire consequence along electric lines and equipment
- **Initiative 7.3.1.3**: Ignition probability mapping showing the POI along the electric lines and equipment
- **Initiative 7.3.1.5**: Match drop simulations showing the potential wildfire consequence of ignitions that occur along the electric lines and equipment

The figures below provide illustrative outputs showing wildfire POI and ignition consequence (Figure SCE 7-26), POI (Figure SCE 7-27) and ignition consequence (Figure SCE 7-28) along distribution lines, and individual consequence simulations showing the potential wildfire consequence of ignitions that occur along the electric lines and equipment (Figure SCE 7-29). Figure SCE 7-26 and Figure SCE 7-28 are outputs of SCE's WRRM. These outputs correspond with the OEIS initiatives identified above and demonstrate some of the capabilities of the geospatial viewer tool.

Figure SCE 7-26

Illustrative Wildfire Risk Map from WRRM along Distribution Lines (POI and Ignition Consequence)

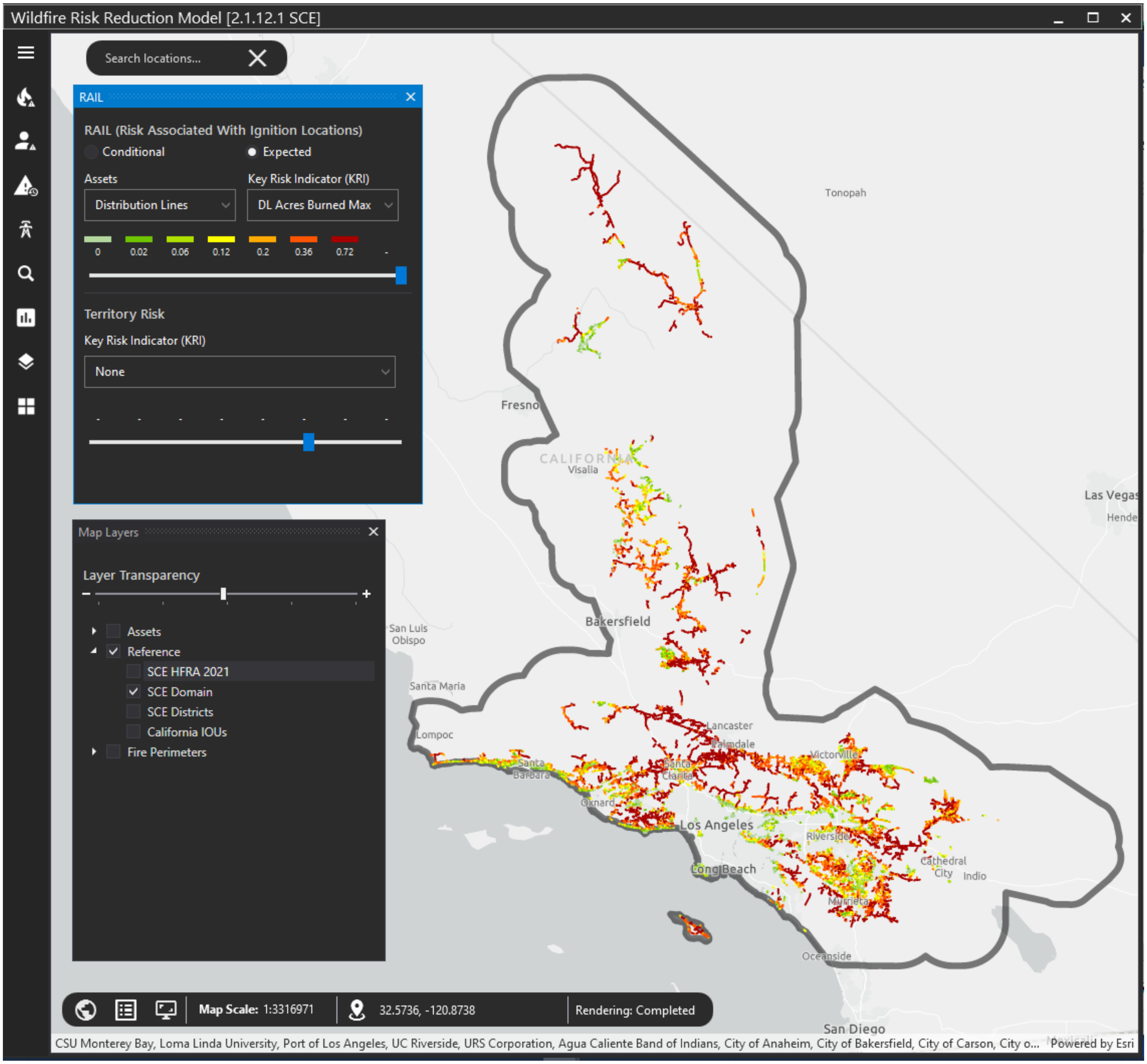


Figure SCE 7-27

Illustrative Wildfire Risk Map Along Distribution Lines – POI

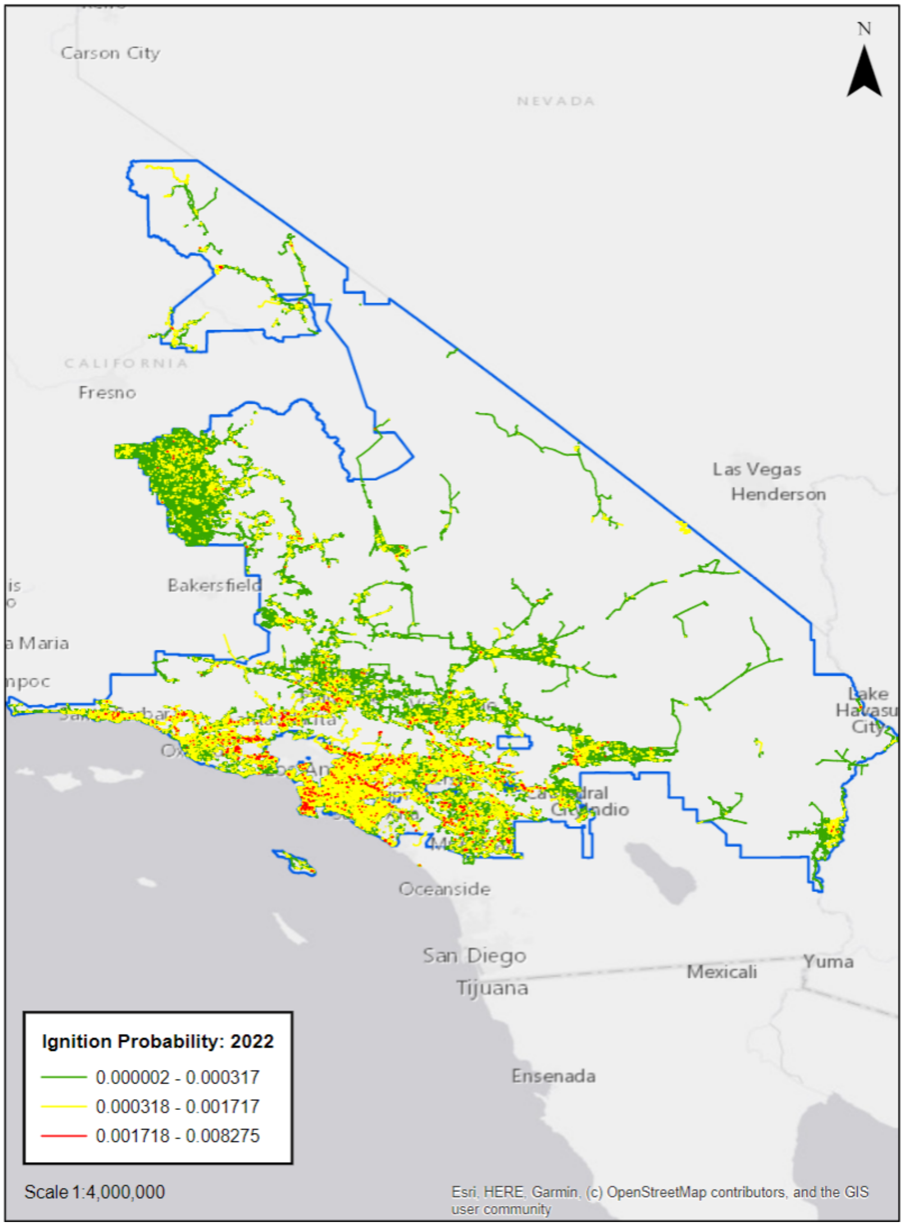


Figure SCE 7-28

Illustrative Wildfire Risk Map from WRRM along Distribution Lines - Ignition Consequence

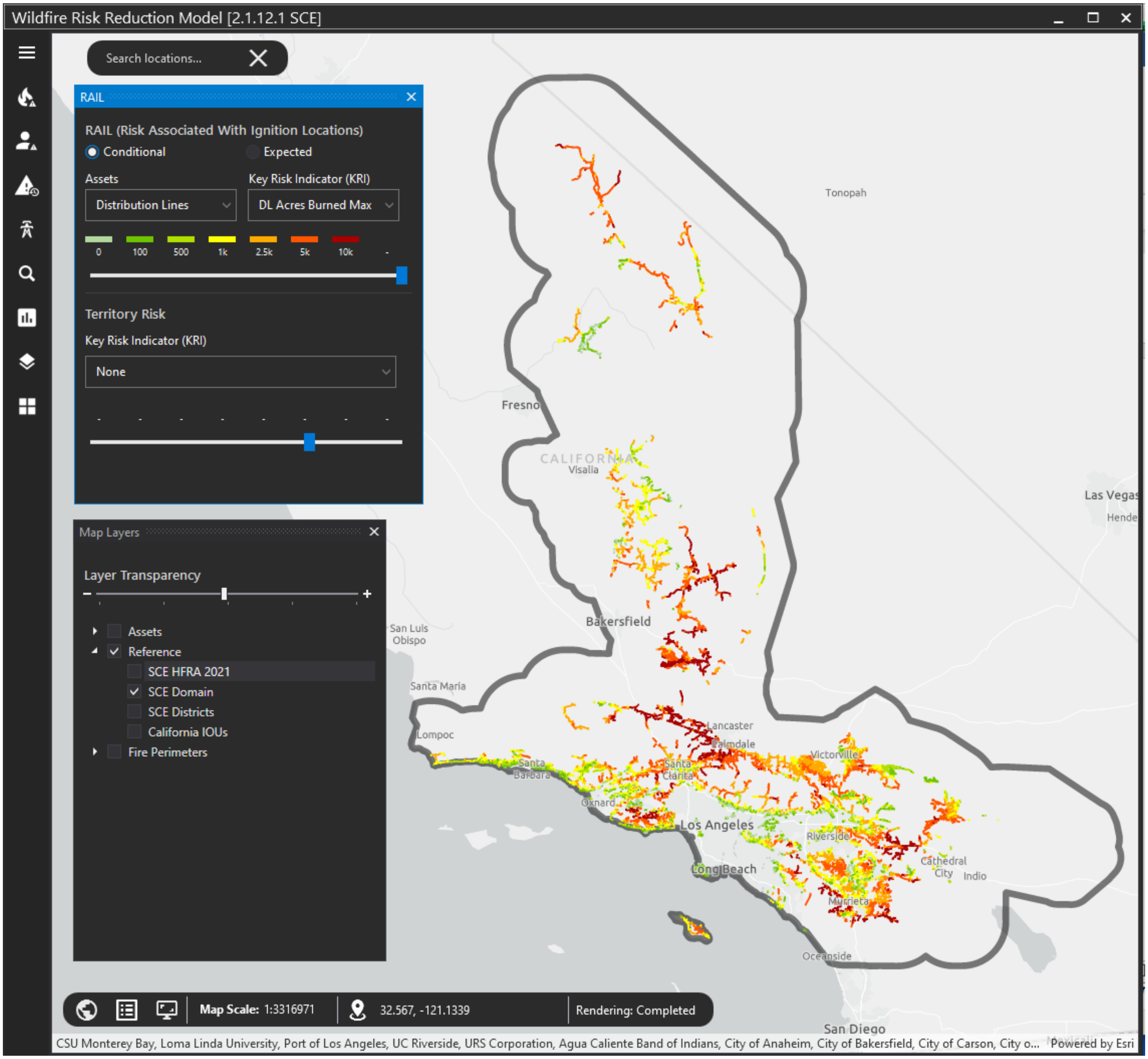
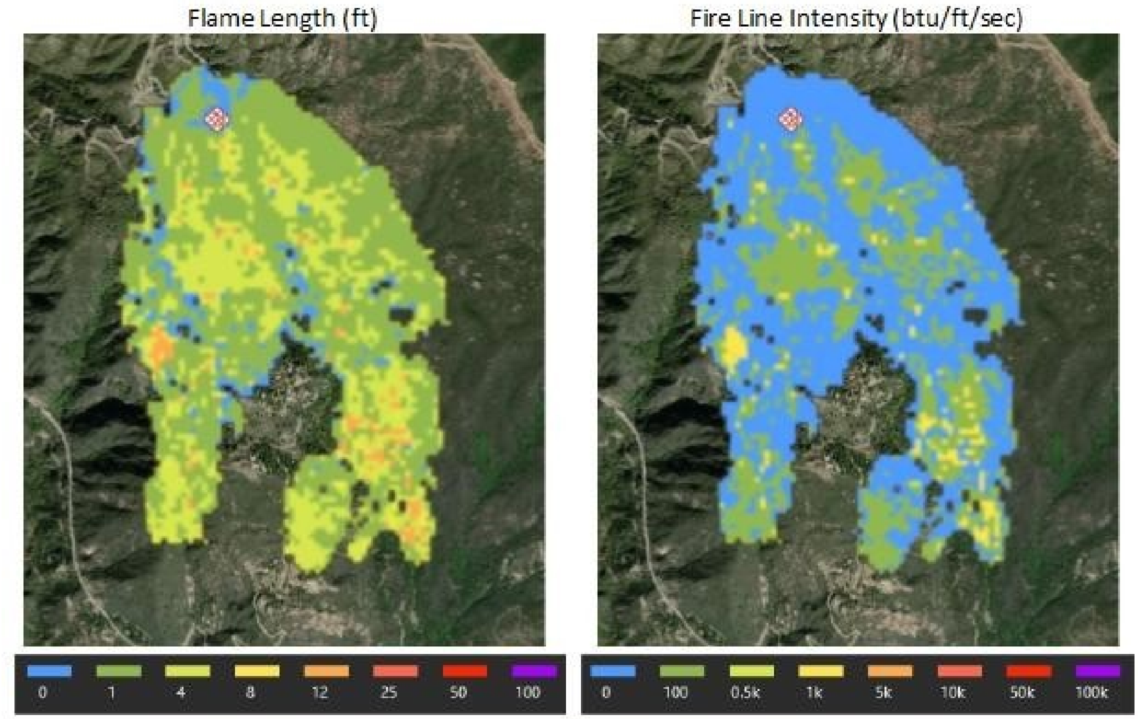


Figure SCE 7-29

Illustrative Example of an Individual Consequence Simulation



As discussed in Section 4.3.3, the WRRM provides advanced wildfire modeling capabilities that quantify risk through: (1) the integration of historical weather data, topography, and ground fuels; (2) the location of SCE overhead assets; and (3) the potential for fire propagation and impact to population and building structures. Since the WRRM is now implemented, SCE no longer lists RA-1 as a WMP Activity.

1. Risk to be mitigated / problem to be addressed:

The development of the WRRM is foundational to SCE establishing a robust risk reduction capability at the asset level, which can be aggregated to the program and portfolio level.

2. Initiative selection:

This initiative developed modeling capabilities that indirectly reduce risk. With the enhanced modeling capability in WRRM including location- and asset-specific wildfire risk quantifications, this initiative enhanced SCE's ability to prioritize and target deployment of wildfire mitigations, thus accelerating the reduction of wildfire risks. Because these mapping and risk modeling simulations do not themselves directly reduce wildfire or PSPS risk, SCE did not calculate an RSE score for them. The risk reduction benefits of this initiative are captured in the respective mitigations that are informed by the results of these risk models.

3. Region prioritization:

The WRRM is used to determine the wildfire risk score (probability and consequence) of an asset or group of assets to identify and prioritize the deployment of mitigation alternatives.

4. Progress on initiative (amount spent[104], regions covered) and plans for next year:

SCE achieved its 2020 WMP Goal for this activity (RA-1) of implementing Technosylva consequence values and a geospatial viewer. For more details about the WRRM implementation and timeline, see SCE's response to recurring deficiency SCE-5 in its Second Quarterly Report submitted on December 9, 2020 and Section 4.3.

In 2021, SCE continued to expand its risk modeling capabilities by identifying new features (such as the inclusion of atmospheric corrosivity) and variables (such as distance from the coast) associated with ignition events, discovered through engineering root cause analysis, field observations, and subject matter expertise. The consequence model will also be refreshed in the first quarter of 2022 to reflect changes to the territory vegetation profile and 2021 fire scars. Additionally, the model's algorithms for POI will be further refined as 2021 data is added to validate the model's accuracy. SCE will also seek to add additional improvements to the WRRM model on both the POI and consequence side.

5. Future improvements to initiative:

Moving beyond 2021, SCE will focus efforts on automating the WRRM. Today, each refresh of the WRRM components occurs only after significant changes or additional variables are discovered. This typically resulted in two or three major updates per year. For example, the conductor sub-model within the EFF element of the wildfire component was refreshed two times in 2019; twice in 2020; and twice in 2021. The process is manual and requires significant effort by SCE's data science team. Over the coming years, each of the data inputs to the model will be evaluated for automation capabilities, and methods and tools will be implemented to allow for near real-time updating.

7.3.1.1.1 Response to SCE Action Statement, 2021 WMP Additional Issue to Address in 2022 WMP

The following is one of the Additional Issues Improvement as provided by OEIS in the Final Action Statement on SCE's 2021 WMP.

> *"Issue: SCE did not show improvement in the maturity matrix model in the areas of: 1) ignition risk estimation, and 2) risk maps and simulation algorithms. SCE predicts improvement in 2021 due to WRRM consequence modeling.*

[104] *See* Table 12 for amount spent and forecasted for all initiatives in Sections 7.3.1 to 7.3.9.

Remedy: "SCE must evaluate and report on whether it achieved its anticipated capability improvements in: 1) ignition risk estimation, and 2) risk maps and simulation algorithms. SCE must provide quantitative advancement results."

SCE's response to this Issue/Remedy is described below:

SCE improved in the areas of ignition risk estimation, risk maps and simulation algorithms. SCE has made further improvements in the WRRM consequence modeling, as discussed in Section 4.3. Prior to 2021, SCE utilized 41 weather scenarios. In 2021, SCE added an additional 403 weather scenarios to represent a wider range of both fuel and wind driven fire conditions. Similarly, SCE incorporated a more granular fuel model to account for fuel regrowth in recently burned locations with fuel regrowth projected out to the year 2030. In addition to asset-specific consequence values, SCE also enhanced its geospatial viewer tool to display aggregated and disaggregated risk scores geospatially across SCE's service area, as well as wind and weather variables associated with each of those weather scenarios for all assets in HFRA with an additional 20-mile buffer outside of HFRA. Future improvements to SCE's WRRM are discussed in Section 4.3.10.

7.3.1.2 Climate-driven risk map and modelling based on various relevant weather scenarios

SCE used historical climatology in its WRRM model and intends to evaluate the capability to develop forward-looking climate scenarios to inform SCE's wildfire mitigation strategies and programs.

1. Risk to be mitigated / problem to be addressed:

Climate change represents a primary driver of a range of underlying conditions that affect wildfire initiation, spread, and intensity. Climate related conditions (e.g., droughts, extreme temperatures, high evapotranspiration, dry winds, etc.) produce environments for extreme fire risk and create the potential to amplify the consequences (e.g., acres burned) of any ignition. Climate projections by Westerling (2018)[105] point to increasingly intensifying and expanding areas of elevated wildfire risk, strongly driven by these types of climate conditions. Other research, notably by Williams, *et al.* (2019),[106] further strengthens the primary link between climate change and wildfire activity in California.

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[105] Westerling, Anthony Leroy. (University of California, Merced). 2018. Wildfire Simulations for California's Fourth Climate Change Assessment: Projecting Changes in Extreme Wildfire Events with a Warming Climate. California's Fourth Climate Change Assessment, California Energy Commission. Publication Number: CCCA4-CEC-2018- 014.

[106] Williams, A. P., Abatzoglou, J. T., Gershunov, A., Guzman-Morales, J., Bishop, D. A., Balch, J. K., & Lettenmaier, D. P. (2019). Observed impacts of anthropogenic climate change on wildfire in California. Earth's Future, 7, 892–910. https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2019EF001210

To account for a wide range of historical weather scenarios, SCE uses currently employs 444 weather scenarios across a 20-year historical climatology. By using a wide range of models, SCE can determine the relative risk of wildfire consequence for each location under the maximum likely weather conditions, based on a historic climatology for any given location. In 2022, SCE is developing a probabilistic view of future weather and fuel conditions to better understand how the climate change may exacerbate existing wildfire risk both spatially as well as consequentially.

2. Initiative selection:

The above modeling approach results in a relative ranking of locations by ignition consequence across SCE's service HFRA. Because this mapping and modeling does not itself directly reduce wildfire or PSPS risk, SCE did not calculate an RSE score. The risk reduction benefits of this initiative are captured in the respective mitigations that are deployed as a result of thesetools.

3. Region prioritization:

The weather scenarios used for the WRRM apply to SCE's entire HFRA, plus a 20-mile buffer.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

In 2020, SCE used 41 weather scenarios across a 20-year historical climatology in its WRRM consequence model. In 2021-22, SCE integrated 400+ additional weather scenarios to increase the range and magnitude of possible wildfire related outcomes.

5. Future improvements to initiative:

In addition to leveraging a historical climatology, SCE intends to evaluate the capability to integrate forward-looking climate scenarios that will inform SCE's wildfire mitigation strategies and programs.

7.3.1.2.1 Response to SCE Action Statement, 2021 WMP Additional Issue to Address in 2022 WMP

The following is one of the Additional Issues as provided by OEIS in the Final Action Statement on SCE's 2021 WMP.

> *"Issue: SCE indicates historical climatology was used in its risk modeling and intends to develop forward looking climate scenarios into the 2022 modeling process. However, the maturity matrix model indicates progress in 2021.*
> *Remedy: Though SCE achieved several key milestones in 2020 which enhance risk analytics, evidence of maturity is unclear for historical climatology. SCE must demonstrate the improvements that have been implemented to support the corresponding progress indicated by its maturity matrix model."*

SCE's response to this Issue/Remedy is described below:

In 2021, SCE added an additional 403 weather scenarios for a total of 444 weather scenarios to represent a wider range of both fuel and wind driven fire conditions. Similarly, SCE incorporated a more granular fuel model to account for fuel regrowth in recently burned locations with fuel regrowth projected out to the year 2030. See Section 4.3 for a discussion of future improvements to SCE's WRRM.

7.3.1.3 Ignition probability mapping showing the probability of ignition along the electric lines and equipment

Please refer to Section 7.3.1.1 and Figure SCE 7 27 which shows the POI along the electric lines and equipment.

7.3.1.4 Initiative mapping and estimation of wildfire and PSPS risk-reduction impact

SCE estimates the reduction in wildfire and PSPS risk via the deployment of its WMP activities.

1. Risk to be mitigated / problem to be addressed:

Energy Safety defines wildfire risk as "[t]he potential for the occurrence of a wildfire event expressed in terms of ignition probability, wildfire impact/consequence"[107] and PSPS Risk as "[t]he potential for the occurrence of a PSPS event expressed in terms of acombination of various outcomes of the event and their associated probabilities."[108]

2. Initiative selection:

As described in Chapter 4, SCE quantifies wildfire and PSPS risk through the WRRM.

The WRRM is used to determine the wildfire risk score (probability and consequence) of an asset or group of assets to identify and prioritize the deployment of mitigation alternatives. SCE estimates the wildfire risk reduction of its deployed mitigations using the WRRM. The WRRM is capable of quantifying the risk reductions, based on the result of a deployed or planned mitigation. For example, replacing a segment of bare conductor with covered conductor will result in a decrease in the POI of the segment, since there is a lower probability that the new conductor will fail or that vegetation or animal contact will result in a spark. This calculation is performed at the individual asset level for all assets in the WRRM. It also serves as the basis for calculating the risk reduction potential, which can help SCE prioritize the deployment of mitigations or determine the risk reduction realized after executing the mitigation.

[107] *See* OEIS's 2022 WMP Guidelines Attachment 2, pp. 22 for General Glossary of Defined Terms "Wildfire Risk."
[108] *See* OEIS's 2022 WMP Guidelines Attachment 2, pp. 19 for General Glossary of Defined Terms "PSPS Risk."

Similarly, the WRRM is capable of quantifying the PSPS risk associated with each segment of conductor based on the backcasting, using historical weather data and SCE's current PSPS operation protocols. For example, when an isolable segment is fully covered with covered conductor, the wind/gust thresholds on that segment will increase compared to today's wind/gust thresholds. The change in the thresholds has the indirect effect of reducing the PSPS frequency and PSPS risks associated with those conductor segments.

3. Region prioritization:

Within HFRA, SCE uses the WRRM (where feasible) to identify specific assets and segments for wildfire and PSPS mitigations and for calculating RSE values for portfolio planning.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

In 2021, SCE refreshed its existing POI models by using the latest available asset, weather and operational data. Meanwhile, SCE updated its ignition consequence model by using the latest fuel layer with additional historical weather scenarios added to better reflect potential fire impacts.

In 2022, SCE will continue to expand its risk modeling capabilities by identifying new features contributing to ignition events discovered through engineering root cause analysis, field observations, and subject matter expertise. The consequence model will also be refreshed in the first quarter to reflect changes to the territory vegetation profile and 2021 fire scars. Additionally, the model algorithms for POI will be further tuned as 2021 data is uploaded to test for accuracy. SCE will continue to improve its PSPS risk modeling methodology by modeling towards isolatable segments of the circuits instead of at the full circuit level, which will more closely align with our improved PSPS operation strategies.

5. Future improvements to initiative:

The future improvements are the same as those anticipated for the WRRM. Please see SCE's response to prompt 5 in Section 7.3.1.1. above for anticipated future improvements to the WRRM.

Match drop simulations showing the potential wildfire consequence of ignitions that occur along the electric lines and equipment

Please refer to Section 7.3.1.1 and Figures SCE 7-28 and SCE 7-29 which show ignition consequence along the electric lines and equipment.

7.3.2 Situational Awareness

7.3.2.1 Advanced weather monitoring and weather stations (Weather Stations SA-1)

Weather stations are used to provide critical situational awareness for PSPS decision-making and help improve weather models.

1. *Risk to be mitigated / problem to be addressed:*

Weather conditions can differ significantly at any given time within the HFRA in SCE's service area, due to the large size and diverse topography involved. For example, Southern California's mountains have rapid elevation changes and differing canyon orientations, which create localized weather zones. SCE needs to monitor and analyze weather data at a granular level across circuits in HFRA to inform critical operational decisions such as deploying PSPS protocols during elevated weather conditions. IMT personnel rely on real-time weather data from weather stations to inform initiation of PSPS events, customer notifications, and de-energization decisions for SCE circuits and circuit segments.

2. *Initiative selection:*

To improve the resolution of existing weather models and access more granular real-time information during wildfire risk conditions, SCE increased the number of weather stations across distribution and sub-transmission circuits in its HFRA. A higher density of weather stations on SCE distribution circuits allows SCE to validate real-time conditions in the field during elevated fire conditions. Adding weather stations to transmission circuits will also help improve the visibility of the service area for PSPS decision-making for transmission and sub-transmission lines. Such decision-making must often rely on distribution-sited weather stations for situational awareness, as there are far fewer sub-transmission circuits than distribution circuits that currently have weather stations. Having more stations also expands and increases the granularity of data to enable improved weather forecasting capabilities at the circuit and sub-circuit level. This in turn improves the accuracy and precision of PSPS activations, and de-energization and re-energization decisions. Finally, by installing weather stations on specific segments of circuits, SCE can sectionalize circuits and reduce the scope of PSPS events, thereby reducing the impact on our customers.

Currently, SCE has over 1,400 weather stations deployed across its HFRA, primarily on the distribution system, with 49 stations on the sub-transmission system. SCE used industry equipment standards and placement techniques to capture the wind profiles of its circuits, while at times siting more than one station per circuit to account for variations in terrain. These practices are also used by SDG&E's weather program, which has been in place for several years. Figure SCE 7-30 illustrates the data output provided by SCE's weather stations, and includes data points such as temperature measurements, wind speeds, dew point, and solar radiation.

Figure SCE 7-30

Example of an SCE Weather Station Output

Latest Observation

10 Minute Data

1520 Station

as of 12/16/21 9:54 AM PS

Load Interactive

Station	Date	Time	Temp (°F)	RH (%)	Dew Pt (°F)	Wind Spd (mph)	Wind Dir (°)	Wind Gust (mph)	Wind Gst Dir (°)	Solar Rad (W/m2)	BatVolt (V)	Circuit Name	Daily Min Temp (°F)	Daily Max Temp (°F)	Daily Max Wind (mph)
SCE Marion Ridge	12/16/21	0950	37.7	74	30.2	2.2	NW | 306	6.9	NE | 45	427	13.9	Pine Cove	25.6	38.6	8.2
SCE Idyllwild	12/16/21	0950	41.0	67	30.9	2.9	SSE | 161	7.4	SSE | 159	406	13.9	Pine Cove	32.0	42.4	10.1
SCE Saddle Peak	12/16/21	0950	41.0	89	38.0	6.2	WNW | 299	10.4	WNW | 291	233	13.8	Plateau	37.8	43.0	14.5
SCE Santa Anita Canyon 2	12/16/21	0950	49.5	58	35.6	2.6	SSW | 203	5.3	S | 183	438	13.8	Arboretum	38.3	50.1	5.4
SCE Boquet Canyon	12/16/21	0950	45.3	57	31.2	4.2	S | 191	7.2	SW | 227	427	13.8	Bouquet	31.7	45.7	8.6
SCE Topanga Canyon	12/16/21	0950	51.2	63	39.2	2.3	WSW | 241	7.7	SW | 235	285	13.6	Cheney	38.9	52.1	7.7
SCE Santa Anita Canyon	12/16/21	0950	46.9	61	34.1	4.1	S | 185	7.6	S | 186	268	13.8	Arboretum	42.0	60.6	8.0
SCE Vasquez Canyon Rd	12/16/21	0950	45.0	61	32.3	1.6	ESE | 116	3.5	ENE | 68	628	13.8	Bouquet	29.7	45.7	5.0
SCE Old Topanga Canyon Rd	12/16/21	0950	48.2	66	37.6	3.4	NNW | 328	7.2	NNW | 330	317	13.8	Paradise	42.0	49.5	11.5
SCE Laguna Beach	12/16/21	0950	51.5	66	40.6	0.6	SE | 141	2.3	SE | 139	31	12.0	Acres	35.8	52.5	3.2
SCE Acton Canyon	12/16/21	0950	45.6	56	31.0	4.0	SW | 236	5.8	WSW | 239	438	13.8	Bootlegger	34.1	46.9	9.6
SCE Monrovia Wilderness Preserve	12/16/21	0950	49.8	59	35.9	1.9	S | 180	5.3	SSE | 161	425	13.7	Chantry	36.0	50.3	5.3
SCE Stokes Canyon	12/16/21	0950	44.0	84	39.6	0.9	S | 173	2.6	SSE | 164	320	13.6	Plateau	29.1	44.8	4.4
SCE Laguna Beach 2	12/16/21	0950	53.6	63	41.1	1.8	SW | 236	4.9	W | 265	409	13.8	Agate	41.5	54.0	7.3
SCE Laguna Beach 3	12/16/21	0950	55.8	62	43.0	2.4	SW | 219	5.9	WSW | 247	426	13.7	Agate	44.7	56.3	7.7
SCE Aliso Canyon Rd	12/16/21	0950	44.9	56	30.1	4.1	N | 358	5.8	NNW | 342	443	13.8	Bootlegger	32.5	47.7	11.6
SCE Laguna Beach 4	12/16/21	0950	51.0	67	40.3	4.2	WSW | 248	7.3	WSW | 248	458	13.8	Acres	47.7	51.6	9.0
SCE Monrovia	12/16/21	0950	50.3	58	36.2	0.9	S | 184	4.5	SSE | 165	422	13.8	Chantry	35.5	51.1	4.5
SCE Bixby Rd	12/16/21	0950	49.2	61	36.1	1.3	N | 354	2.7	N | 354	273	13.8	Rainbow	38.3	49.8	5.2
SCE Golden Valley	12/16/21	0950	43.5	70	34.4	1.7	SE | 124	4.2	ESE | 111	456	13.8	Mamba	35.3	44.4	11.0
SCE Cajon Pass	12/16/21	0950	45.7	56	30.7	5.3	SE | 139	8.7	SE | 126	399	13.8	Blue Cut / Verdemont	34.0	46.2	12.4

To address limitations in placing weather stations that are driven by the use of cellular connection (which constrain the range), SCE began installing a satellite communication system in 2019. This satellite system allowed for greater range and placement of stations on circuits with limited cell connection. In 2020, SCE conducted a study, the Weather Station to Circuit Mapping Project, to identify spatial gaps in the data that, if addressed, may lead to improved situational awareness and weather modeling. Finally, as SCE works to sectionalize circuits, siting weather stations along those circuit segments will allow SCE to limit the number of impacted customers.

The RSE for this activity is low, because it does not directly reduce ignition risk or PSPS impacts. However, the activity is critical for driving improvements in precision and accuracy in PSPS decision-making, by providing real-time weather observations that contribute to critical situational awareness. The data collected from SCE's weather stations also help improve weather modeling. The majority of SCE's existing weather station installations have been performed on the distribution system. SCE's focus going forward will be on gaining adequate weather station coverage on SCE's transmission and sub-transmission systems, on circuits where sectionalization devices have been added, and in those areas where the Weather Station to Circuit Mapping analysis highlighted a need for a weather station. Without installations in these identified circuits and systems, SCE may lose a certain degree of precision when trying to determine the exact circuits that may be impacted by severe weather, and when issuing customer notifications of a potential PSPS.

3. Region prioritization:

SCE prioritizes weather station installations on those HFRA circuits that are most likely to exceed PSPS wind thresholds. All distribution circuits that have met or exceeded PSPS wind thresholds in the past five years now have a weather station installed. There are still many distribution circuits in the HFRA that do not have a weather station, and some that require additional stations to obtain the desired level of situational awareness. However, prior experience demonstrates that the data from existing weather stations are directly actionable for PSPS. Additionally, there are several sub-transmission and transmission circuits that currently have limited weather station coverage. SCE considers the following in sequential order when prioritizing the locations of weather station installations:

1. HFRA distribution circuits with historical instances of forecasts reaching PSPS criteria and no representative weather stations.

2. HFRA Circuits that have previously experienced PSPS conditions and could benefit from extra weather stations for additional sectionalizing or that are frequently impacted.

3. Sub-Transmission and transmission monitoring zones with historical instances of forecasts reaching PSPS criteria and have no representative weather stations.

Once the location is identified, placement along the circuits depends on several factors including, but not limited to, the following:

- Location is in a wind prone area (SCE prioritizes those circuits in wind-prone locations where the potential consequences of a catastrophic fire[109] are high)
- Location is easily accessible to maintenance crews
- Location has a clear view of the southern horizon for solar power recharge purposes
- Location is free from major obstructions such as trees and buildings

4. Progress on initiative (amount spent, regions covered) and plans for next year:

In 2021, SCE deployed 406 weather stations, many of which were on circuits that met or exceeded PSPS wind thresholds since they have been in operation. Additionally, SCE completed its Weather Station to Circuit Mapping analysis for all HFRA circuits that identifies, using statistical proximity analysis, the optimal locations to place weather stations to address spatial gaps in areas where strong winds have historically occurred. SCE also made improvements to weather station forecasts to reduce model bias, by developing ML algorithms to train the forecasts at each weather station location to detect areas that are missed by other models.[110] In 2021, SCE trained 64 weather station locations using ML algorithms.

[109] Fire consequence is determined using the latest version of Technosylva.
[110] ML is a type of artificial intelligence, broadly defined as the capability of a machine to imitate

In 2022, SCE will deploy 150 to 175 additional weather stations along distribution, transmission and sub-transmission circuits. Since weather stations are now installed on nearly all circuits in Tier 2 and Tier 3 HFRA identified for PSPS risk, SCE will focus its 2022 weather station deployments on transmission and sub-transmission systems, on circuits where sectionalization devices have been added, and in those areas where the Weather Station to Circuit Mapping analysis highlighted a need for a weather station. To improve forecast accuracy, SCE will create ML forecasts at an additional 400 to 500 weather station locations to remove forecast bias that can be present in raw weather model outputs.

5. *Future improvements to initiative:*

SCE plans to deploy 345 total weather stations between 2022 and 2025. Some of these deployments will be sited on transmission systems that require longer lead times for installation than distribution, and SCE is working to expand its proximity analysis to sub-transmission and bulk transmission circuits to determine where weather stations should be installed. SCE will focus on maintaining (through annual calibrations) and improving its weather forecasting capabilities at its existing weather stations.

7.3.2.1.1 Response to SCE Action Statement, 2021 WMP Additional Issue to Address in 2022 WMP

The following is one of the Additional Issues as provided by OEIS in the Final Action Statement on SCE's 2021 WMP:

"Issue: SCE answered the questions related to its 2020 Class B Deficiencies (SCE-6, Actions SCE-14, and SCE-15; see Appendix 10.1), but there is no indication that SCE will be installing weather stations in locations requested in SCE-6 Class B Deficiency. It is unclear on whether SCE will be able to track predicted weather conditions away from its assets prior to them materializing in its service territory as well as its peer utilities.
Remedy: SCE must discuss:
1) how the present and future effects of climate change are potentially informing weather station outputs and placement
2) how SCE's weather station network is being used in its operations beyond PSPS de-energization related decision-making.
3) progress and locations of weather stations derived from any partnerships with or applications to the USFS to install weather stations and "meteorological sample sites" as it relates to 36.2 CFR 220.6."

SCE's responses to the remedies identified in the Action Statement are described below:

(1) SCE installs weather stations on circuits in HFRA to improve weather forecasting for infrastructure and provide real-time observations in support of PSPS decision-making. Therefore, the projection of future climate change effects do not currently inform weather station placements. However, outputs from SCE's weather stations can be used to document and track historical climate change in SCE's HFRA. As discussed above, SCE has

intelligent human behavior. Training machine learning models involves analyzing past weather forecast data against known outcomes (observations from weather stations) such that a computer algorithm can detect patterns in the forecast data to better predict the outcome than the raw weather model forecast. After a model is trained, it can be used operationally to predict the weather outcomes with less forecast bias.

strategically deployed weather stations to maximize situational awareness capabilities. This was in part informed by SCE's Weather Station to Circuit Mapping Project study, which identified spatial gaps that, if addressed, would lead to improved situational awareness and weather modeling throughout our system.

(2) The output of SCE's weather station network is used in several ways in addition to PSPS decision-making. SCE's weather stations help improve overall weather modeling for circuits in HFRA, which can be used to understand weather patterns as it affects reliability and capacity, in addition to wildfire risk. As weather station observation history builds, the data can be used to help identify climate trends that could inform utility adaptation measures in the future. As discussed above, the Weather Station to Circuit Mapping project involved identifying locations where there were gaps in spatial observations. The results of the project are being used to site future weather stations. SCE is also using its existing weather stations to develop more accurate weather forecasting (e.g., by using ML algorithms to train the weather station location's forecast). Finally, weather station data may be leveraged to help to analyze unexplained outages to see if weather was a factor in why assets were impacted. In the future, SCE is considering using weather station forecasts to help predict energy demand, especially during overcast days when solar generation is lower.

(3) SCE does not have a partnership with USFS to install weather stations and meteorological sample sites. However, SCE does have a partnership with University of California, Santa Barbara (UCSB) to develop model outputs that could account for spatial gaps in observed data and can share this data with USFS.

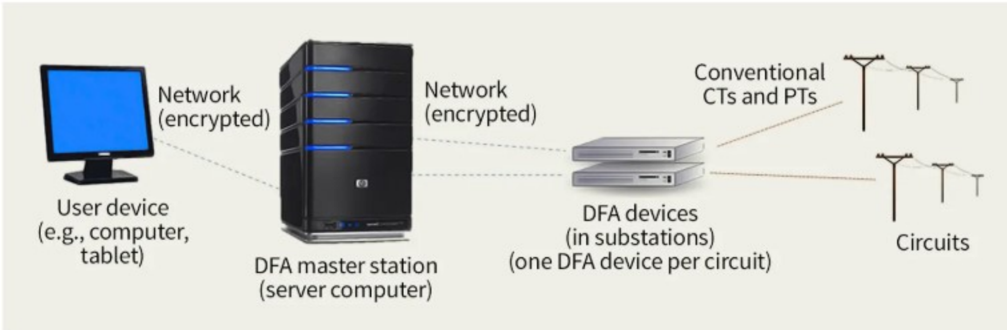
7.3.2.2 Continuous monitoring sensors

7.3.2.2.1 Distribution Fault Anticipation (DFA) (SA-9)

DFA technology incorporates electrical system measurements to detect the potential for pending equipment failures. These devices continually monitor circuits to detect and assist with locating and categorizing electrical events (e.g., incipient and traditional faults). Figure SCE 7-31 below shows the DFA system where the DFA devices installed at the substations use current transformers (CT) and potential transformers to monitor circuits. The DFA master station retrieves information from the DFA devices and provides the encrypted data to the user for further evaluation.

Figure SCE 7-31

DFA Technology



1. *Risk to be mitigated / problem to be addressed:*

Ignitions can be mitigated by reducing faults occurring on its system. One way to prevent faults is to detect fault precursor conditions and mitigate them before they become an actual fault (i.e., incipient fault detection). DFA installations can assist in detecting incipient fault conditions and provide remote access to fault data. The remote fault data can help locate faults where conventional circuit patrols were unable to determine a cause. For example, circuit patrols may find it difficult to detect where a momentary fault from wind-blown conductors may result in minimal damage. This type of fault may repeat itself in the future, potentially resulting in a more damaging event or ignition. Identifying these types of fault locations allows mitigation steps to avoid future re-occurrences. In the example of the wind-blown conductors, we may be able to add line spacers or covered conductor to a span to protect against future events.

2. *Initiative selection:*

SCE applied DFA technology to 60 circuits, which traverse HFRA, as pilot implementations in 2019 and 2020. The pilot program helped us understand the costs and complexities of DFA adoption on SCE's system. In 2021, SCE installed and commissioned an additional 130 units in HFRA in order to increase circuit coverage and expedite the evaluation while continuing to monitor the existing 60 units. An additional 25 units were installed in 2021 with commissioning planned in Q1 2022.

Beyond the commissioning of these additional 25 DFA units, SCE does not have further DFA installations planned for 2022 and therefore has not calculated an RSE. In 2022, SCE will focus on monitoring the installed units. Accordingly, if the technology is implemented more widely and more data is gathered, the RSE calculation will be re-evaluated as appropriate.

An alternative to the remote data collection of DFA requires manually retrieving fault data by SCE personnel visiting substations and other relay sites. However, this manual process is both more costly and time intensive without automation. With DFA, the data not only can be collected using far less manpower, but can be collected much faster, thereby fostering early detection and enabling timely remediation. Therefore, DFA avoids sending personnel to substations to collect data and limits the manual technical evaluation. Additionally, DFA uses a vendor's proprietary algorithms to identify Power System anomalies. The algorithms are updated as needed with input from multiple utilities. DFRs however would require developing a library of algorithms. Another potential alternative is EFD, which is currently being piloted. While DFA and EFD both focus on incipient fault detection, the methods of detection are completely different. SCE is evaluating the complementary and similar features between these technologies. See Section 7.1.5 for more information on EFD.

3. *Region prioritization:*

There are no installations planned in 2022.

4. *Progress on initiative (amount spent, regions covered) and plans for next year:*

As of Q4 2021, DFA has collected 1,068 alerts across the initial 60 circuits within the service period. The bulk of the alerts do not require additional review as they are not identified as incipient fault events. Examples of many of these events are non-recurring faults, when breakers close, and other normal operational events. Some of the highlights of these alerts during the pilot which are further studied are summarized below:

- 2 faults related to Fault Induced Conductor Motion
- 18 events classified as arcing
- 28 capacitor bank arcing or re-strike events
- 29 re-occurring faults

Currently data from the additional 130 installations are minimal as they were commissioned in late 2021. In 2022, SCE will evaluate the performance of installed fault anticipation technology and develop recommendations for future use by year-end 2022. SCE is utilizing other systems such as smart meters, remote monitored intelligent electronic devices, and power system analysis modeling software to further improve benefits from the remote data provided by DFA.

5. *Future improvements to initiative:*

There have been improvements in the DFA detection algorithms as well as the development that continues from Texas A&M based on alerts and information sharing between SCE and Texas A&M. Improvements to the algorithms will be incorporated across the existing installations to increase SCE's incipient fault detection capabilities.

7.3.2.2.1.1 Response to SCE Action Statement, 2021 WMP Other Issue to Address in 2022 WMP

The following is one of the Additional Issues as provided by OEIS in the Final Action Statement on SCE's 2021 WMP:

> ***"Issue:** SCE is not moving forward with continuous monitoring pilots at the same installation pace as other utilities. Regarding continuous monitoring technology, at this point, SCE is not working towards greater coverage until the technology is proven to be beneficial.*
>
> ***Remedy:** SCE must: 1) Provide an update on the status of its continuous monitoring sensor pilots, including any intentions on expanding projects."*

SCE's response to this Issue/Remedy is described below:

Deploying continuous monitoring sensors for wildfire mitigation has been a focus of SCE's WMP for the past few years. As discussed above, SCE has installed and commissioned 190 DFA units for evaluation since 2019. Further, SCE has installed another 25 DFA units in 2021 which will be commissioned in 2022.

SCE plans to monitor and evaluate the results. So far, DFA has collected over a thousand alerts across the original 60 circuits within the service period. SCE continues to monitor the newly-commissioned units installed in 2021 and will monitor the 25 units as commissioned in 2022. In 2022, SCE will performance and lessons learned from previous DFA installations. This will inform our future intentions on expanding this project.

In 2020 and 2021 SCE piloted the EFD technology with approximately 140 installations on both distribution and sub-transmission voltages. In 2022, SCE will install between 50 units and 150 EFD units, expanding the scope of the pilot and validating next-generation EFD equipment that will increase sampling rates and improve the signal-to-noise ratio, which is expected to allow for increased detection sensitivity.

7.3.2.2.2 High-Definition (HD) Cameras (SA-10)

HD camera installations can resolve gaps in SCE's spatial data and provide improved fire detection capabilities.

1. *Risk to be mitigated / problem to be addressed:*

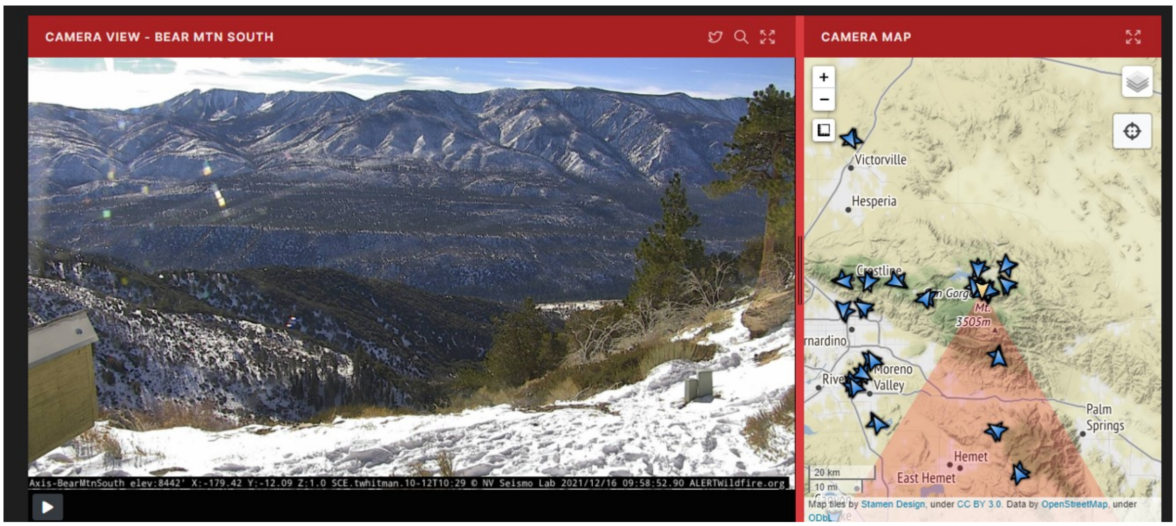
SCE's ability to respond to wildfires in its service area requires accurate and timely situational awareness information about the wildfire's location, spread and proximity to communities, buildings and assets. However, SCE has observed gaps in its ability to view certain parts of its service area where wildfires are more prevalent, including in locations where communities and mountainous terrain intersect. Left unaddressed, these blind spots could compromise SCE's ability to provide adequate and timely response to the fires.

2. *Initiative selection:*

SCE will install HD cameras in areas determined to be blind spots by SMEs to provide more complete and timely fire detection/monitoring for fire response. Figure SCE 7-32 provides an illustrative example of the outputs of one of the HD cameras in SCE's service area and shows the area covered by the camera's view. While SCE considered alternatives to HD cameras, such as reliance on satellite detection, web cameras and other agencies' cameras (e.g., USFS or CAL FIRE data), these alternatives would provide less timely information and sometimes less granular information about the wildfires than the data that could be gathered from HD cameras determined by SCE of greatest need.

Figure SCE 7-32

HD Camera View of Inland Empire and Eastern Sierra



To support situational awareness with respect to fuel conditions and help inform PSPS decision-making, SCE also maintains the current network of 166 HD cameras installed on its system.

The RSE for this activity is medium, based on HD cameras' ability to provide timely fire detection/monitoring for fire response.

3. *Region prioritization:*

SCE partners with University of California, San Diego (UCSD) to install HD cameras on non-SCE-infrastructure, such as a communications towers, in locations where its Fire Science Team, Fire Management Team, IMT and fire agencies have previously identified gaps in the spatial data related to fire detection and have requested an HD camera. The number and location of these installations will be based on requests by SCE's fire science, fire management, IMT teams or by fire agencies. To fulfill these requests, SCE is forecasting to install up to 20 HD cameras per year through 2024.

4. *Progress on initiative (amount spent, regions covered) and plans for next year:*

SCE has already installed 166 HD cameras through 2021, providing visual coverage of over 90% of our HFRA. However, SCE has since identified blind spots in this coverage. To help address these blind spots, SCE will install up to 20 high-definition cameras in 2022, including locations where communities and mountainous terrain intersect, including but not limited to along the Interstate 5 corridor where there are several transmission lines, and on Catalina Island, among other areas identified by SMEs.

5. Future improvements to initiative:

SCE plans to install up to 60 HD cameras between 2022 and 2024 and equip HD cameras with AI capabilities. This will enhance the HD cameras' ability to send timely and more accurate information on fire activity than can be provided by satellite technology and provide increased visibility of identified blind spots to help SCE fire management staff and fire agency personnel more quickly assess and respond to reported fires.

7.3.2.3 Fault indicators for detecting faults on electric lines and equipment

Fault indicators are included in SCE's standards throughout its service territory (not just HFRA) and continue to be installed on new and existing bare wire circuitry. Installation targets and specific efforts for fault indicators are not a part of this WMP update as a specificwildfire mitigation activity.

1. Risk to be mitigated / problem to be addressed:

A fault is an electrical disturbance in the power system accompanied by a sudden increase in current. When a fault occurs, it is important to expeditiously identify the cause and location of the fault. Fault indicators can aid in providing initial indication to circuitry sections where the cause can be located and this information can aid in fasterelectric service restoration. Restoration of load with the use of sectionalizing devices following a fault event generally occurs in a sequence of steps of opening and closing devices with an end result of minimizing the section that remains de-energized. As part of the electric service restoration process patrols, SCE also looks for causes of the fault or electric service interruption.

2. Initiative selection:

Fault indicators generally activate based on elevated fault currents, which aid in electric service reliability by providing information on the fault locations and thus provide intelligence on grid operations. SCE has two general versions of fault indicators that can be differentiated based on whether or not they provide indication remotely to system operators through the Distribution Management System (DMS).

An RSE was not developed and no alternatives were identified for this initiative, because fault indicators are installed and used as part of SCE's standard grid operations and are not specifically deployed for wildfire mitigation purposes.

3. Region prioritization:

Fault indicators are common equipment in SCE's standard circuit design, and thus their installations are not prioritized by high fire region.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

SCE continued to apply industry-accepted and available technologies for both local and remote fault indicators in alignment with SCE standards. SCE does not have a specific fault indicator initiative which is tracking costs and installations for wildfire mitigation.

5. Future improvements to initiative:

SCE is leveraging the advances in fault indicator technology to provide better intelligence of its grid operations to help improve and automate electric service restoration. Remote fault indicators offer benefits of near real-time data to aid in locating faulted line sections. Remote fault indicators also provide telemetry data which may be helpful in operation of distribution circuits for managing DER. SCE continues to research remote fault indicator options that are compatible with covered conductor. SCE intends to continue review of equipment options for remote fault indication, along with other sensing benefits for covered conductor systems in 2022.

7.3.2.4 Forecast of a fire risk index, fire potential index, or similar

In the 2022 WMP, SCE has combined the following activities from the 2021 WMP into SA-8 – Fire Science due to their complementary and integrated characteristics in supporting and advancing fire science: Fire Potential Index (SA-2), Fire Spread Modeling (SA-4), Fuel Sampling Program (SA-5), Remote Sensing (SA-7) and Fire Science Enhancements (SA-8). However, for transparency into the progress made in 2021 and the activities set forth for 2022, SCE continues to provide details for each of these sub-activities in this section and within Section 7.3.2.6.2 below.

7.3.2.4.1 Fire Potential Index (FPI) (Fire Science SA-8)

SCE is improving the accuracy of its FPI through the integration of historical weather and vegetation data for more precise PSPS decision-making.

1. Risk to be mitigated / problem to be addressed:

SCE's current FPI is a direct input into PSPS calculations and provides an estimate of the potential risk of having a large fire at the circuit level. To enable more targeted PSPS decision-making that has the potential to reduce the number of customers impacted by PSPS, the FPI was calibrated to better understand the index output in the context of historical fire activity. The FPI can then be enhanced to develop more accurate estimates of large fire potential at the circuit level, including at the transmission and sub-transmission circuit level.

2. Initiative selection:

SCE's current FPI is based on SDG&E's index, which was adopted in 2018 and used for PSPS in 2019. During the 2019 PSPS events, SCE observed limitations in its current FPI. SCE added a fuel-loading modifier in 2019 to account for areas where fuels are sparse and unlikely to support a significant fire. In 2021, SCE calibrated the index and was able to raise FPI thresholds across much of its HFRA as a result. SCE is looking to improve upon its current FPI in subsequent iterations. For example, with the current FPI, fire potential is capped at 17 which limits its ability to differentiate high end events. Also, weather, fuel moisture, and green-up[111] are essentially weighted the same in the FPI, which does not reflect the realities of how these factors each contribute to fire potential. For example, wind speed should have a higher weighting since wind can dominate the fire environment. Finally, the fuels portion of the index is heavily dependent on live fuel moisture, but there are other fuel moisture variables to consider that are equally important.

[111] Green-up refers to the development of the annual grasses from sprouting to full maturity which occurs during the winter and spring months.

SCE is implementing FPI improvements in two phases. In the first phase, SCE focused on the calibration of the FPI to contextualize the index with respect to historic fire activity, by correlating each discrete value of the index output (i.e., historical FPI values) with certain levels of previous fire activity (i.e., fire sizes). These calibrations helped inform how to adjust PSPS activation FPI thresholds, as needed, and allowed for documentation of what the index output values meant in terms of potential fire activity. For the second phase, SCE formulated a new FPI (2.0) to address the limitations stated previously, by placing more emphasis on wind speeds and adding a new fuels component to account for the diversity of fuel conditions across the SCE's service area. The output of FPI 2.0 will be compared with the current FPI in 2022, to determine if FPI 2.0 captures more detailed environmental conditions and provides a more accurate representation of fire potential across the SCE service area than the current FPI.

Finally, SCE developed calculations for the maximum FPI along virtual segments, which are circuits that are artificially and not physically segmented for the purposes of the calculation, of its transmission and sub-transmission circuits. This helps reduce the number of instances that FPI is underestimated along these circuits and allows SCE to deploy pre-patrols and LFOs more efficiently to only those segments that are expected to meet or exceed PSPS activation criteria.

The RSE for this activity is low because it does not directly reduce ignition risk or PSPS impacts. However, the activity is critical for driving improvements in precision and accuracy in PSPS decision-making, by providing more accurate information about circuits in scope that may experience subsequent consequence impacts from a potential wildfire.

3. Region prioritization:

All FPI-related projects will be developed for all of SCE's service area. Within HFRA, SCE is calculating an FPI for each of its circuits.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

SCE provides in the following descriptions of progress to date on each of its efforts related to FPI:

- <u>FPI Calibration:</u> In 2021, SCE completed an in-depth calibration of its FPI so that the index output (with numbers ranging from 1-17) would have meaning and context with respect to historic fire occurrence data. The subsequent output of this calibration shows that each FPI index value is associated with a certain amount/type of fire activity.

- <u>FPI 2.0 Development, Testing (Backcasting) and Evaluation</u>: In 2021, SCE created a fuels index and weather component for FPI 2.0, and then backcasted the FPI 2.0 calculations 40 years. SCE also had FPI 2.0 calculated for each Fire Climate Zone back to 1980 and operationalized to produce daily circuit-level output.

- <u>Transmission & Sub-Transmission FPI</u>: SCE began developing a more realistic assessment of the fire potential along its sub-transmission and bulk transmission circuits. By dividing the circuits into relatively small virtual segments[112] for which

[112] The division of circuits into virtual segments was determined using subject matter expertise based on vegetation, terrain, and several other factors.

the maximum FPI could be calculated, SCE produced operational products twice a day to show which circuit segments are forecast to reach or exceed PSPS criteria within the next five days.

In 2022, SCE is running FPI 2.0 in parallel with the current FPI to demonstrate the difference and improvements over the current index, and will make refinements to FPI 2.0 as needed, based on its evaluation of the outputs. If FPI 2.0 demonstrates a significant improvement over the current FPI, SCE expects that FPI 2.0 will replace the current FPI before the start of the 2023 fire season and the 2023 WMP. SCE's activities will also include backcasting of FPI along virtual segments for a select number of weather events to show the levels of improvement in this approach compared with previous methods.

5. Future improvements to initiative:

Since the FPI is a derived calculation based on output values from SCE's in-house weather and fuels modeling, any improvements to SCE's modeling efforts will result in a more refined assessment of fire potential across the service area.

7.3.2.4.2 Fuel Sampling (Fire Science SA-8)

SCE takes bi-weekly measurements of vegetation moisture at 15 sites across its service area.

1. Risk to be mitigated / problem to be addressed:

Dry fuel conditions contribute to increased wildfire risk. As a result, during weather events SCE incorporates information such as fuel conditions in its PSPS decision making process. Although models can be used to estimate fuel dryness, results from fuels sampling can be used to assess vegetation dryness in near real-time, adjust inputs for fire spread and fire potential calculations, and help train live fuel moisture models.

2. Initiative selection:

While local fire agencies conduct fuel sampling, SCE determined it would be beneficial to sample in areas where major gaps exist both spatially and temporally. Fuel sampling consists of physically collecting small portions of the native vegetation, which is then brought to a lab to be weighed, dried, and then weighed again to determine the vegetation's moisture content. SCE makes certain that the fuels sampling program is properly managed and there is little interruption of data by checking that all samples are collected and analyzed properly and resolving problems that may arise at any of the sites with the vendor as quickly as possible. This helps to ensure that the fuel sampling data is high-quality and will result in better model solutions and outputs.

While SCE considered alternatives such as reliance on fuel samples from federal or other agencies or on historical data points, conducting its own fuel sampling program helps SCE to target the areas that have the greatest fire potential and allows for more informed PSPS decision-making. SCE uses the data from its fuel sampling to develop and train ML models to approximate live fuel moisture across SCE's service area at a 2 km resolution, which serves as one of the inputs into the FPI. SCE also uses the data to calibrate FPI (increasing the precision of PSPS decision-making) and to adjust inputs for fire spread calculations (improving the accuracy of fire consequence modeling).

The RSE for this activity is low, because it does not directly reduce ignition risk or PSPS impacts.

However, the activity is critical for driving improvements in precision and accuracy in PSPS decision-making, by providing more accurate information about circuits in scope that may be impacted from a potential wildfire.

3. Region prioritization:

The 15 fuel sampling sites in SCE's HFRA were selected by determining where spatial gaps in data sampling currently exist. Once these areas were identified, specific sites were selected based on SCE's right-of-way access, proximity to major roads, and the amount, type, and health of the vegetation at each location.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

In 2021, SCE performed updated fuel sampling at the 15 sites once every two weeks (weather permitting). SCE used the sample data to adjust FPI values as needed prior to potential PSPS events.

In 2022, SCE intends to continue sampling moisture levels within the live vegetation at all 15 locations through its Fuels Sampling Program. SCE is currently evaluating the feasibility of expanding the program to collect samples from additional sites in SCE's HFRA where observation gaps may still exist. Also, SCE will use some of its sampled data over the past two years to approximate live fuel moisture content in other vegetation species such as sagebrush and ceanothus/manzanita (discussed in Section 7.3.2.6).

5. Future improvements to initiative:

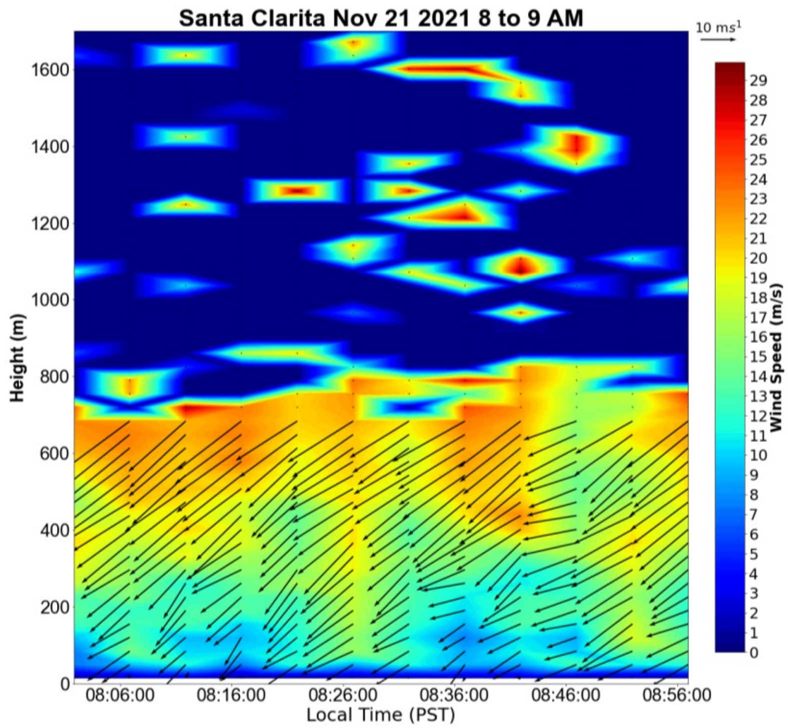
SCE plans to investigate whether remote sensing technology could potentially replace the fuel sampling program by providing the same information. In addition, SCE may add more sampling sites to the extent that gaps are identified.

7.3.2.4.3 Remote Sensing (Fire Science SA-8)

SCE is implementing remote sensing technology to collect additional information on weather, fuels, and fire activity to enhance SCE's wildfire modeling capabilities. Figure SCE 7-33 provides an example of a vertical wind profile captured by remote sensing technology in Santa Clarita.

Figure SCE 7-33

LiDAR Data Demonstrating the Vertical Wind Profile of the Atmosphere on Nov 21, 2021



1. *Risk to be mitigated / problem to be addressed:*

Collecting weather, fuels, and fire activity information in remote areas is challenging, which makes it necessary for SCE to continually evaluate ways to improve its situational awareness in these areas. SCE seeks to improve its ability to monitor its environment, estimate the risk to its system, make more informed decisions about potential PSPS de-energizations and improve its risk modeling.

2. *Initiative selection:*

SCE is piloting and evaluating remote sensing technology using satellite imagery to collect additional information on weather, fuels, and fire activity in order to enhance SCE's overall risk modeling and situational awareness capabilities. Remote sensing, using LiDAR technology, will be leveraged for a pilot project to obtain additional data points above ground level to potentially support de-energization decisions. When circuit level windspeeds are difficult to predict due to complex terrain, monitoring wind speeds above these circuits could provide insight into the behavior of the wind and the potential for stronger winds to surface down to the circuit level. Also, this data could be useful for improving model predictability in areas where challenges in accuracy exist.

Also, SCE will use remote sensing technology to assist with early wildfire detection to enable faster fire agency response time. Finally, remote sensing will be used to assist SCE with restoration efforts in areas affected by fires/natural events, by enabling SCE's ability to monitor the health of the environment. In assessing how circuits have performed against models in the past, SCE determined that additional remote sensing technology would be useful to improve its modeling capabilities.

The RSE for this activity is low because it does not directly reduce ignition risk or PSPS impacts. However, the activity is critical for driving improvements in precision and accuracy in PSPS decision-making, by providing more accurate information about circuits in scope that may be impacted from a potential wildfire.

3. Region prioritization:

Remote sensing technology will be used across all of SCE's service area, although deployment will be prioritized in HFRA due to elevated fire risk in areas such as Santa Clarita.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

SCE began implementing a lower atmospheric wind profiler pilot project in 2021 in connection with SJSU (see also Section 4.4.1). The pilot profiles winds in the lower atmosphere using LiDAR technology to collect wind observations above ground level, using multiple deployments of SJSU's LiDAR system to sample wind speeds at specific locations on demand. This will provide SCE with the ability to measure winds above the ground at high frequency intervals during PSPS events, contributing to greater situational awareness. In 2021, this project was deployed for two Santa Ana wind events. Upon evaluation, SCE found that the wind profiler data matched well with observed surface winds but concluded that more data was needed to understand model performance and how the model could be improved.

In addition, SCE finalized its agreement to work with Earth Lab in association with the University of Colorado at Boulder to develop the Vegetation Buildup Index, which is a heat map showing the approximate areas where the dynamic combustibility of fuels is greatest, through the consideration of vegetation moisture, type, and amount as well as taking into account the long-term climatological affects upon the vegetation. This product will use remote sensing data that is publicly available to allow for an objective, quantifiable process to inform where and when to perform inspections and if any potential remediations should be accelerated. This product will provide SCE with the ability to see changes in the service area on a quarterly basis, by processing frequently updated imagery into vegetation indexes specifically designed for SCE service area to monitor the health of the environment, which assists with restoration efforts in areas affected by fires/natural events.

In 2022, SCE will continue collecting data for its wind profiling project during critical wind events and plans to develop a vegetation buildup index using remote sensing data.

5. Future improvements to initiative:

If successful, the wind profiler work with SJSU may be used to improve SCE's in-house weather models and evaluation of upper level winds to determine when stronger winds would surface. SCE will continue to work with the University of Colorado at Boulder to scope out additional remote sensing projects.

7.3.2.4.4 Fire Science Enhancements (Fire Science SA-8)

SCE's fire science enhancements[113] improve SCE's ability to estimate PSPS impacts, such as the number

[113] The Weather and Fuels Climatology project, along with other projects, contributes towards enhancing SCE's fire science capabilities.

of PSPS events and the number of circuits that may be in scope for PSPS events.

1. Risk to be mitigated / problem to be addressed:

SCE's weather forecasts provide critical information for PSPS events, such as information about whether a circuit will exceed PSPS criteria. This information may be used for de-energization decisions, customer notifications, and external coordination, among others. Inaccurate or outdated weather models may impact PSPS decision-making by, for example, having a bias that impacts the circuits forecasted to exceed PSPS criteria.

2. Initiative selection:

Upgrading the ability to contextualize current weather information will enhance the interpretation of weather conditions and improve the weather models' ability to estimate weather impacts, forecast the seasonal weather outlook and make informed decisions for PSPS events.

SCE's Weather and Fuels Climatology project aims to provide historical context for current weather events, by developing a climatology of temperature, wind, humidity, vegetation moisture, and many other parameters at each grid cell across the SCE service area, based on access to an unprecedented and unique 40-year historical data set of weather and fuels. In addition, this project would help place current forecasts in the context of its historical climatology to help improve messaging regarding upcoming weather events, e.g., if the forecasted weather is an anomaly with respect to historic weather. The data set was created using SCE's in-house Weather Research and Forecasting model to approximate the initial state of the atmosphere in the past, back to 1980. This historical database provides the information necessary to develop predictive models that will improve the overall understanding of environmental factors (weather and fuels) and their relationship with ignition drivers for utility-caused wildfires. SCE will then use these models to inform wildfire mitigation activities and real-time decision-making for PSPS events.

SCE's Santa Ana Wind Outlook project will update the model that produces 1-month and 3-month ahead forecasts of Santa Ana winds across SCE's service area. The model consists of several components, including a ML approach that needs to be retrained to include more recent Santa Ana wind events. These forecasts are used in combination with SCE's seasonal outlooks to help inform the frequency of these events when planning for inspections and remediations across SCE's service area.

SCE continues to address emergent needs associated with this activity, such as changes to modeling output to accommodate improvements in forecasting. In furtherance of these objectives, SCE has partnered with the California Polytechnic State University, San Luis Obispo (Cal Poly-SLO) and SJSU on academic research initiatives through the Wildland Urban Interface Fire Institute and the WIRC, respectively. These projects are described in Section 4.4.1.

The RSE for this activity is low, because it does not directly reduce ignition risk or PSPS impacts. However, the activity is critical for driving improvements in precision and accuracy in PSPS decision-making, by providing more accurate information about circuits in scope that may be impacted from a potential wildfire.

3. Region prioritization:

The Sana Ana Wind Outlook will be updated for all of Southern California excluding the desert areas. The Weather and Fuels Climatology project will be updated for SCE's service area.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

In 2021, SCE developed a climatology of various weather and fuel parameters based on a 40-year history for each grid cell in the 2-km weather model domain. However, due to limited resources, SCE did not complete the comparison between the forecast with the climatology.

In 2022, SCE plans to retrain the ML components of its Santa Ana Wind Outlook model in order to account for more recent Santa Ana wind events. SCE also plans to complete the Weather and Fuels Climatology project by comparing forecasted weather with historic weather events.

5. Future improvements to initiative:

SCE will work to continuously improve the accuracy of its weather modeling capabilities by incorporating inputs from observed and historic events.

7.3.2.5 *Personnel* monitoring areas of electric lines and equipment in elevated fire risk conditions

SCE trains and deploys personnel to perform line patrols and live field observations LFOs, providing critical situational awareness during elevated fire risk conditions to inform PSPS decision-making.

1. Risk to be mitigated / problem to be addressed:

When elevated fire risk conditions are identified in specific areas of SCE's service area, real-time information regarding the impacted areas can help determine the need for various just-in-time wildfire mitigations efforts, such as PSPS, vegetation remediation and infrastructure repairs. In-person observations may help to identify flying debris, wire slap and other hazardous conditions that may be present at the impacted area. Prior to re-energization, in-person observations may also help to identify whether lines are clear of potential hazards. Without these observations, SCE would miss some valuable inputs, compromising its ability to make informed decisions about potential PSPS de-energizations and re-energizations.

2. Initiative selection:

Line patrols and LFOs (monitoring) provide critical sources of situational awareness that allow for the execution of SCE's PSPS protocols before and during a PSPS event, and after weather conditions have abated. Before an event, line patrols are carried out by qualified personnel (e.g., troublemen, senior patrolmen, etc.) to examine SCE assets for any potential concerns that may be exacerbated by the upcoming wind event. During an event, qualified personnel can be deployed to high-risk portions of the grid to take live wind readings and to watch for other inclement hazards (e.g., airborne debris). These LFOs are performed to provide real-time data back to SCE's Emergency Operations Center. After concerning weather conditions have abated, SCE must dispatch qualified personnel again to perform restoration patrols on all circuits that experienced a PSPS de-energization to ensure that re-energization is very unlikely to cause a spark or ignition and is safe for service restoration.

These protocols are imperative to SCE's decision making and will continue to be a part of SCE's WMP for the foreseeable future. Even with expanding automation and new technology, providing SMEs with visibility to grid and weather conditions provides invaluable situational awareness on local hazards like swaying lines with potential for wire-to-wire contact and airborne debris or vegetation. Field observers can also provide real-time weather reads using portable devices, supplementing weather station coverage of SCE's HFRA circuits. As line patrols are a necessary component of implementing PSPS events, a separate RSE for just this activity was not calculated.

3. Region prioritization:

Line patrols and field observations are performed throughout the HFRA on any circuit that is in scope for PSPS consideration.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

In 2021, SCE trained 2,828 qualified personnel at SCE and select personnel from its contract company partners to perform line patrols and live field observations for PSPS events.

In 2022, SCE is piloting the use of enhanced truck-mounted windspeed measurement devices that can provide more precise readings than using hand-held devices from the ground and can automate the communication of windspeed readings back to the IMT. In addition, SCE will be testing the use of UAS technology in HFRA in connection with line- LOS pre- and post-patrols for PSPS events. As the processes, procedures and technology mature, the use of additional situational awareness devices—such as weather stations and High-Definition cameras—may further influence where resources are stationed.

5. Future improvements to initiative:

SCE will continue these processes for future events. SCE is testing the use of UAS, or drones, and remote sensing capabilities to determine whether and how UAS can assist in data gathering for improved situational awareness. For instance, UAS in the coming years may be able to supplement in-person patrols, allowing qualified personnel to more quickly assess circuit conditions beyond visual line of sight.

7.3.2.6 *Weather forecasting and estimating impacts on electric lines and equipment*

7.3.2.6.1 Weather and Fuels Modeling (SA-3)

SCE previously implemented and is now refining the NGWMS to upgrade SCE's current in-house weather modeling capabilities.

1. Risk to be mitigated / problem to be addressed:

In order to minimize the customer impacts of PSPS, SCE must obtain more granular weather data at the sub-circuit level, decrease bias in its modeling, and increase its windspeed forecast accuracy at site-specific locations. Finally, SCE must remove processing inefficiencies associated with analyzing its weather, asset and fuels data.

2. Initiative selection:

SCE implemented the NGWMS to provide an extensive upgrade to SCE's current in-house weather modeling capabilities and enhance SCE's ability to make more targeted PSPS decisions. SCE continues to make enhancements to its in-house modeling capabilities. The alternative to making enhancements to the NGWMS is to rely on SCE's existing in-house weather modeling capabilities. Because this would not address existing model bias and limitations with developing forecast uncertainty estimations, SCE did not pursue this alternative. It is also difficult to extract and analyze data from the existing models, which are housed on multiple platforms.

The RSE for this activity is relatively low because it does not directly reduce ignition risk or PSPS impacts. However, the activity is critical for driving improvements in precision and accuracy in PSPS decision-making, by providing more accurate information about circuits in scope that may be impacted from a potential wildfire.

3. Region prioritization:

The NGWMS will include weather forecasts and historic weather data spanning the entire SCE service area. Circuit-level forecasts used for PSPS are specific to HFRA and are derived from the initial data that spans the entire territory. Additionally, efforts to equip weather station locations with ML capabilities are focused on HFRA.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

In 2021, SCE procured and installed two HPCCs to implement the NGWMS, incorporated a European forecasting model to help improve forecasting accuracy, and extended its PSPS forecast from 5 to 7 days as part of the NGWMS implementation. SCE's vendor also developed the Data Manager to support faster and more efficient queries of its 40-year historic dataset.

In 2022, SCE plans to improve in-house weather modeling capabilities, by 1) employing the use of AI and probabilistic modeling to remove forecast biases and provide reliable estimates of forecast uncertainty, and, 2) by continuing to add ML capabilities to its weather station locations to reduce bias in its weather models. In addition, SCE will continue to enhance its in-house modeling capabilities by updating live fuel moisture models (discussed in Section 7.3.2.4.2), incorporating Santa Ana wind forecasts (discussed in Section 7.3.2.4.4), and utilizing the Data Manager. SCE is considering additional resources to support fire modeling, analysis, and weather forecasting activities. Finally, SCE has partnered with the UCSB to develop additional weather observation data and is developing a Weather Visualization Portal to enhance its ability to analyze data from several sources. A brief description of each improvement is noted below.

- ML models will be developed for select SCE weather station locations to improve wind forecasts in areas where current modeling capabilities have difficulties resolving local circulation features within complex terrain. SCE plans to equip 400 to 500 weather station locations with ML capabilities in 2022.

- SCE will update its live fuel moisture models by incorporating additional vegetation species. This will help improve the accuracy of the FPI forecast.

- To enable quicker and more efficient data retrieval than the current process of having to apply additional filtering processes to further distill the requested subset of data, an offsite data platform, SCE initiated development of the Data Manager to house and manage SCE's 40-year historical dataset of weather and fuels. The Data Manager improves data analysis by providing users with the ability to interact with SCE's historical data set quickly and efficiently to retrieve only the data needed for the analysis.

- SCE is partnering with UCSB to create a gridded observation data set that supplements the information provided by SCE's existing network of weather stations. Information about the research can be found in Section 4.4.1.

- SCE is developing a Weather Visualization Portal that, along with a more robust graphic user interface, will allow users to view and analyze large amounts of data from these models quickly and efficiently. This represents a marked improvement over the current process in which users are retrieving information from different data sources and comparing them, in order to produce an analysis.

5. Future improvements to initiative:

SCE will be expanding the development and implementation of AI models to provide high-level forecasting capabilities at site-specific locations representing circuits. SCE will continue working to improve its weather forecasting confidence and capability.

7.3.2.6.2 Fire Spread Modeling (Fire Science SA-8)

SCE is working with Technosylva to help mature Technosylva's fire spread modeling products (FireCast and FireSim) by accounting for fire suppression and by producing reliable estimates of the potential number of buildings destroyed by a wildfire to better understand and quantify potential wildfire impacts to communities based on an informed scenario analysis.

1. Risk to be mitigated / problem to be addressed:

SCE's fire spread modeling capabilities must be able to provide adequate risk and consequence information for SCE to be more precise in its PSPS decisions and limit the number of customers impacted by de-energizations. Depending on the location, some wildfires will be more impactful, regardless of size, due to the presence of populations, buildings, and utility assets in the area, among other factors. This type of information could help fire spread models better estimate where the greatest impacts will take place during critical fire weather events and enable more targeted, proactive de-energization decisions.

2. Initiative selection:

SCE plans to use advanced fire spread modeling tools—Technosylva's FireCast and FireSim[114] applications—to simulate various scenarios to predict fire ignition and consequence outputs such as fire perimeter size, structures impacted, populations affected, and injury and death. Figure SCE 7-34 below provides an illustrative example of a fire simulation produced by FireSim that estimates the fire size and impacts to population and buildings impacted. Figure SCE 7-35 provides an illustrative example of fire size potential at the distribution circuit level as displayed in FireCast. Prior to deployment, SCE is undertaking an extensive evaluation of FireCast and FireSim for the applications' ability to estimate the impacts that fire activity will have on a particular area (i.e., wildfire consequences). The evaluation process will inform how these applications should be integrated into PSPS protocols.

SCE is working on a fuels mapping project that will provide an updated, realistic assessment of fuel

[114] As described in SCE's 2020 WMP, FireCast is an application that provides a 3-day forecast of potential fire ignitions across the SCE service area and FireSim provides real-time simulation modeling to derive potential fire impacts for active suppression response or weather event planning.

amount and type across the landscape. Surface fuels and canopy characteristics data are key inputs into producing accurate fire behavior and risk outputs for both daily risk forecasts and on-demand spread predictions and can have dramatic effects on the modeling output. SCE has a subscription service with Technosylva to keep the surface and canopy fuels layer current to help ensure that the latest vegetation information (e.g., reflecting landscape changes caused by fires, landslides, blowdown, urban growth, etc.) is incorporated into the fire simulations going forward. The alternative to having an updated fuels layer is to rely on existing data sets. However, when FireCast and FireSim were first implemented in 2020, SCE used a LANDFIRE 2016 fuels dataset. This dataset produced less than accurate fire behavior modeling results (when compared to actual events) necessary to meet SCE's operational needs, leading SCE to conclude that more enhanced and accurate fuels were needed.

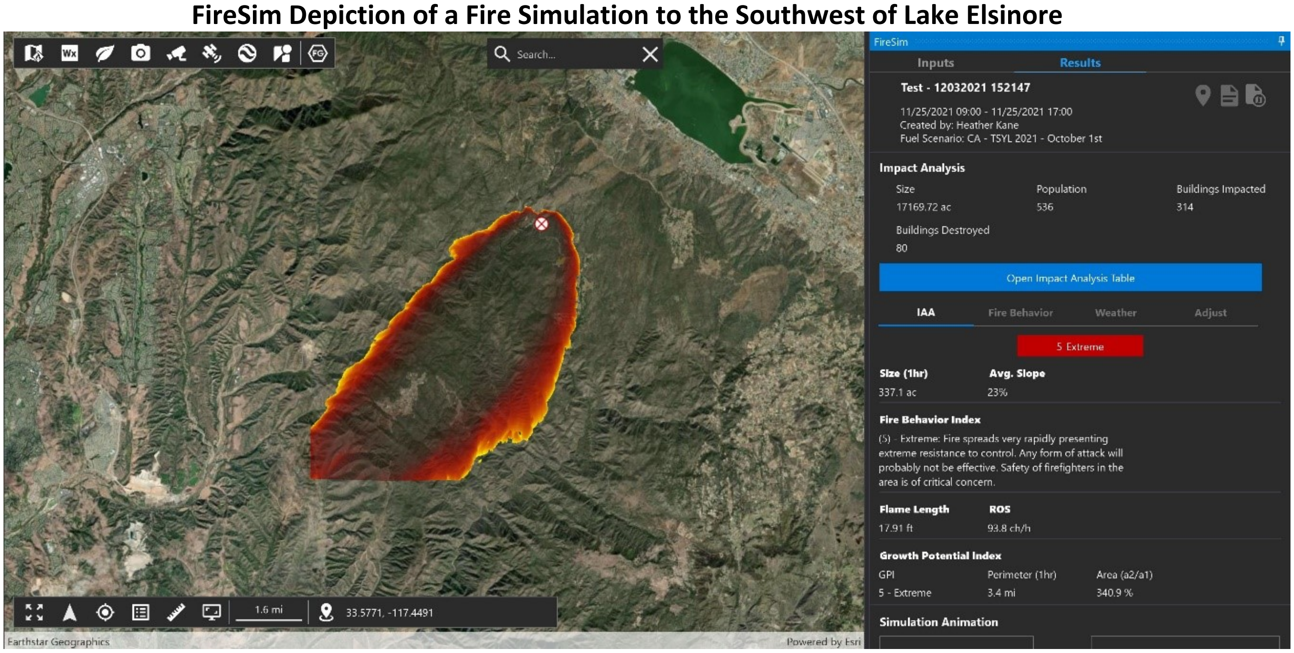
Finally, SCE will add supporting services and undertake additional analyses to further advance its ability to model fire spread in its service area.

While this initiative does not reduce ignition risk or consequence directly, the output of these models will help SCE coordinate its response to protect critical assets during active wildfire events and may be used as an input into PSPS decision-making.

The RSE for this activity is low because it does not directly reduce ignition risk or PSPS impacts. However, the activity is critical for driving improvements in precision and accuracy in PSPS decision-making, by providing more accurate information about circuits in scope that may be impacted from a potential wildfire.

Figure SCE 7-34

FireSim Depiction of a Fire Simulation to the Southwest of Lake Elsinore



3. Region prioritization:

The Technosylva modules will be used to run scenarios across SCE's HFRA.

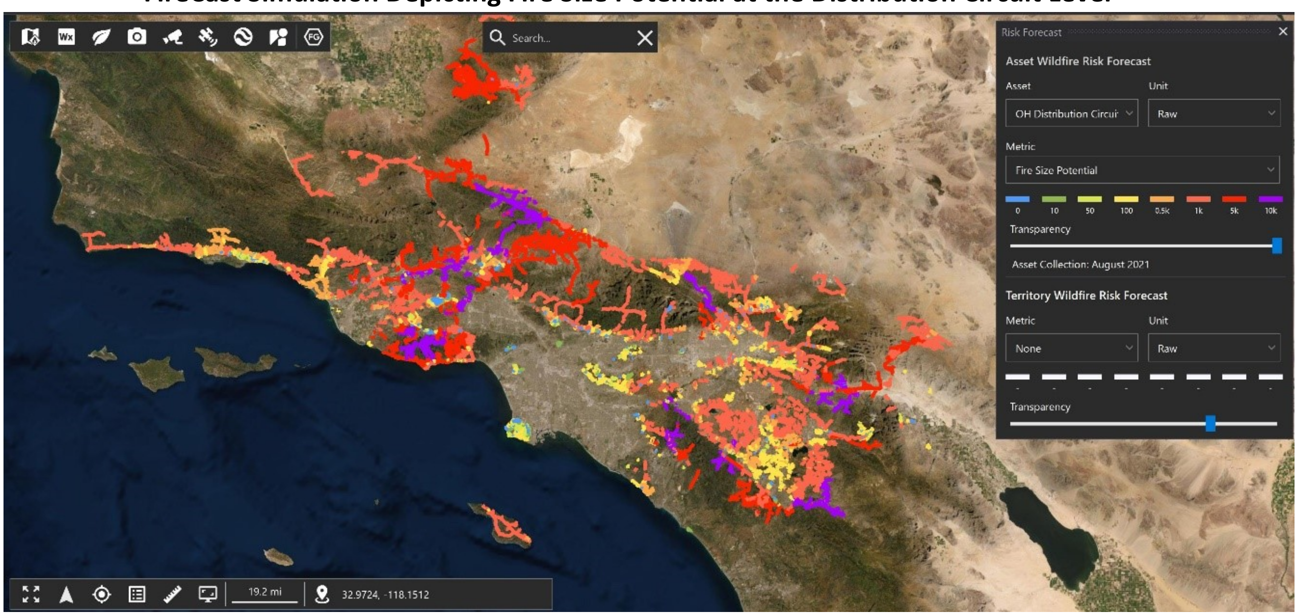
4. Progress on initiative (amount spent, regions covered) and plans for next year:

In 2021, SCE received an asset risk analysis from Technosylva using backcasted data from 2020 and performed an analysis to understand the impacts of incorporating this information into PSPS decision-making. SCE discovered during testing that the initial analysis overestimated impacts. SCE also completed its PSPS Asset Risk Analysis project. The PSPS Asset Risk Analysis project was used to determine if potential PSPS de-energization is necessary when considering the possible consequence provided by FireCast asset risk metrics. SCE now receives regular reports regarding circuits that meet the consequence criteria as defined by the PSPS Asset Risk Analysis project; however, it was determined that additional information was needed before the results of the reports could be incorporated into PSPS decision-making.

Beginning in 2021 and through 2022, SCE will work with Technosylva to develop a mature product that is capable of providing more precise estimates of impacts to buildings, populations, fire size potential, etc. SCE will also incorporate additional layers and analyses to support the maturation of the FireCast/FireSim models. Once the applications have been revised, SCE will evaluate their performance during a test phase to inform how these applications should be integrated into PSPS protocols. SCE is considering additional resources to support fire modeling, analysis, and weather forecasting activities.

Figure SCE 7-35

FireCast Simulation Depicting Fire Size Potential at the Distribution Circuit Level



SCE's fire spread modeling efforts will be of increasing importance moving forward, as information about wildfire impacts on communities will be key in reducing the scope of de-energization during PSPS events. As a result, SCE will engage in several projects and enhancements in 2022 to advance wildfire modeling:

- The Surface and Canopy Fuels Layer Subscription Service allows Fuels Mapping updates to be performed at a regular cadence, improving the accuracy of the fire simulation outputs. The subscription may include regular updates to land disturbances that incorporate burn scar perimeters and new land development projects.

- The Risk Associated with Value Exposure (RAVE) Analysis produces service area-wide risk metrics that uses advanced prediction modeling to support the analysis of how populations and assets will be affected by a utility-caused ignition.

- The Herbaceous Live Fuel Moisture Model Subscription Service ensures that SCE has regular access to the modeling output that estimates live fuel moisture. The output serves as a critical, direct input into all fire spread modeling calculations.

- SCE enlists Fire Behavior Analysis Consulting Support by a qualified Fire Behavior Analyst (FBAN) to assist with the daily monitoring of fires throughout the SCE service area. The support will include on-demand FBAN services to document, monitor, and simulate large fire events with advanced analysis and reporting during large fire outbreaks.

- SCE plans to make FireCast, FireSim, and WRRM upgrades[115] to address new and emerging needs that may require the use of new metrics, analytic tools, and additional data. The upgrades will also cover changes that will likely be needed to account for the new output from the NGWMS, such as higher resolution data. Before SCE can begin implementing FireCast (which includes FireSim) into the PSPS decision-making process, significant improvements to the application are needed. SCE is working with its vendor in 2022 to add the following improvements to the FireCast application:

  - Building Loss Factor: A new building-level loss factor metric (BLF) will be developed to allow fire simulations to estimate the number of destroyed buildings. Currently, only the number of buildings impacted (threatened) is calculated.

  - Suppression Effectiveness Simulation: The simulation would estimate suppression effectiveness by combining historical data with ML methods and landscape characterization. There are currently no scientific research or models that effectively allow for consideration of suppression for fire spread predictions.

  - Custom Fuels Atlas: This atlas would provide an updated set of fuel model measurements, specific to key areas within SCE service territory, that would be used to define custom fuel models. The models, in turn, would be used to update fuels on a regular basis as part of the fuels mapping program.

  - Extended Attack Index: This index would improve detection of potentially destructive fires by identifying extended fire suppression response ("extended attack") scenarios using new metrics developed to capture potential large

[115] The implementation of WRRM (RA-1 - Expansion of Risk Analysis in SCE's 2020 WMP) was previously a WMP activity and was discussed in this chapter in the 2020 WMP. SCE includes a write-up of the WRRM implementation within the Risk Assessment and Mapping Chapter in SCE's 2021 WMP. Please refer to Section 7.3.1 for more details.

destructive fire scenarios that are not typically identified during initial fire suppression response ("initial attack") conditions. Assessments of initial attacks over the past few years have generally been a good indicator of whether fires will become larger and more destructive, but recent fires have indicated a need to analyze extended attack conditions.

- WRRM Historical Percent Daily Forecast Integration: This deliverable will integrate the WRRM percentiles data into the FireCast application and forecast to allow SCE to compare daily risk forecasts against history.

The updated fuels layers (Surface and Canopy Fuels, Herbaceous Live Fuel Moisture) will improve the accuracy of all fire simulation calculations, while the RAVE and PSPS Asset Risk analyses will inform how to integrate FireCast into PSPS decision-making by creating a single composite score of asset risk. The Fire Behavior Analysis Consulting Support will provide additional support to help SCE monitor fire activities and run fire simulations. Finally, SCE will work with the vendors to provide necessary software upgrades for FireCast, FireSim and WRRM.

5. Future improvements to initiative:

Following development of the enhancements to improve FireCast, SCE will need to extensively evaluate and validate the features before any substantive consideration of implementation can occur. The evaluation process will likely take place in 2023 or 2024. Depending on the results of the evaluation phase, SCE may perform a full integration of FireCast/FireSim into its PSPS operations.

7.3.3 Grid Design and System Hardening

Report detailed information for each initiative

Grid design and system-hardening mitigation activities are central to SCE's efforts to combat wildfires associated with utility equipment. The hardening activities primarily aim to reduce the probability of a fire initiating. SCE carefully evaluates each mitigation alternative and then selects the appropriate one(s) that address the key risk drivers and sub-drivers, utilizing a risk-informed decision-making process as described in Section 7.1.2. For example, while covered conductor may prevent CFO and wire-to-wire faults, it does not prevent pole damage after a wildfire. But fire-resistant poles (FRPs) can prevent such damage. Therefore, these two activities are performed in tandem to maximize the risk buydown.

Further, SCE has developed an Integrated Grid Hardening Strategy to evaluate the optimal set of mitigations to reduce wildfire and PSPS risks most effectively throughout SCE's HFRA. This strategy is built upon advancements made in SCE's risk modeling capabilities and understanding of the effectiveness of mitigation alternatives. Grid hardening activities – including many of those discussed in this section – are central components of this forward-looking strategy. Please refer to Section 7.1.2.1 for additional discussion on this strategy.

By the end of 2021, SCE has met a significant majority of the grid hardening goals, and for some activities, exceeded the target goals set forth in its previous WMPs. For instance, since 2019, SCE's WCCP has installed approximately 2,500[116] circuit miles of covered conductor (or approximately 25% of the circuit miles in SCE's HFRA) and completed nearly six miles of targeted undergrounding. In 2022, SCE will continue to install more covered conductor, targeted undergrounding, and other important grid hardening initiatives. SCE will also implement several new activities identified and evaluated through lessons learned and further risk and engineering analyses, such as the vibration damper retrofit[117] for the covered conductor program.

7.3.3.1 Capacitor Maintenance and Replacement Program

A capacitor is an electric device that stores energy. A capacitor bank is an array of multiple capacitor units combined in series and parallel connections to meet overall system needs (see Figure SCE 7-36 below). Capacitors are a critical component for the electric power system and SCE has historically had maintenance and infrastructure replacement programs for capacitors. Accordingly, SCE does not view this activity as a specific wildfire mitigation effort and will continue to maintain and replace capacitors as part of SCE's traditional maintenance program.

[116] The 2,500 circuit miles does not include non-WCCP miles, such as those performed for storm restoration, etc. The total number of circuit miles completed under WCCP and non-WCCP programs is more than 2,900 through 2021.

[117] The aeolian vibration issue was discussed in the Covered Conductor Compendium, as well as in Exponent® Initial Effectiveness of Covered Conductors for Overhead Distribution System Hardening.

Figure SCE 7-36

Overhead Capacitor Bank

1. Risk to be mitigated / problem to be addressed:

In addition to voltage support, capacitors play a critical role in helping avoid or limit overload conditions on distribution circuits during times of high electricity demand. Aging increases the potential for capacitor bank equipment failures, as does normal degradation during operations. Component failures of capacitor banks have varied ignition risks, though many are relatively benign, creating a fuse operation or inoperable capacitor bank. Some exceptions include contact-from-objects and a subset of capacitor switch failure mechanisms.

2. Initiative selection:

To help avoid in-service malfunction or failure, SCE routinely inspects capacitors as part of its compliance-based inspection programs as well as HFRI inspections. If unacceptable degradation in capacitor condition or associated hardware is observed, capacitors are remediated as part of those programs. Capacitors are also repaired and/or replaced when identified as not functioning or have failed in service. When conducting repairs and/or replacements, SCE routinely applies wildlife protection to equipment bushings and leads for capacitor bank installations to help prevent external contact with objects. New switched capacitor bank installations typically incorporate solid dielectric vacuum switches and solid dielectric control power transformers instead of oil insulated equipment which is expected to help avoid ignition risks with oil filled equipment failure modes.

3. Region prioritization:

Capacitor maintenance and replacements are performed across SCE's service area based on inspection results and priority assigned to the findings. Since overhead detailed inspections are combined with HFRI inspections in SCE's HFRA, regional prioritization in HFRA follows the same approach as HFRI inspections and are prioritized based on POI and consequence. Capacitor replacements based on field or engineering feedback are performed in the order identified. However, if there is an identified voltage issue on the circuit, the capacitor replacement for that circuit is prioritized.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

SCE's inspection programs surrounding capacitors are expected to continue without significant changes for 2022 HFRA capacitor installations. As with prior years, the inspection findings are collected and reviewed to prioritize the remediation actions. However new capabilities exist from the expansion of DFA installations on a selection of HFRA circuits. The new circuit monitoring provides the capability to identify arcing associated with capacitor banks. These arcing signatures may alert SCE of a degraded capacitor switch in need of replacement or other arcing components. Benefits for ignition risk reduction are realized with these incipient fault detections where replacements or repairs can occur prior to complete failure.[118]

5. Future improvements to initiative:

Over the next several years, SCE expects to further refine its ability to remotely monitor capacitor performance to improve its inspection and maintenance efforts. This includes continued development of advanced algorithms to aid in inspection and/or maintenance efficiencies as well as monitoring applications of DFA alerts surrounding capacitor arcing detections.

7.3.3.2 Circuit Breaker Maintenance and Installation to De-energize Lines upon Detecting a Fault

Circuit Breaker Relay Hardware for Fast Curve (SH-6)

A relay is a device designed to trip a CB when it detects a fault, which is an electrical disturbance in the power system accompanied by a sudden increase in current. The CB then interrupts the current flow, or in other words, cuts off the power supply to minimize damage to the circuit.

In 2018, SCE initiated a program to deploy FC settings at substation CB relays. This type of setting increases the speed in which the relay detects a fault. SCE developed a plan to upgrade old electromechanical relays with new microprocessor relays, and in some cases update microprocessor relay settings to enable FC settings for the remaining HFRA feeder circuits.

1. *Risk to be mitigated / problem to be addressed:*

CB relays with conventional settings take a certain time to detect and respond to a fault. FC settings reduce fault energy by increasing the speed with which a relay reacts to most fault currents, and can reduce heating, arcing, and sparking for many faults compared to conventional settings. These replacement and updated devices reduce the POI associated with CFO and EFF risk drivers.

2. *Initiative selection:*

For SCE to have the capability to toggle between normal and FC operating settings during high fire threat conditions, it requires CB relays to have the new or updated microprocessor-type relays (see Figure SCE 7-37 below). The alternative, which is to not implement FC settings, would not provide this ignition risk reduction. FC settings for the CB relays provide coverage to the end of the mainline with CLF for branch line coverage (SH-4). Longer circuits may have additional mitigations such as a RAR installed with FC (SH-5) on the mainline of the circuit to provide coverage to end of the mainline circuit and CLFs for branch line coverage (SH-4).

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[118] EFD is also being evaluated if it can provide these types of incipient detection capabilities.

Before 2021, SCE targeted updates to circuits serving HFRA that had CBs with existing microprocessor-based relays. These previous activities concentrated on relay *setting* updates and not relay *hardware* replacements. In both 2021 and 2022, the targeted scope requires new and updated hardware to accommodate the FC settings.

Figure SCE 7-37

Old Electromechanical Relays (left) and Modern Microprocessor Relays (right)

A greater portion of the work performed in 2021 required relay hardware upgrades to accommodate the FC settings integration, which are more costly than setting updates not requiring hardware replacement. Despite this, the RSE for this activity is high, therefore, SCE will continue this activity to reduce the number of faults that could lead to ignitions.

3. *Region prioritization:*

Prioritization for FC setting installations occurs on circuits that traverse HFRA, and then factors in construction and scheduling feasibility. Work began on relays with less complex scope in 2020, then more complex scope requiring extensive engineering or that have operational considerations in 2021, with the remaining relays in scope for 2022-2024.

4. *Progress on initiative (amount spent, regions covered) and plans for next year:*

In 2021, SCE implemented FC settings on 95 relays; 85 of which were in HFRA, exceeding the target of 60 relays. During this year, SCE refreshed the distribution circuit list after an internal QC audit of HFRA circuits found additional circuits in need of FC settings updates. The additional required circuits were added to the 2022 to 2024 scope.

In 2022, SCE plans to replace/update 104 relays and up to 125 relays[119] units in SCE's HFRA, subject to resource constraints and other execution risks.

[119] SCE will also perform 11 relay unit replacements/updates on non-HFRA circuits in 2022.

5. *Future improvements to initiative:*

SCE expects to complete FC settings capability upgrades to identified CBs in HFRA by 2024, including 66 circuits impacting an additional 122 relays in need of FC setting upgrades in 2023 and 2024.

SCE is modifying the settings strategy for future scope to increase the amount of the circuit covered by FC while still providing coordination with downstream devices. As an alternative, SCE will deploy or further utilize existing downstream protection devices (such as SH-4 and SH-5) which may reduce the number of CB relays with FC settings targeted for 2022. The intent is to reduce the incident energy along an increased number of circuit miles, while maintaining customer electric service reliability.

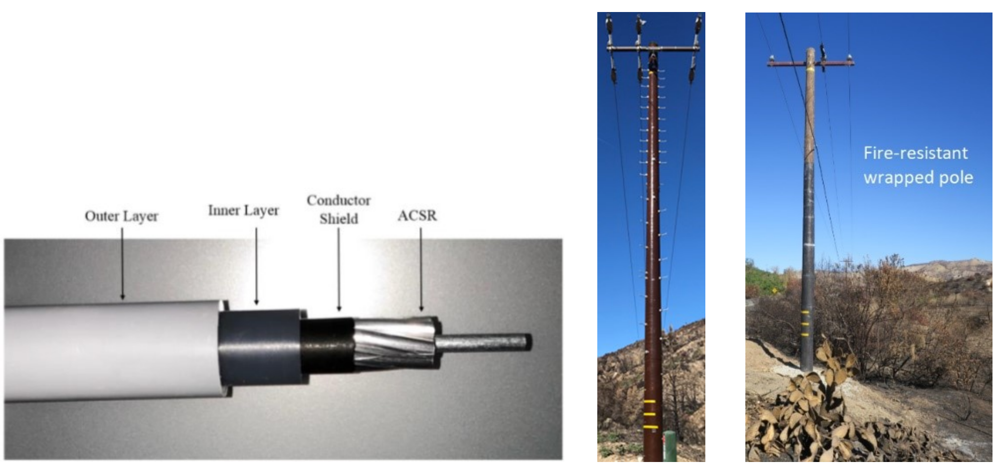
7.3.3.3 Covered Conductor Installation

7.3.3.3.1 Covered *Conductor (SH-1)*

The WCCP in HFRA focuses on replacing bare overhead conductor with covered conductor. SCE performs this work with appropriate urgency and risk-informed prioritization. Poles that require replacement as part of WCCP are replaced with FRPs (see Figure SCE 7-38 below). SCE also installs covered conductor in HFRA during post-fire restoration work (outside of the WCCP) and other non-WCCP programmatic work, e.g., through the OCP where bare wires are replaced with covered conductor as part of SCE's current engineering standards in HFRA. SCE tracks and reports the installation of covered conductor under both WCCP and non-WCCP in this WMP.

Figure SCE 7-38

Cross Section of a Covered Conductor Wire (left)[120] and Fire-Resistant Poles (Composite (middle) and Fire-Resistant Wrap (right))



1. *Risk to be mitigated / problem to be addressed:*

[120] ACSR is the acronym for Aluminum Conductor Steel Reinforced.

Covered conductor refers to a conductor being "covered" with insulating materials to protect against the impacts of incidental contact. This mitigation is effective at reducing the ignition drivers associated with CFO and wire-to-wire faults. In addition to those drivers, fault conditions can weaken and sometimes cause conductor failures, resulting in energized wire-down events. This in turn could result in electrical arcing in the air or on the ground leading to ignitions. In the case of a downed wire, covered conductor reduces the area of exposed base wire thus reducing the likelihood of ignition and serious injury or fatality[121] than contact with bare conductor. Covered conductor can also help reduce PSPS risks by decreasing the likelihood of de-energization due to higher real-time windspeed thresholds for circuits that are covered. Moreover, on circuits that have been fully covered, there is also a significant improvement in reliability in terms of number of faults compared to bare wire circuitry in HFRA.

Installing FRPs, such as composite poles, helps prevent ignitions at the top of the pole as well as further reduces the reliability impact after a fire. For instance, burned and/or fallen poles can cause other equipment on the pole to fail, making service restoration after a fire more difficult. SCE installs composite poles or fire-resistant wrapped wood poles (together known as FRPs) as needed per pole loading requirements to withstand a fire and maintain system resiliency and shorten the service restoration time.

2. *Initiative selection:*

Based on benchmarking and industry research, SCE identified insulated or covered conductor as an effective long-term grid hardening solution[122] to reduce overhead conductor faults associated with CFO or adjacent conductors, thereby reducing the risk of ignitions associated with utility equipment. SCE evaluated the effectiveness of deploying covered conductor in its HFRA based on historical analysis of ignitions, expert judgment, and industry benchmarking analysis. This included conducting lab tests of covered conductor under different types of contact with objects (such as metallic balloons and vegetation) and wire-down fault current. SCE utilized its enterprise-level RAMP risk model to evaluate the scale of deployment of covered conductor and validated this initiative as the most practical option to reduce ignitions in SCE's HFRA, taking into account (among other factors) the expected risk reduction, cost, lead time to deploy, resource availability, and feasibility of efficient and productive long-term maintenance and repair. For instance, covered conductor has significantly lower costs than undergrounding and can be deployed much faster than undergrounding to mitigate wildfire risks. While covered conductor does not fully address all drivers of overhead conductor-related ignition risks, SCE deploys complementary mitigations such as HTMP, pole brushing and asset inspections in conjunction with covered conductor. Please see Appendix 9.3 for more technical details such as design considerations and implementation process relating to the covered conductor work.

Covered conductor has a high RSE[123] and when considered with other favorable decision-making factors, discussed above, and is a prudent mitigation to continue to deploy in 2022 and beyond. For more

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[121] Based on SCE's study with National Electric Energy Testing Research and Applications Center which was discussed extensively in SCE's GSRP filed in September 2018.

[122] SCE expects covered conductor to have a useful life of 45 years based on manufacturer's consensus, historical records, and SCE's similar products.

[123] It is important to recognize that risk analysis and RSEs cannot serve as the only factor used to develop a risk mitigation plan. The RSE metric, while valuable and carefully considered, necessarily cannot take

discussion of the alternatives considered, please see Section 7.1. As part of the mitigation selection process, each mitigation option was compared to other alternative measures, as shown in the Table SCE 7-15 below.

Table SCE 7-15

Alternatives Considered to Covered Conductor

Alternatives	Key Considerations Relative to Covered Conductor
Undergrounding	**Potential Advantages** • Almost completely addresses risk drivers associated with overhead conductor failure • Uniquely beneficial for high consequence areas with risks such as PSPS and egress • Long term grid hardening solution (useful life of ~45 years) • Improved customer experience with the eliminated PSPS • Potential for reduced costs associated with tree trimming and other inspections /maintenance, as well as PSPS and other possible avoided costs **Potential Disadvantages** • Introduces a different set of risks related to underground equipment, e.g., vault explosions, underground cable failure, dig-ins, etc. • Lower RSE compared to covered conductor • Terrain that is not conducive to undergrounding (e.g., rocky terrain, soil erosion issues) • Longer lead times to deploy due to permitting, resource needs, and operational challenges in installation; as a result, it cannot mitigate wildfire risk in HFRA as rapidly as covered conductor

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into account a number of operational factors that are critical in developing the final scope for deployment. These factors include planning and execution lead time, construction methods, permitting issues, work management efficiencies, and compliance requirements.

Alternatives	Key Considerations Relative to Covered Conductor
REFCL	**Potential Advantages** • Rapidly reduces the current if a powerline comes in contact with the ground or a tree limb; i.e., effective at reducing energy phase-to-ground faults • REFCL and covered conductor are complementary in nature (where both are feasible). When deployed in conjunction with covered conductor, which is effective at reducing energy from phase-to-phase faults, can significantly increase the mitigation effectiveness[124] **Potential Disadvantages** • REFCL is complex and there are few utilities to benchmark against (the technology is new to North America), and it will take time to fully evaluate the technology in the field and scale the mitigation • REFCL cannot reduce energy from phase-to-phase faults or multiple phase-to-ground faults, only single phase-to-ground faults
PSPS	**Potential Advantages** • Protects public safety under extreme weather conditions **Potential Disadvantages** • Does not protect against non-wind driven dry-fuel fires • Can be targeted based on near-term forecasts or actual conditions and deployed immediately as a mitigation of last resort • Causes customer hardships and community impacts, requiring ongoing work to reduce the need and mitigate the impacts, and does not represent a sustainable long-term solution • Used only as a measure of last resort • There is no "useful life" for this mitigation; calling a PSPS event does not mitigate or reduce the chances of future PSPS events
Other Alternatives	• Other alternatives include spacer cables, aerial bundled cables, partial covered conductor, insulated sleeves/wraps, bare wire and reconductoring with heavier gauge wire • SCE also evaluated emerging alternative technologies, which are in various stages of assessment and deployment, and generally not yet viable or ready for scalable, system-wide implementation

3. *Region prioritization:*

The underlying POI and consequence score models have undergone several refinements, and SCE continues to incorporate these enhanced risk scores into its deployment strategy to the extent practicable. Given that the general lead time for progressing from scoping to construction takes approximately 16 to 24+ months, the scope to be completed in 2022 necessarily relies on the risk-prioritized scope selection that was performed and released to the execution team in 2020 based on the best available information and modeling at that time. For the purpose of future scope release, SCE's practice is to incorporate the results of its most up-to-date risk model. To the extent that previously less risky miles now present as

[124] REFCL technology can only be applied to 3-wire systems. In some cases, it can be economically applied to 4-wire systems by removing the phase to neutral connected transformers or putting them behind an isolation transformer. In other cases, the costs would actually be higher than the costs of covered conductor.

relatively riskier, they are prioritized for scoping. 50% of SCE's 2022 WCCP scope will target the remaining top 25% riskiest circuit segments. The top 25% riskiest circuit segments relate to the circuit segment risk rankings from SCE's WRRM, as described in Section 4.3. For details on future scope prioritization, please refer to the integrated grid hardening strategy in Section 7.1.2.1.

While SCE's POI and consequence models are a critical component in dictating which miles of distribution HFRA to address first, there are other operational factors to consider when deploying covered conductor. These include extending the construction to the next structure with appropriate guying, or to a natural dead-end structure that the covered conductor can transition to bare wire, or to a structure with an isolatable sectionalizing device that can provide PSPS mitigation benefits. With specific regard to PSPS mitigation benefits, in 2022 the covered conductor scope will include miles performed under PSPS considerations. SCE will continue with the remaining covered conductor scope from the FICs list as described in the PSPS Action Plan and implement the covered conductor scope as outlined in SH-7 in order to reduce the likelihood of PSPS by enabling the ability to increase windspeed thresholds for PSPS de-energization.

***4.** Progress on initiative (amount spent, regions covered) and plans for next year:*

In 2021, SCE completed covered conductor installation on approximately 1,500[125] circuit miles, exceeding the WMP program target of 1,000 circuit miles. SCE also replaced approximately 12,000 wood poles with FRPs in HFRA in the same year. The regions covered were based on the prioritization approach described above. SCE has seen in-field success from covered conductor. For example, when a vehicle hit a pole with an energized covered conductor and the pole made contact with vegetation, no fault or ignition occurred (see Figure SCE 7-39).

Figure SCE 7-39

Car-Hit-Pole with Covered Conductor – No Fault Occurred - Ojai, California – July 24, 2020

[125] Approximately 1,400 circuit miles were completed under WCCP and the remainder were completed under traditional maintenance programs such as SCE's OCP.

With the increasing wildfire risks in California due to drier and hotter weather conditions caused by climate change and the expected risk reduction benefits of covered conductors, SCE is continuing the current pace of this program to the extent feasible within operational and resource constraints. In 2022, SCE's goal is to install 1,100 circuit miles of covered conductor in HFRA driven by risk needs and prioritization, operational needs, regulatory requirements, and guidance. The deployment location prioritization will follow the approach described above. SCE will strive to install 1,250 circuit miles, subject to resource constraints and other execution factors. When identified for replacement in WCCP or otherwise (such as in post-fire restoration work), SCE will continue to install FRPs in HFRA.

As part of an ongoing improvement effort, SCE hired an independent third-party test lab to perform testing of covered conductor effectiveness in 2022.[126] The testing results will be compared with results from SCE's internal testing of covered conductor and in collaboration with the other California utilities. The independent third-party will also be testing additional scenarios not previously tested by SCE.

5. *Future improvements to initiative:*

SCE expects to install approximately 3,800 circuit miles total within the next three years (2022-2024). As described in its response to the 2021 WMP Progress Report Item SCE-21-06 in Section 7.1.2.1, at the end of 2021, SCE underwent a comprehensive and granular risk analysis to better understand wildfire mitigation deployment going forward, including covered conductor. The analysis considered the potential consequence of an ignition at each circuit-segment within SCE's HFRA. SCE determined which initiatives and combinations of initiatives are potential viable mitigations for a segment, based on factors such as risk drivers, mitigation effectiveness and cost, and potential consequences. The analysis also considered circuits that have been frequently impacted by PSPS events and prioritized the work to help reduce the need for PSPS. SCE's new integrated grid hardening strategy may impact the expected scope of 3,800 circuit miles for the 2022-2024 period.

Response to SCE ***Action Statement SCE-21-05, 2021 WMP Key Areas For Improvement***

The following is one of the Key Areas for Improvement as provided by OEIS in the Final Action Statement on SCE's 2021 WMP

> *"**Issue**: SCE provides a risk buydown curve based on its old modeling efforts to justify the need for covered conductor. SCE acknowledges that its current models provide different and more accurate results but does not provide an updated risk buydown curve. SCE should not use outdated information to justify its covered conductor program scope. Additionally, if an updated risk buydown curve shows historic catastrophic ignitions on the low end of the curve, it raises doubts regarding the accuracy of SCE's wildfire risk models.*
> ***Remedy**: SCE must:*
> *1. Provide an updated Figure 9.01-1 based on SCE's latest risk modeling assessment, including the ignitions shown.*
> *2. Provide the cause of the nine ignitions shown in Figure 9.01-1.*

[126] Please also see Appendix 9.8 and the Joint IOUs report on covered conductor effectiveness that further describes the testing SCE, PG&E, and SDG&E are collaborating on.

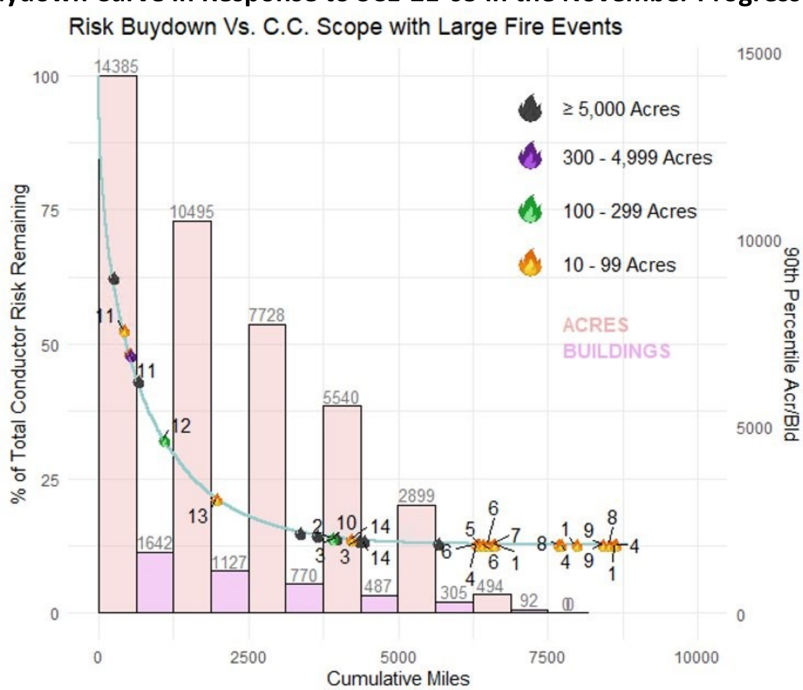
3. For each of the nine ignitions shown, provide an assessment of the likelihood that covered conductor installation would have prevented the ignition.
4. Provide a similar risk buydown curve for all cumulative circuit miles, including historic ignitions and ignition size.
5. If the updated risk buydown curves provided in response to the above continue to show historic catastrophic ignitions on the low end of the risk buy down curve, then provide the calculated accuracy of SCE's current risk model."

SCE's response to this Issue/Remedy is described below:

SCE addressed the remedies within the response to SCE-21-05 in the Progress Report submitted November 1, 2021[127]. The risk buydown curve shared in the Progress Report was based on analysis of the current version of SCE's WRRM, which was also used for this WMP. Also, there have been no additional CPUC-reportable fires greater than ten acres within SCE's HFRA. Thus, the curve remains the same and SCE again presents it here for convenience (see Figure SCE 7-40). Nonetheless, SCE is continuing to refine and enhance its wildfire risk modeling to help provide more granular risk-informed decision-making informing mitigation selection and scope as discussed in Section 7.1.

Figure SCE 7-40

Risk Buydown Curve in Response to SCE-21-05 in the November Progress Report



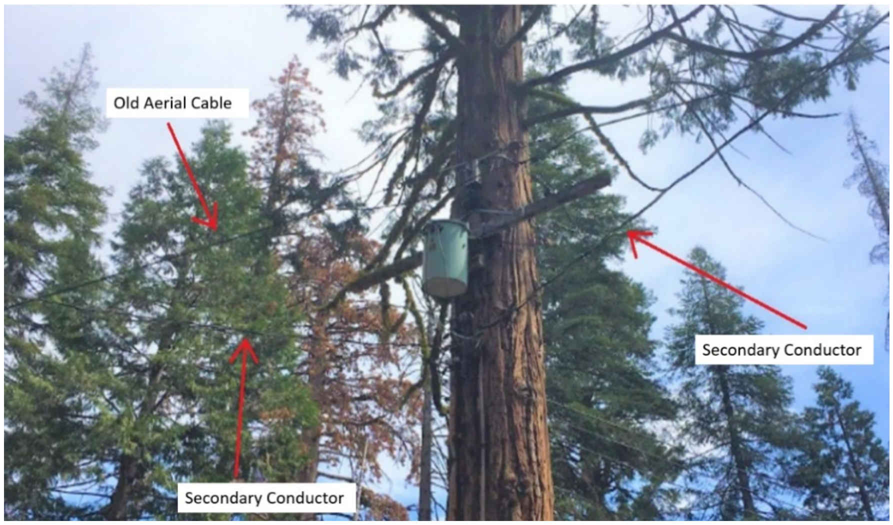
[127] SCE 2021 WMP Update Progress Report, pp.13-18.

7.3.3.3.2 Tree Attachment Remediation (SH-10)

Tree attachment remediation refers to the installation of new poles in order to eliminate instances where existing electrical equipment, including overhead conductor, are attached to trees (see Figure SCE 7-41 below).

Figure SCE 7-41

Electrical Equipment Attached to a Live Tree (Tree Attachment)



1. *Risk to be mitigated / problem to be addressed:*

Older construction methods used in SCE's forested service area leveraged existing trees to support overhead conductors instead of installing utility poles. These "tree attachments" do not meet SCE's current design standards. The integrity of the trees cannot be verified using inspections and assessment techniques for poles. In addition, tree attachments increase the probability of faults and damages from vegetation contact and "fall-ins". To address risk until tree attachments are no longer used, vegetation management contractors (pre-inspectors and trimmers) perform a visual inspection for the structural integrity of the tree. Removing the electrical equipment and installing them on a new pole reduces ignition driver risks.

2. *Initiative selection:*

This activity relocates tree attachments from the tree to a pole to reduce the probability of faults and consequence of a spark close to vegetation, i.e., to address the CFO and EFF risk drivers. Note that most tree attachment work is completed with aerial cable as that is the design standard for areas with dense vegetation. Aerial cable is a fully insulated conductor, equivalent to underground cable, and can withstand permanent phase-to-phase and phase-to-ground contact. Conversely, covered conductor can withstand contact from objects temporarily (a few months).[128] If the existing tree attachment has aerial cable in good condition, SCE will relocate the aerial cable to a pole instead of installing covered conductor.

An alternative to relocating tree attachments to a utility pole is to underground the overhead equipment, however, the terrains where these tree attachments exist most likely make undergrounding infeasible or very costly. Additionally, if the tree and equipment are in good condition, an alternative to this activity is to leave the utility attachments on the tree and reinforce the tree attachment (i.e., properly secure the equipment to the tree). However, the integrity of the trees cannot be verified using inspections and assessment techniques for poles, SCE intends to continue to replace all tree attachments in HFRA.

The RSE score for tree attachment remediation is the second highest compared to other mitigations. Leaving overhead conductors attached to trees, especially in HFRA, is inherently risky and it is imperative to expeditiously transfer overhead conductors to poles.

3. *Region prioritization:*

In 2022, SCE continues to prioritize the tree attachment remediations in HFRA Tier 2 and Tier 3, specifically most locations in the San Joaquin and Rural regions. The 2022 scope was determined using the highest Reax risk scores calculated at each structure. During those planning processes, tree attachment remediation scope occasionally overlaps other grid hardening scope. For example, Segment A is a tree attachment needing remediation and is also identified by our risk models for covered conductor installation. This means that Segment A exists in both tree attachment scope and WCCP scope. Engineering would prioritize and choose the program that best executes risk reduction. That is, both programs have scoping rounds where segments that meet the risk criteria are further evaluated before the total scope is finalized. Segment A will most likely be executed by whichever program had the scoping round first, which will most likely ensure that Segment A is hardened as early as possible.

4. *Progress on initiative (amount spent, regions covered) and plans for next year:*

In 2021, SCE remediated approximately 540 tree attachments exceeding the 2021 WMP target of 500 remediations. In the process of remediating tree attachments, SCE learned that scoping can be impacted by external factors. For example, a wildfire in 2020 (not caused by tree attachments) destroyed some tree attachments that were planned for remediation in 2021. Additionally, SCE learned that field scoping of the project needs to account for erroneous data. For instance, some tree attachments exist on a map or in the database but not in the field and vice versa. SCE reviewed and corrected the database to identify and remediate most of the data issues to ensure an accurate list of scope. SCE also found that the recorded unit cost for tree attachment remediation is lower than initially forecasted.

In 2022, subject to resource availability and continuing evaluation of remaining risk, SCE expects to remediate approximately another 500 tree attachments and will strive to complete up to 700 tree attachments in SCE’s HFRA, subject to resource constraints and other execution risks.

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[128] Wareing, J.B., “Covered Conductor Systems for Distribution.” EA Technology, December 2005.

5. *Future improvements to initiative:*

Due to limited regional resource constraints, there have been challenges remediating the high volume of work planned in the regions this program is targeting. Thus, SCE is continuing to evaluate the remaining work. If the pace remains the same, the program will likely complete in 2025.

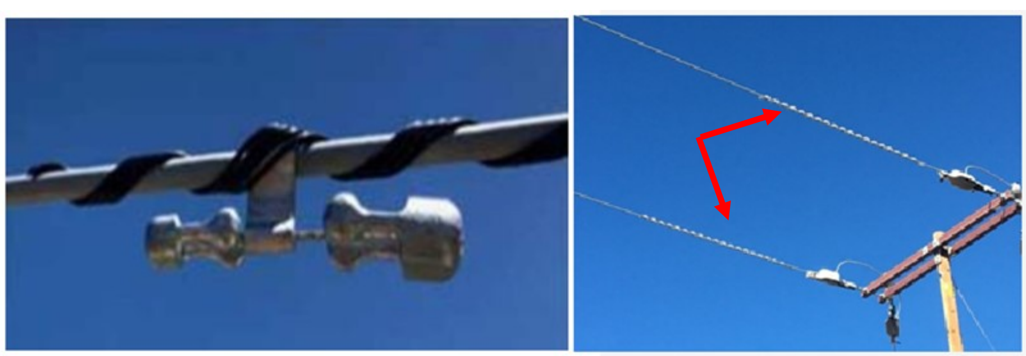
7.3.3.3.3 Vibration Damper Retrofit (SH-16)

1. *Risk to be mitigated / problem to be addressed:*

Vibration dampers can stop wind-driven vibration (known as Aeolian vibration) that may lead to conductor abrasion or fatigue over time (see Figure SCE 7-42 below). This is an issue for both bare and covered conductor. However, covered conductor may be more susceptible to vibration because of the covering's smoothness (perfect cylinder) and the reduction of strand movement due to the covering. If this vibration is not mitigated, the long-term damage may reduce the covered conductor's useful life. Particularly, in high and medium vibration susceptibility areas, vibration can reduce the covered conductor's useful life from 45 years to an average of 20 years if not addressed. Installing dampers minimizes equipment failure ignition drivers, such as damage or failure of the conductor, connector, and/or splice.

Figure SCE 7-42

Types of Vibration Dampers: Stockbridge Damper (left) and Spiral Damper (right)



2. *Initiative Selection*

A study was conducted to determine the susceptibility of the 2018 to 2020 covered conductor installations to Aeolian vibration. Installations were categorized into high susceptibility, medium susceptibility, or low susceptibility. Risk analysis indicated that targeting high and medium susceptibility areas will provide the best value. High susceptibility areas are near large bodies of water or with flat and open terrain. Medium susceptibility areas are flat, open terrain or residential suburbs with some obstacles (trees, buildings, etc.). Depending on the terrain, the conductors may be exposed to a certain threshold of smooth and low speed winds which could induce Aeolian vibration on the covered conductor. For areas with more obstacles, this threshold is higher. Vibration damper retrofits were selected to address the risks associated with Aeolian vibration. Through the susceptibility analysis we determined the scope for this initiative. This scope and the corresponding useful life were subsequently processed through the WRRM to understand the risk buydown. The RSE score for vibration damper retrofit is medium compared to other mitigations. SCE pursues this mitigation as it maintains the useful life of covered conductor to ensure the full risk buydown expected by covered conductor is realized.

An alternative is to lower the tensions for covered conductor installed in high and medium susceptibility areas by re-sagging, or in some cases, re-conductoring the targeted spans with covered conductor again, which would decrease the likelihood of Aeolian vibration. However, the costs will be much higher for this alternative than the proposed initiative of retrofitting the vibration dampers.

3. Region prioritization:

This work is prioritized based on the wind susceptibility study mentioned above. The work is spread out across SCE's HFRA, with the majority work focused in the North Coast and North Valley regions where susceptibility to Aeolian vibration is high.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

In 2021, SCE published vibration damper design and construction standards for covered conductor application based on an assessment[129] SCE performed in 2020, which concluded that vibration dampers mitigate the risk of premature failure of covered conductors due to vibration.

In 2022, SCE will retrofit vibration dampers on 100 structures and strive to complete up to 115 structures where covered conductor is already installed in SCE's HFRA.

5. Future improvements to initiative:

2022 will be the first year that SCE begins to retrofit existing covered conductor installations. Any lessons learned from the 2022 vibration damper retrofit will be used to make improvements for future years. SCE expects to retrofit approximately 2,700 structures in total by 2026 (400, 600, 830, and 830 structures for the years 2023, 2024, 2025, and 2026, respectively).

7.3.3.4 *Covered Conductor Maintenance (includes Response to SCE Action Statement SCE-21-12, 2021 WMP Key Areas for Improvement)*

The following is one of the Key Areas for Improvement as provided by OEIS in the Final Action Statement on SCE's 2021 WMP:

> *"**Issue:** SCE does not have a separate covered conductor maintenance program. On-going covered conductor inspection and maintenance is included in HFRI inspections and remediations and follow the same approach, schedule, and prioritization. Given SCE's plan for rapid deployment of covered conductor, it is particularly important that SCE has a comprehensive and effective plan for maintaining its covered conductor once installed. Additionally, SCE did not initially include*

[129] This effort was described as SCE's 2020 WMP as Activity AT-4.

vibration dampeners in its covered conductor installations, and states that it is now retrofitting existing covered conductor with vibration dampeners."

Remedy: "SCE must: Provide all supporting material to demonstrate that its maintenance programs effectively maintain its covered conductor, including the following information:

- Pace and quantity of scheduled maintenance;
- Pace and quantity of inspections; and
- Pace and quantity of vibration dampener installations.

If SCE finds that its existing maintenance programs do not provide effective maintenance for covered conductor, SCE shall:

1. Enhance its current operations to provide such maintenance;
2. Detail the enhancements to its existing programs;
3. Provide all supporting material for the enhancements to its existing program, including the information listed above."

SCE's response to this Issue/Remedy is described below:

1. Risk to be mitigated / problem to be addressed:

With the significant amount of covered conductor being installed across SCE's service territory, SCE needs to ensure it is maintaining the covered conductor once installed and identifying and remediating any issues from previous installments and improve the effectiveness of future installments. This activity reduces ignition risk drivers, particularly conductor failure.

2. Initiative selection:

SCE does not have a separate covered conductor maintenance program. As part of new construction, QA/QC is performed to make sure that work standards are adhered to for the installation of covered conductor. This is similar to SCE's practice for bare wire, where SCE inspects the installation to ensure the work is up to SCE standards and replaces or repairs improperly installed equipment.

Additionally, the HFRI inspections and remediation program (IN-1.1 and IN-1.2) include covered conductor in its inspection criteria. Hence, there is no separate RSE score for covered conductor maintenance.

3. Region prioritization:

Ongoing covered conductor inspection and maintenance is included in HFRI inspections and Remediations (IN-1.1 and IN-1.2) and follows the same approach, schedule, and prioritization. As covered conductor installation is relatively new for SCE, SCE continues to analyze installation practices to identify any additional inspection and maintenance required.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

As mentioned in Progress Report for Key Issue SCE-21-12[130], in late 2019, SCE engineers engaged in a focused effort to observe covered conductor installations completed in 2018 and 2019 to help ensure adherence to the then-new construction standards. Lessons learned from that effort have helped inform the current inspection survey that ESIs use during inspections. The survey includes six questions specifically inquiring about covered conductor. SCE and contract crews have remediated instances of standards non-conformance observed in 2018 to 2019 installations and are in the process of remediating the remaining findings. The bulk of issues found were lack of wildlife covers at dead-ends, connectors, fuses, and other equipment.

Additional information on the pace and quantity of SCE's HFRI program including scheduled maintenance and inspections to effectively maintain its covered conductor installations can be found in Section 7.3.4.9.1.

Additional information on the pace and quantity of vibration damper installation can be found in Section 7.3.3.3.3 (SH-16).

5. Future improvements to initiative:

Like the previous engineering review of 2018 and 2019 covered conductor installations, in 2022 SCE is planning a focused effort to review additional 2018 and 2019 installations to ensure adherence to SCE's construction standards. The focus will be covered conductors at 1,200 locations in higher elevations (greater than 3,000 ft) which are more likely to have excessive crossarm angle limits and over tensioned spans which may result in downed wires.

7.3.3.5 Crossarm Maintenance, Repair, and Replacement

A crossarm is a horizontal mount attached near the top of a pole to support the mechanical load of the conductors, insulators, and related hardware.

1. Risk to be mitigated / problem to be addressed:

Wood crossarms are subject to deterioration due to age, weather and animal-caused damage which can lead to crossarm failure potentially resulting in outages, wires-down or an ignition. Figure SCE 7-43 below shows a picture of a broken wood crossarm and composite crossarm. Crossarm remediation can help mitigate ignition drivers and minimize the reliability consequences.

[130] SCE 2021 WMP Update Progress Report, pp. 42-44.

Figure SCE 7-43

Broken Wood Crossarm (left) and Composite Crossarm (right)

2. Initiative selection:

SCE inspects its crossarms during the course of both HFRI and compliance-driven inspections. If a wood crossarm needs to be replaced due to damage or concurrent covered conductor installation, SCE's current standard is to replace it with a composite crossarm since wood crossarms can twist, shrink, and warp, which may lead to performance issues for the associated equipment. Composite crossarms provide high impedance path reducing tracking that helps eliminate pole top ignitions. Composite crossarms are also inherently fire resistant and will not ignite in the event of equipment failure or conductor contact. These composite crossarms will reduce the POI associated with EFF risk driver. There is no separate RSE score for crossarm maintenance since it is not a specific wildfire mitigation and is a part of SCE's standard maintenance and remediation practices.

3. Region prioritization:

As mentioned above, crossarm inspections, repairs, and replacements are part of HFRI inspections and remediations (IN-1.1 and IN-1.2) in HFRA. In non-HFRA locations, crossarm inspection, repairs, and replacements are primarily conducted as part of compliance-driven detailed inspections and corresponding maintenance. Wooden crossarm replacements are also a part of new installations, including WCCP. Crossarm inspections, repairs, and replacements follow the same prioritization approaches as these other activities.

Due to the COVID-19 pandemic and recent hurricane in other parts of the country, there was a material supply shortage of composite crossarms and its components. Additionally, there was a delay in the delivery of the material due to a decrease in manpower required to fabricate and assemble components of composite crossarms. As of November 2021, composite crossarms on-hand and those being delivered were reserved for use in HFRA Tiers 2 and 3. For competing projects within HFRA, priority was given to Tier 3 over Tier 2.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

SCE does not have a separate crossarm maintenance program. SCE will continue crossarm replacement work as a part of HFRI inspections and remediations (IN-1.1 and IN-1.2) and WCCP in HFRA, and compliance-driven inspections in non-HFRA.

5. Future improvements to initiative:

SCE will evaluate if adjustments in scope and methods are necessary for this initiative over the next three to ten years.

7.3.3.6 Distribution Pole Replacement and Reinforcement, Including with Composite Poles

WCCP Fire Resistant Poles

In SCE's 2021 WMP Update, the WCCP FRP activity[131] was merged with the Covered Conductor program (SH-1), as covered conductor scope determines when new FRP installations are required. In this 2022 WMP Update, SCE continues with this structure, however, SCE calculates a separate RSE for FRPs which results in a relatively high score compared to other mitigations.

SCE has two major pole replacement programs, Deteriorated (Det) Pole Program and Pole Loading Program (PLP)[132], to improve the safety and reliability of the electric grid.[133] As part of the Det Pole Program, SCE intrusively inspects poles through the Intrusive Pole Inspection (IPI) Program. An intrusive inspection involves drilling into the pole's interior to identify and measure the extent of internal decay that is typically undetectable with external observation alone. Additionally, through PLP, SCE assesses poles to identify and repair or replace poles that do not meet GO 95 loading, temperature and safety factor requirements or, in areas with known local conditions such as high winds, SCE's loading, temperature and safety factor requirements.

Poles are also replaced as part of SCE's HFRI inspections and maintenance programs. In addition, poles may be identified for replacement during miscellaneous activities if they do not meet pole loading criteria when new equipment is added or if visual damage is identified by field personnel. All these programs span SCE's entire service area, except for HFRI inspections and maintenance which are only in SCE's HFRA. In HFRA, degraded poles will be replaced with FRPs using the same strategy as the WCCP described above. The details of each of the programs above are described in Section 7.3.4. SCE does not consider pole replacements to be a WMP initiative but will continue to replace poles as part of its system hardening and asset management activities. FRPs are installed in HFRAs as part of WCCP and non-WCCP activities (such as post-fire restoration work).

7.3.3.7 Expulsion Fuse Replacement- Branch Line Protection Strategy (SH-4)

Fuses are safety devices consisting of a filament that melts and breaks an electric circuit if the current exceeds the fuses rating. CLFs for branch line protection are now the standard for SCE's system, and as part of the branch line protection strategy, SCE has been replacing conventional fuses since program inception in 2018 (see Figure SCE 7-44 below). SCE initially focused efforts for installing fuses at branch lines where fusing did not exist, followed by fusing replacements with a focus on CLF technology to reduce fault energy.

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[131] Fire Resistant Poles were SH-3 in SCE's 2020 WMP.

[132] SCE's Pole Loading Program was completed in 2021. Some resulting remediations will take place up to 2024.

[133] Both programs are described in Section 7.3.4.

Figure SCE 7-44

An Example of a Current Limiting Fuse and Fuse Holder

1. *Risk to be mitigated / problem to be addressed:*

Arcing and currents associated with faults may produce incandescent particles or create equipment failures which can lead to ignitions. Reducing fault energy can lessen the amount and size of incandescent particles to reduce ignition risk. Additionally, reduced fault energy can also help minimize some equipment failures, such as splices and conductors which can lead to down wires and the potential for ignitions.

2. *Initiative selection:*

SCE's prior fusing mitigation efforts have focused on application of new branch line fuses where fusing did not previously exist and targeted fuse replacements. SCE's efforts to replace existing branch line fuses helps reduce fault energy, to bring the fuses up to the CAL FIRE "Exempt" classification, and/or replace fuse types identified with operational issues. Existing fuses are typically replaced by CLFs, although larger branch circuits may use other CAL FIRE "Exempt" fuse designs. Branch line protection strategy will reduce the POI associated with CFO and EFF risk drivers. The WRRM is then used to quantify the risk reduction associated with this mitigation.

As an alternative to branch line fusing, SCE considered broad application of single phase reclosers for branch line protection and concluded the infrastructure upgrades required are not as cost effective as fusing. Given the relatively high RSE, SCE continues to deploy fusing upgrades to limit ignition risks, improve protection coordination with CB relay FC operational settings, and improve customer electric service reliability.

3. *Region prioritization:*

Prioritization for fuse replacements considers fuses at risk of failure and geographic bundling. Geographically close locations allow SCE to bundle work and improve application efficiencies. When combining risk and geographic location, SCE aggregates the fuses at the circuit level for scope selection.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

In 2021, SCE installed or replaced fusing at 352 fuse locations, exceeding the goal of 330 locations. Before 2021, SCE conducted the work with dedicated crews in targeted areas, which enabled work to be performed at a higher number of locations. The smaller scope in 2021, compared to 2020, allowed the work to be distributed across HFRAs instead of being focused on targeted areas.

In 2022, SCE plans to install or replace fusing at 350 fuse locations, and up to 483 locations subject to resource constraints and other execution risks. New installations are expected to be a small percentage of work performed and will be targeted where only portions of the circuit extend into the HFRA. The replacement scope will be based on a targeted subset of fuses that present operational issues. SCE may bundle work to improve work management efficiencies.

5. Future improvements to initiative:

In-service fuse performance, CAL FIRE Exemption status, and new product development may influence directional changes for the branch circuit protection initiative. New product development continues in the industry around branch line circuit protection. However, most advancements are focused on circuit reliability through the use of reclosing devices rather than wildfire risk reduction.

7.3.3.8 Grid Topology Improvements to Mitigate or Reduce PSPS Events

7.3.3.8.1 Circuit Evaluation for PSPS Driven Grid Hardening Work (SH-7)

1. Risk to be mitigated / problem to be addressed:

PSPS de-energizations are disruptive and can have an impact on customers and communities. While PSPS may be utilized as a measure of last resort, reducing the frequency, scope, and duration of PSPS events is very important to us. This activity entails *evaluating* circuits highly impacted by PSPS to develop targeted plans for grid hardening and circuit modifications to reduce PSPS impact.

2. Initiative selection:

Targeted efforts such as covered conductor deployment, undergrounding circuit segments, and adding switching devices to facilitate circuit reconfigurations can help reduce or eliminate the need for PSPS or reduce the number of customers impacted by PSPS. For example, these efforts will reduce the impact of PSPS on customers located in non-HFRA that are connected to circuits that traverse HFRA, and customers located on certain underground circuit segments within HFRA that are fed from overhead circuitry within HFRA. Targeted covered conductor deployment can potentially help increase windspeed thresholds for PSPS de-energization in some circumstances. Developing these tailored solutions requires circuit-specific analysis. The results of these analyses are used to develop work scope to be completed for other relevant wildfire mitigation activities (e.g., covered conductor deployment (SH-1), RARs settings updates (SH-5) or deployment of additional weather stations (SA-1) to pair with sectionalizing devices).

Risk analysis is not applicable for this activity (hence, no RSE score) as the circuit evaluation by itself does not reduce ignition or PSPS risks; rather, it is used to define scope for other grid hardening activities (e.g., covered conductor, RARs, RCS, etc.). The risk reduction and costs for the work undertaken stemming from the circuit evaluation are included in the risk analyses of the corresponding activities, as appropriate.

3. *Region prioritization:*

In 2021, SCE targeted circuits that experienced a PSPS de-energization in 2019 and 2020, prioritizing the most impacted circuits. A subset of the most impacted circuits was categorized as FICs and was evaluated under the 2021 SCE Corrective Action Plan. The remaining most impacted circuits were evaluated under SH-7. SCE applied the methodology developed previously to calculate a PSPS POD score for each circuit utilizing five years of backcast weather data. SCE ranked the circuits according to their predicted POD score and PSPS de-energization history. Of the identified work that could help reduce PSPS frequency and scope, SCE further prioritized the execution of the grid hardening scope to consider AFN/NRCI. In 2022, SCE is targeting all circuits that experienced a PSPS de-energization in 2021.

4. *Progress on initiative (amount spent, regions covered) and plans for next year:*

In 2021, SCE completed evaluation of 140 HFRA circuits comprised of 72 FICs, an additional 62 circuits previously impacted by PSPS in 2019 to 2020,[135] and an additional six circuits with no previous PSPS outages but identified as having a POD of one event every two years. The analysis from 2021 resulted in SCE identifying the appropriate system hardening activities to implement such as SH-1 (Covered Conductor) and SH-5 (RARs Settings Update) for each circuit.

In 2022, SCE will evaluate approximately 70 highly impacted circuits based on previous PSPS events including those in 2021to determine additional deployment of PSPS mitigations.

5. *Future improvements to initiative:*

On an annual basis, SCE will reevaluate the prioritization method for this evaluation based on expected PSPS probability and consequence considering more vulnerable customers, such as those on MBL. Results of the evaluation will help inform the integrated grid hardening strategy described in 7.1.2.1.

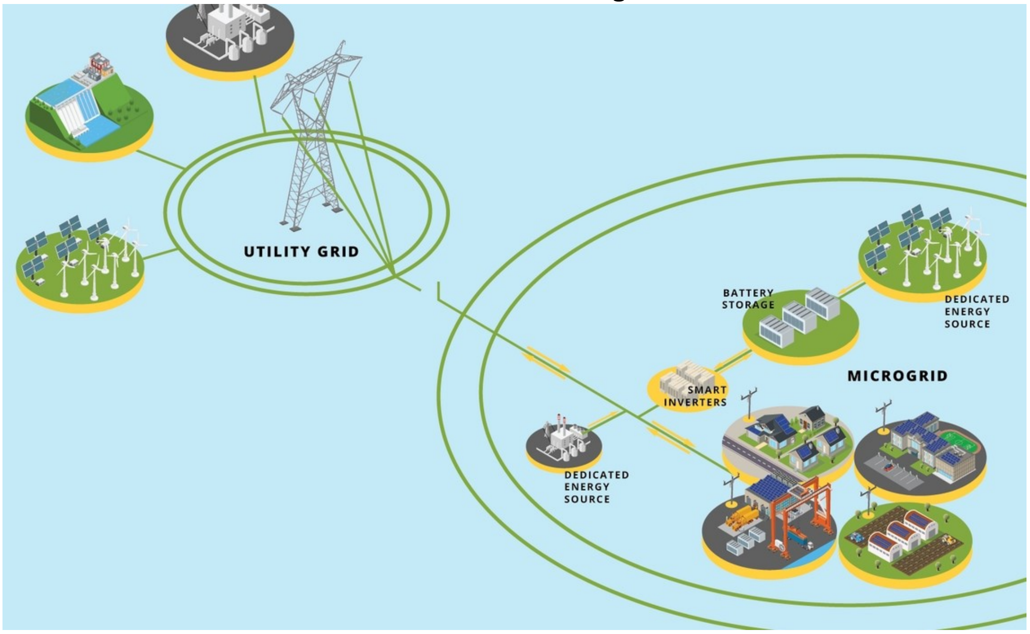
7.3.3.8.2 Microgrid Assessment (SH-12)

The first track of CPUC's Microgrids and Resiliency Strategies Order Instituting Rulemaking OIR (R.19-09-009)[E15] sought to facilitate resiliency planning using microgrids in areas prone to outage events and wildfires. SCE is planning to install a microgrid, as depicted below in Figure SCE 7-45, to reduce the consequence of PSPS in a location heavily impacted by PSPS.

[135] *Id*.

Figure SCE 7-45

Illustration of Microgrid



1. *Risk to be mitigated / problem to be addressed:*

De-energizations during PSPS events, though necessary to reduce wildfire risks during extreme weather conditions, have adverse impacts on customers, especially when critical facilities or critical care customers are impacted. Having a microgrid maintains system reliability and minimize customer impact during de-energization events.

2. *Initiative selection:*

Microgrids that can island from the grid during de-energization events can provide backup power and increase community resilience. Legislators, regulators, industry stakeholders, and communities are increasingly interested in the potential of this technology, and SCE continues to assess the viability of microgrids in mitigating PSPS impacts. SCE evaluated options for cost effective and clean microgrids for PSPS resilience, including detailed analysis considering local system configurations, costs, air quality requirements, policy objectives, and regulatory requirements.

There are other alternatives to reduce PSPS frequency and scope, but a microgrid solution may be more appropriate in certain circumstances. The learnings from this microgrid project will help determine effectiveness of rolling out microgrids on a broader scale, and how that would compare against other mitigation alternatives that help reduce PSPS frequency (e.g., covered conductor and undergrounding) or PSPS consequence (e.g., battery backup programs and temporary generation solutions).

SCE did not perform risk analysis on this initiative (hence, there is no RSE score) since it is a pilot and a microgrid is not expected to be deployed until at least 2023. If microgrids are deemed successful and move beyond the initial stages of development, SCE expects to have an RSE in a future WMP.

3. *Region prioritization:*

Locations in HFRA Tier 2 or Tier 3 with a high frequency of outages due to PSPS were identified as potential sites for the microgrid. From this list, a cost benefit analysis was performed to select locations that would receive the most benefit from a microgrid. The final circuit selected is in HFRA Tier 3 and serves 189 residential customers, 26 low-income customers, and 16 non-residential customers. SCE is exploring using a microgrid to establish a CRC at one of the non-residential customer locations. SCE identified two community groups / landowners with sufficient available land to accommodate the equipment needed to create a microgrid site on the selected circuit.

4. *Progress on initiative (amount spent, regions covered) and plans for next year:*

In 2020, SCE explored alternative microgrid sites that could be safely and economically islanded and issued a second Request for Proposal (RFP) for a single site. The second RFP resulted in multiple responses, and SCE narrowed down the responses to select a potential partner.

In 2021, SCE finalized the decision to proceed and successfully negotiated a contract with the microgrid equipment vendor. SCE is currently attempting to acquire the land needed for the microgrid pilot and to come to terms with the landowners. Since negotiations are ongoing with the potential partner, SCE did not complete the design package in 2021, as discussed in the 2021 WMP Update.

SCE has learned much from the contract negotiation process in 2021, including the need to allocate more time and perform more community outreach in order to educate the community groups on the potential benefits of the microgrids project. The community groups should also be allowed more time to discuss internally and reach a decision related to developing a microgrid on the owner's property. Also, in order to better support progress towards the goal of having a microgrid site in SCE's territory, SCE should negotiate with multiple landowners in parallel, to diversify options and be able to reach an agreement quicker with one of the selected landowners.

In 2022, SCE will actively attempt to obtain approval of easement with the landowner of the microgrid site, and if approval is received, SCE will move forward with microgrid project. If an approval is not received by June 30, 2022 or rejected, SCE will start to pursue other microgrid opportunities.

5. *Future improvements to initiative:*

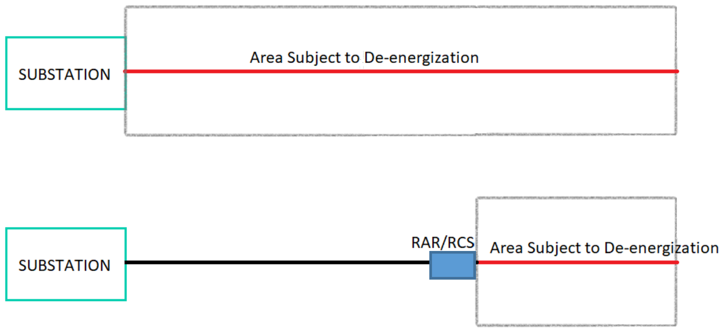
In 2023 and 2024, SCE aims for the substantial completion of a microgrid site and to gain improved understanding of the value of microgrids for mitigating PSPS impacts. SCE is developing the implementation plan for the multi-customer microgrid site, and by doing so, SCE is advancing the work required by Microgrid OIR Track 4.

7.3.3.9 Installation of System Automation Equipment - Remote Controlled Automatic Reclosers Settings Update (SH-5)

A recloser is an automatic switch that shuts off electric power when issues occur, such as a short circuit. RARs are reclosers which have been modified to be remotely operated by means of a radio. RARs operate in a similar fashion to a substation CB but are located on distribution lines. Similar to RARs, RCSs are another type of sectionalization device that helps SCE limit PSPS de-energization to fewer and smaller circuit segments. SCE has traditionally installed automation equipment to improve reliability and provide operational flexibility and has expanded its distribution automation activities as part of wildfire and PSPS mitigation strategy (see Figure SCE 7-46).

Figure SCE 7-46

RARs/RCSs Are Used to Sectionalize or Divide the Circuit to Limit De-energization to Smaller Segments



1. *Risk to be mitigated / problem to be addressed:*

Distribution circuits span many miles and cross multiple risk consequence zones, contain assets at various levels of resiliency, and are subject to varying weather conditions based on specific asset locations. During PSPS events, portions of circuits or circuit segments that do not pose ignition risks also have to be de-energized along with portions that present ignition risks as there is no available means of isolating these segments from each other. Having manual switches also increases the time and resources needed for de-energization, testing, and re-energization. The remote-control capabilities associated with RARs are necessary to enable SCE to quickly respond to emergent fire danger conditions to reduce ignition driver risks and minimize the effects of PSPS events.

2. *Initiative selection:*

Installing automated fault detection and sectionalizing equipment is a time-tested approach that SCE and other utilities have successfully implemented. SCE installed additional RARs on circuits across its HFRA. In some instances, SCE installed RCSs instead of RARs when they were deemed to be more cost-effective solution in those locations. RCSs are a less robust sectionalizing device since they are not rated to interrupt fault current like RARs but are capable of dropping load current. Adding these automated sectionalization devices helps SCE limit PSPS de-energization to fewer and smaller circuit segments. In addition to minimizing the effects of PSPS events, RARs also minimize outage impacts to customers by isolating or restoring power quickly to circuit segments not impacted by weather conditions. Additionally, RARs reduce ignition risks allowing reduced fault energy and increased fault sensitivity by way of the operational settings, which includes the capability of toggling to FC operating settings during adverse weather conditions. When High Fire Weather Threat is declared, system operators may enable FC settings on the RARs in HFRA.

In some cases, FC settings at the CB may not be feasible due to construction limitations (a pole top substation has a limited footprint and cannot accommodate a standard size CB and relay and would require an RAR instead) or ownership agreements (a third-party owns the substation and SCE owns the circuit so SCE can only do work on SCE's property). SCE will install RARs with FC settings on these circuits. Therefore, part of the scope is dependent on SH-6. The remaining scope is driven by Circuit Evaluation for PSPS Driven Grid Hardening Work (SH-7).

The relatively high RSE score for RARs bolsters SCE's pursuit of this initiative. Although the RCSs' RSE is relatively low, SCE still actively pursues this initiative due to its benefits to customers.

3. *Region prioritization:*

SH-5 prioritization methodology follows the CB Relay Hardware for FC (SH-6) and the Circuit Evaluation for PSPS Driven Grid Hardening Work (SH-7).

4. *Progress on initiative (amount spent, regions covered) and plans for next year:*

In 2021, SCE installed 23 RAR/RCS devices on 15 circuits of the FICs as part of SCE's expedited grid hardening effort explained in the PSPS Action Plan[136].

In 2022, SCE will install 15 and strive to install up to 31 sectionalizing devices, such as RARs/RCSs, driven by the results of evaluations/assessments conducted under SH-6 and SH-7 subject to resource constraints and other execution risks. SCE assessed locations that could benefit from RAR/RCS devices, most notably as part of the ongoing review of PSPS impacted circuits. To the extent that additional locations are found, SCE will continue expanding its system automation equipment strategy in 2022 to target both RARs and additional sectionalizing devices to provide important isolating capabilities that could minimize the frequency of customer outages during PSPS and other outage events.

5. *Future improvements to initiative:*

SCE is refining the execution prioritization approach for SH-7 scope to consider AFN/NRCI impacted customers. In addition, SCE is continuing to re-evaluate alternatives and refinements to installation of grid hardening to circuits impacted by PSPS. SCE is also refining SH-6 CB FC scope for pole top substations and third-party affected circuits to deploy RAR with FCs under SH-5.

7.3.3.10 Maintenance, Repair, and Replacement of Connectors, Including Hotline Clamp

SCE regularly performs remediations, adjustments, and installations of connectors such as hotline clamps. A hotline clamp is a tool used to make a tap connection between the hot line and transformer (see Figure SCE 7-47 below).

[136] https://www.sce.com/sites/default/files/custom-files/R1812005-SCE%20Corrective%20Action%20Plan.pdf.

Figure SCE 7-47

An Image of a Hotline Clamp

1. *Risk to be mitigated / problem to be addressed:*

Connector failures can result in incandescent particles and/or conductor failures, which pose a potential risk for ignitions.

2. *Initiative selection:*

SCE does not have a separate WMP activity to target connector maintenance, repair, and replacement, but rather identifies deteriorated connectors as part of its detailed visual inspections (aerial and ground) and IR or corona inspections across its service area. Connectors are often replaced during repair and replacement work activities, such as transformer replacements or a reconductor project such as installation of covered conductor. Given inspection related repairs and replacement work activities and the low frequency of connector related ignitions as described below, having a separate program is not cost effective. As detailed in the CAL FIRE, Fire Prevention Field Guide many versions of hotline clamps are "Exempt" equipment, and the types SCE uses or has historically used commonly are exempted. Further details on hotline clamps are provided in California Public Resource Code 4292[137].

The information on IR detection counts and ignition events shows that hot line clamps can be a contributor or the cause of an ignition much like other types of connectors on the distribution system. Connector degradation can be found by IR scanning, which SCE conducts on the HFRA circuitry helping to locate connectors to be replaced. SCEs replacement and installation standards provide requirements and guidance on connector applications for both HFRA and non-HFRA applications.

The risk analysis for connector inspection and repair or replacement is included in the risk analysis for HFRI and IR inspections (IN-1.1), hence there is no separate RSE score for connectors maintenance.

3. *Region prioritization:*

Since connector inspection and maintenance is included in the inspection programs mentioned above, it follows the same regional prioritization as those within HFRA.

[137] https://leginfo.legislature.ca.gov/faces/codes_displayText.xhtml?lawCode=PRC&division=4.&title=&part=2.&chapter=3.&article=

4. *Progress on initiative (amount spent, regions covered) and plans for next year:*

SCE does not account for counts or costs of connector inspections and maintenance separately, as they are routinely conducted as part of its detailed inspection and IR/corona inspection programs. This approach will continue in 2022. Please see Response to SCE's Action Statement Other Issue related to hotline clamps in 7.3.3.10.1 for more explanation.

5. *Future improvements to initiative:*

SCE continues to install and evaluate continuous monitoring detection capabilities provided by DFA and / or EFD, to determine if those technologies could improve identification of degraded connections more expeditiously and create alerts to prompt maintenance, repair, or replacement.

7.3.3.10.1 Response to SCE Action Statement, 2021 WMP Additional Issue to Address in 2022 WMP

The following is one of the Additional Issues as provided by OEIS in the Final Action Statement on SCE's 2021 WMP[138].

> *"**Issue**: As identified in 2021 through the Quarterly Reports, SCE does not have a WMP specific activity for hotline clamp replacements.*
> ***Remedy**: "SCE shall provide all supporting material to demonstrate that its maintenance programs effectively track, repair, and replace hotline clamps. If its existing maintenance programs do not provide effective maintenance for hotline clamps, SCE shall explain how it will be enhancing its current operations to provide such maintenance and provide supporting material to detail the enhancements to its existing programs."*

SCE's response to this Issue/Remedy is described below:

SCE's existing maintenance programs effectively track, repair, and replace connector issues including hotline clamps. SCE uses hotline clamps and other connectors in HFRA applications based on the specific installation and site requirements. SCE actively inspects for hotline clamp issues and/or failures, and if an issue or failure is identified, it will be scheduled for remediation.

SCE performs IR scanning targeting its HFRA circuitry. In 2021, approximately 45% of the problems flagged during distribution IR scanning were identified as connector issues.[139] Of these connector issue findings, only one issue was associated with hotline clamp connectors. See Figure SCE 7-48 below, which is supported by the raw data found in Table SCE 7-16: (connector issues highlighted in yellow, issue related to hotline clamp highlighted in red).[140]

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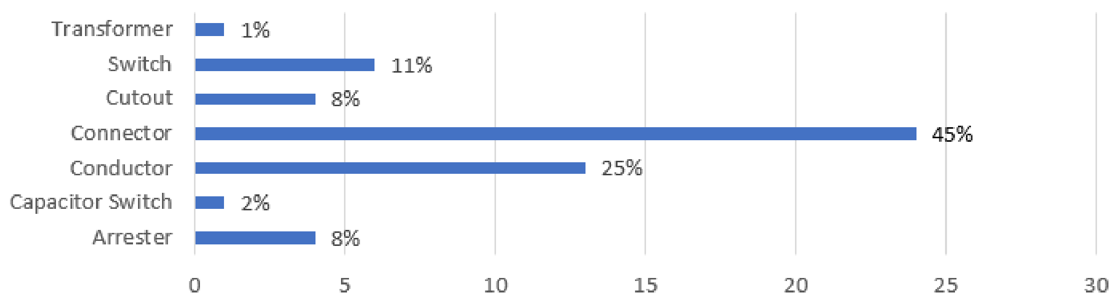
[138] OEIS Report SCE WSD-020 Action Statement on SCE 2021 WMP Final, p. 64.
[139] The 2021 scope of the distribution IR program was completed in May.
[140] One hotline clamp finding was categorized as a "Cutout" finding, due to the respective equipment found in conjunction with the hotline clamps.

Figure SCE 7-48

Summary of the Cause of Issues Idenfied from 2021 Distribution Infrared Scanning



	Arrester	Capacitor Switch	Conductor	Connector	Cutout	Switch	Transformer
Total	4	1	13	24	4	6	1

Table SCE 7-16:

2021 Distribution IR Scan Raw Data

Date	Circuit Name	Source Data Pole Number	Number Hot Spot	Component Finding
3/2/2021	TENNECO	2003772E	1	Conductor
3/4/2021	KINSEY	1821302E	1	Connector
3/5/2021	SAUNDERS	19214S	2	Transformer
3/6/2021	PICK	1935652E	1	Connector
3/10/2021	HAMMOCK	4526052E	1	Conductor
3/10/2021	CARBINE	1623285E	1	Connector
3/11/2021	PARSONS	1544041E	1	Conductor
3/11/2021	ROADRUNNER	1607811E	2	Conductor
3/11/2021	TRAUTWEIN	815112H	1	Conductor
3/12/2021	SONOMA	4335183E	1	Arrester
3/15/2021	KIMDALE	1999019E	1	Connector
3/18/2021	HELICOPTER	1623679E	1	Connector
3/21/2021	DAVENPORT	717551E	1	Conductor
3/23/2021	PAWNEE	GT17516	1	Connector
3/23/2021	ARAPAHO	213646S	1	Connector
3/25/2021	NEARGATE	269460E	1	Conductor
3/25/2021	NEARGATE	N/A	1	Connector
3/25/2021	SONOMA	569093E	1	Conductor
3/25/2021	CALGROVE	4197704E	1	Switch
3/26/2021	LOPEZ	1865836E	3	Switch
3/26/2021	ARCHIE	4150504E	1	Connector
3/26/2021	BARRINGTON	545856E	1	Conductor
3/26/2021	CALGROVE	22653442E	1	Connector
3/28/2021	HILLFIELD	1383068E	1	Connector
3/29/2021	BALLOON	4207225E	1	Connector

Date	Circuit Name	Source Data Pole Number	Number Hot Spot	Component Finding
3/30/2021	LUISENO	4269884E	1	Arrester
3/30/2021	WILDOMAR	75333S	1	Switch
3/30/2021	WILDOMAR	4768581E	1	Connector
3/31/2021	STONEMAN	4815567E	1	Capacitor Switch
4/1/2021	DONNER	2002952E	1	Conductor
4/2/2021	PHOTON	4130685E	1	Connector
4/2/2021	GUARD	4231395E	1	Cutout
4/5/2021	PIONEERTOWN	343744S	1	Conductor
4/6/2021	CHARDONNAY	44529CWT	1	Connector
4/7/2021	APPALOUSA	4768581E	1	Connector
4/7/2021	JUBILEE	4728912E	1	Switch
4/8/2021	CITY OF BANNING #2	6437	1	Arrester
4/9/2021	CRUMP	1805829E	1	Connector
4/9/2021	SADDLEBACK	456042	2	Connector
4/13/2021	IDA	4445170E	1	Connector
4/14/2021	CALIMESA	2325831E	2	Cutout
4/15/2021	CONINE	2152009E	1	Connector
4/15/2021	SUTT	1253767E	1	Conductor
4/15/2021	SUTT	1645172E	1	Cutout
4/23/2021	BIG ROCK	1383830E	1	Connector
4/23/2021	GLASSCOCK	1297268E	1	Arrester
4/23/2021	ATLANTA	4009199E	3	Connector
4/28/2021	ZONE	1332703E	1	Conductor
4/29/2021	STRATHERN	2116415E	1	Switch
4/30/2021	REJADA	2115779E	1	Connector
4/30/2021	REJADA	4205033E	1	Switch
4/30/2021	GLASSCOCK	1383407E	1	Connector
5/14/2021	HUGO	4230357E	1	Cutout

Additionally, a review of the 2020-2021 CPUC reportable ignitions was conducted to identify potential events related to hotline clamp failures. Three of 320 reportable events were identified as having hotline clamp failures potentially contributing to the ignition. None of these ignition events were in SCE's HFRA. The table below shows summarized data for 2020-2021 CPUC-reportable ignitions.

Table SCE 7-17:

2020-2021 CPUC Reportable Raw Data

Circuit	Date	Size	Structure ID	HFRA	HFTD	Equipment Involved with Ignition
Hub City	1/31/20	< .25 Acres	OH-1813245E	No	No	Conductor
Mercedes	8/5/20	< .25 Acres	OH-970202E	No	No	Other

Schooner	10/16/21	< .25 Acres	OH-2177116E	No	No	Lightning Arrester

In summary, the existing inspections and maintenance programs are well suited to effectively track, repair and replace faulty hotline clamps. Due to the limited number of findings or issues related to hotline clamps over the past few years, a separate hotline clamp inspections and maintenance program would not be an efficient or cost-effective strategy.

7.3.3.11 Mitigation of Impact on Customers and Other Residents Affected During PSPS Event

SCE interprets this section on improving access to electricity to mean either 1) maintaining access to traditional sources of electricity (see descriptions for covered conductor, undergrounding, RARs, etc.) or 2) providing access to non-traditional/non-permanent sources such as backup batteries or generators. This section discusses the latter. To improve access to electricity for customers and other residents during PSPS events, SCE provides backup power (including mobile generators) or assistance to access backup generation. These efforts are further described in Section 8.2 under Protocols on PSPS. SCE also has a Critical Care Backup Battery (CCBB) program supporting income-qualified customers residing in HFRA who are enrolled in the MBL program by providing a free portable backup battery to eligible customers to operate medical equipment during a PSPS event. Please see Section 7.3.6.6.2 for more details on CCBB.

1. *Risk to be mitigated / problem to be addressed:*

When weather and fuel conditions necessitate the use of PSPS protocols, customers can be left without power. This mitigation helps provide power for use of large household appliances and devices to help customers be more resilient during PSPS events.

2. *Initiative Selection*

While SCE's main focus is to harden the grid and deploy other mitigations that lessen the likelihood of PSPS de-energization, SCE does plan for backup power generation in limited use cases. If essential service providers are unable to sustain critical life/safety operations during an extended power outage, SCE will consider requests to provide temporary mobile backup generation on a case-by-case basis. These efforts are typically coordinated with county emergency management agency partners to identify and prioritize back-up generation needs requested by the county.

Aside from these ad-hoc requests, SCE has also undertaken proactive planning to provide backup generation to select underground load blocks and a limited number of resiliency zones and customer resource centers.

3. *Region Prioritization*

   SCE accepts *ad hoc* requests for backup generation from customers and agencies throughout the service territory. Underground load blocks are engineered and deployed only on select circuits prioritized by previous PSPS impacts and customer vulnerability. These underground pockets of load must also be safely isolatable from their overhead, HFRA distribution source, and located in areas where air quality permits are attainable.

Resiliency Zones and CRCs with backup generation are positioned in more rural communities where comparable essential services are not likely to found nearby, should PSPS de-energization take place for that community.

4. *Progress on initiative (amount spent, regions covered) and plans for next year:*

The progress on this initiative can be found in Section 7.3.6.6.2.3 Customer Resiliency Equipment.

5. *Future improvements to initiative:*

Resiliency Zones and backup generation for rural CRCs are relatively new programs and SCE will monitor their effectiveness over the course of the coming PSPS season. Similar to underground load blocks, the need for these programs may wane over time as grid hardening continues to advance and lessen the likelihood of PSPS de-energization.

7.3.3.12 Other Corrective Action

SCE historically conducts maintenance based on findings from its inspection programs. SCE performs "other corrective actions" for various reasons, including safety, reliability, and compliance (e.g., insulator washing on its transmission system, which includes a visual inspection of a circuit for contamination and subsequent washing, when needed). SCE does not consider other corrective actions to be WMP activities but will continue to do this as part of SCE's role as a prudent operator of the grid. Section 7.3.4 describes SCE’s transmission, distribution, and generation structure inspections and corresponding remediation work in HFRA in greater detail.

7.3.3.12.1 Long Span Initiative Remediation (SH-14)

“Long spans” consist of distribution circuits of a certain length, spans with mixed conductor, spans that have a sharp angle, or spans that transition between vertical and horizontal configuration. All these types of long spans can have a higher probability of conductor clash in adverse wind conditions.

SCE has used visual ground inspections and currently uses LiDAR to identify potential long span risks on the distribution overhead system and remediate the highest risks upon field validation.

1. *Risk to be mitigated / problem to be addressed:*

The risk to be mitigated is conductor clashing as a result of long spans which could potentially lead to ignition.

2. *Initiative Selection:*

SCE completed conductor blow-out studies to evaluate risk factors and determine worst-case conditions that could lead to wire-to-wire contact on over-sagged conductors. In 2020, SCE began using LiDAR on its distribution long spans to identify locations with potential issues and planned to remediate the highest risk locations upon field validation. Options for remediation include line spacers between conductors, alternate construction standards (e.g., ridge pin or box construction) or wider crossarms to increase spacing, interset poles, and covered conductor. The type of remediation selected will be determined by the specific details of each span and the corresponding field conditions.

SCE selected the LSI Remediation program due to the speed of deployment for line spacer installations and its effectiveness against wire-to-wire contact. See Figure SCE 7-49 for a line spacer installed on a long span. Additionally, LSI has a relatively high RSE compared to other mitigation programs. Alternatively, LSI remediation can be performed during the course of installing covered conductor, however a more proactive and quicker approach is warranted given the risk associated with wire-to-wire contact especially during extreme wind events.

Figure SCE 7-49

A Line Spacer Installed on a Long Span to Mitigate Wire-to-Wire Contact (Left), Close Up Line Spacer View (Right)

3. Region Prioritization:

SCE developed a risk-ranking from the WRRM combined with the number of wire clash issues to prioritize long span mitigations in all HFRA tiers based on thetype of span issue and risk score. The highest risk locations are prioritized by using the probability of wire-to-wire contact leading to an ignition and the fire consequence score. To determine the probability of wire-to-wire contact, SCE used a risk-informed approach from ground inspections which accounted for problem type[141], conductor type and length of

[141] 2019 ground inspections mitigations included line spacer installations, crossarm change outs, ridge pin or box construction reconfigurations, and reconductoring to covered conductor.

span. After ground inspections were completed in 2019, SCE improved its risk-informed capabilities and analyses with the implementation of a LiDAR collection pilot. This methodology allowed SCE to leverage span, pin, and phase spacing measurements to identify potential risk of wire-to-wire contacts. SCE also updated its risk model in Q2 of 2021 to Technosylva for spans inspected by LiDAR.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

In 2021, SCE continued the LSI Remediation program for spans identified from SCE's ground-based inspections and spans identified from LiDAR collection. SCE completed 361 high risk LSI remediations. SCE also remediated another 419 locations primarily via work bundling performed under other programs such as Covered Conductor (SH-1) and Distribution HFRI (IN-1.1).

SCE had many lessons learned from 2021 LSI remediations. It took longer than anticipated to get LiDAR data from the vendor, and in some instances, fires and inclement weather directly impacted the ability to collect and deliver LiDAR data on a timely basis. Also, field condition changes since mitigation identification extended the time it took to complete field validations and identify new and completed remediations. SCE is evaluating opportunities to streamline processes and improve analysis and tools for future scope development and validation of completed work.

In 2022, SCE expects to remediate at least 1,400 spans and up to 1,800 spans in SCE's HFRA, primarily those with compliance due dates,[142] subject to resource constraints and other execution risks. 2022 scope for the LSI Remediation program is primarily based on compliance due remediations identified from 2019 ground-based inspections. The timing of remediations is being reassessed as many spans have been or are planned to be remediated by covered conductor installations (SH-1). Specifically, SCE is evaluating a line spacer installation program for higher risk spans not planned for covered conductor work by 2023. The RSE calculation for LSI would only include the total costs and spans that do not overlap with covered conductor work by 2023.

5. Future improvements to initiative:

SCE is looking to further update the risk-informed approach to remediate remaining long spans, which could be bundled with locations already planned for covered conductor installations or proactively remediate remaining long spans with line spacers. For 2022, SCE is enhancing its risk methodology and prioritization using LiDAR measurements, conductor POI, and wind-related features to better target conductor clash scenarios for scoping LSI remediations in 2023 and beyond.

7.3.3.12.2 Rapid Earth Fault Current Limiter (REFCL) (SH-17)

1. Risk to be mitigated / problem to be addressed:

A substantial number of public safety hazards from high voltage electrical equipment, including downed wire incidents, energized conductor contacts, events involving underground equipment failures, arc

[142] These are generated as Priority 2 notifications which are to be remediated by their assigned due date.

flashes, step and touch voltage incidents, and fire ignitions come from ground faults. REFCL technology has been found to substantially reduce the energy released in ground faults, and therefore has the potential to significantly reduce these risks. SCE is utilizing its REFCL program in HFRA via several methods to reduce the energy released from ground faults to the point that an ignition is unlikely.

2. Initiative Selection:

SCE selected REFCL as a wildfire mitigation initiative because of its history of effectiveness in reducing energy from ground faults. It works by detecting ground faults as small as a half ampere on one phase in a three-phase powerline and almost instantly reducing the voltage on the faulted line while boosting the voltage on the two remaining phases, to maintain service for customers while extinguishing arcs. However, while REFCL is effective at reducing energy from a phase-to-ground fault, it does not mitigate phase-to-phase faults, which covered conductor is effective at. Thus, the two mitigations deployed together (where feasible) results in significantly increased mitigation effectiveness compared to either alone. Figure SCE 7-50 shows video captures [143] of downed wire testing performed in Australia demonstrating REFCL effectiveness at preventing ignitions.

Figure SCE 7-50

Arcing from a Downed Power Line Test with (left) and without (right) REFCL

Additionally, although REFCL technology is compatible with bare wire, covered conductor, or underground distribution systems, it can also carry high cost and complexity. SCE is exploring multiple approaches because SCE's system is not homogenous and may require specific configuration – thus assessing the most cost-effective solution will vary across SCE's system. In 2022 and beyond, SCE will study how REFCL's mitigation effectiveness overlaps with those of other initiatives to prioritize locations for deploying REFCL projects. Additionally, SCE is exploring how best to manage PSPS de-energization choices in locations that contain REFCL-hardened grid designs. SCE is assessing three variants of this technology: GFN, Resonant

[143] Testing videos of downed wire ignition tests performed in Australia with REFCL and without REFCL, respectively

https://www.youtube.com/watch?v=Q1MNBV48x0Q; https://www.youtube.com/watch?v=JCFQJFrVkSQ

Grounding, and Isolation Transformers.[144] Extensive testing of the technology was performed in the Australian state of Victoria to determine the risk reduction from the use of REFCL systems. REFCL's effectiveness has been further confirmed by staged fault tests showing that the voltage on the faulted conductor is reduced quickly enough to prevent the ignitions that the technology is designed to prevent. Based on this testing, SCE determined that the various forms of REFCL are expected to reduce ignition risk from phase to ground faults by approximately 90%. Accordingly, for 2022, REFCL currently has the highest RSE score in SCE's WMP portfolio. However, this score is modeled solely on the relatively lower cost of a single isolation transformer being deployed for one specific circuit. SCE's initial RSE analyses for the relatively costlier GFN substation installations planned for 2023 suggest more moderate RSE scores, though they would still rank as relatively high compared to other mitigations.

Ground Fault Neutralizer (GFN)

Ignitions caused by single phase to ground faults can be mitigated with the use of the GFN which reduces fault energy by a factor of a hundred thousand or more compared to typical utility designs. Australian utilities have demonstrated that GFN has the ability to detect and act upon ground faults as small as a half ampere, making it substantially more sensitive than traditional protection. The first GFN on the SCE system was recently installed at Neenach substation with the goal of reducing ground fault energy across the approximately 170 miles of circuitry fed by Neenach substation, of which approximately 70 miles are in HFRA. The GFN is equipped with an inverter and is likely to be the preferred REFCL design for large substations because those systems produce greater fault currents, which then require an additional inverter device to limit the fault energy. Figure SCE 7-51 below shows an example of an Isolation GFN.

Figure SCE 7-51

Image of an Isolation Ground Fault Neutralizer

[144] Only Isolation Transformers are installed at the boundary of an HFRA.

Resonant Grounded Substations (RGS)

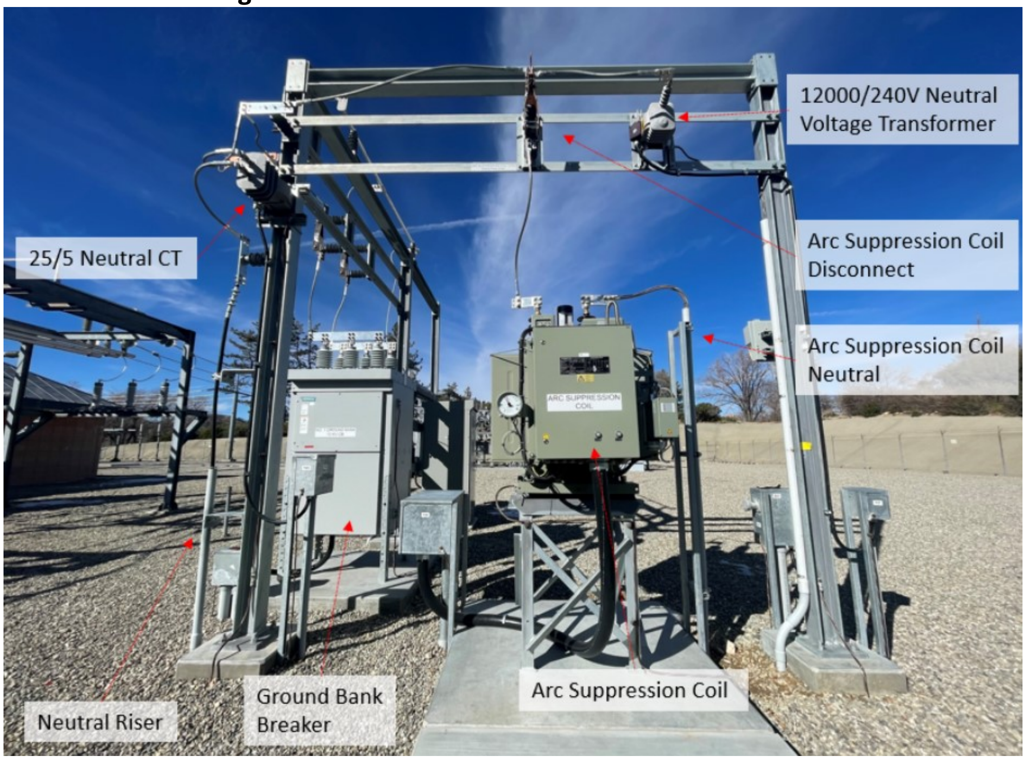
Ignitions caused by single phase to ground fault can be mitigated by Resonant Grounding which reduces fault energy by a factor of a hundred thousand or more compared to typical utility designs. While the energy reduction is less than if a GFN were installed at the same substation, at smaller substations the energy reduction can be enough to prevent some ignitions.

This project converted Arrowhead substation to resonant grounding to reduce the fault current for single phase to ground faults. Compared to GFN, resonant grounding does not include an inverter, which reduces the cost and complexity of the system, and has less reduction in the fault current.

The RGS is likely to be the preferred REFCL design for smaller substations. Smaller substations produce lower fault current and resonant grounding alone has been found to reduce fault currents to help mitigate ignitions from ground faults. For the purposes of REFCL systems, the distinction between "large" and "small" substations primarily depends on the lengths of overhead and underground circuitry. Figure SCE 7-52 below shows an example of an Isolation RGS.

Figure SCE 7-52

Image of an Isolation Resonant Grounded Substation



Isolation Transformer REFCL Scheme

Ignitions caused by single phase to ground fault can be mitigated by the application of isolation transformers which reduces fault energy by a factor of a hundred thousand or more compared to typical utility designs. Costly modifications to underground 4-wire distribution systems can be avoided or minimized when comparing the Isolation Transformer REFCL application to the substation variations for the technology. The Isolation Transformer REFCL scheme allows for a cost-effective approach to gain REFCL system protection to circuit-segments. Isolation transformer installations reduce requirements for system upgrades to deploy the REFCL system in certain cases. Figure SCE 7-53 below shows an example of overhead and pad-mounted isolation transformer installations. Overhead isolation transformer installations have a few limitations when compared to the pad-mounted alternative, with the main limitation being smaller size equipment which limits the amount of customer load that can be converted to the REFCL scheme. The pad-mounted isolation transformers can be built much larger and therefore be applied to serve more customer load, and additionally can simplify certain construction and operational practices.

Figure SCE 7-53

Image of an Isolation Transformer

3. Region Prioritization:

For the Isolation Transformer, a specific location for 2022 installation is being finalized, as construction permit and approvals are being evaluated at multiple locations to work towards project completion before year end. For planned 2023 installations of GFN, in addition to high risk areas identified by the WRRM, SCE considered constraints such as available substation space, costs to replace phase to neutral transformers and other concurrent projects. The eventual locations, Acton and Phelan substations, were chosen for GFN based on an analysis of cost and risk showing that the RSE were among the highest of available candidates. These projects will provide SCE experience operating the GFN alongside with covered conductor and will help SCE better understand the value of pairing these technologies. The two substations feed a total of 677 miles of 12 kV circuitry, of which 297 miles is HFRA. The long distance of HFRA protected per installation combined with the high risk from the circuitry resulted in a high RSE for both substations. In 2022 the main activity for these projects will be engineering and purchasing of long lead time materials. A third project may also be initiated in 2022 for construction in 2024, this project will allow SCE to gain experience with a second equipment supplier.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

Ground Fault Neutralizer

SCE installed, commissioned, and tested a GFN at Neenach Substation in September 2021. The system successfully detected faults as low as 0.5 ampere, which is more sensitive than any other existing SCE substation by more than a factor of ten. Based on SCE's test results, GFN also reduced the energy released from low impedance ground faults by more than 99.9%.

In 2022, SCE will continue to monitor performance of the pilot install and make configuration changes to simplify and improve designs based on lessons learned. SCE will also initiate engineering and material purchase for the GFNs to be constructed in 2023 at Acton and Phelan Substations. These two units will provide increased ground fault sensitivity and reduced worst case energy release on 250 miles of overhead distribution lines in HFRA. Additionally, SCE will continue monitoring the performance of the Neenach pilot to determine whether the pilot has a negative impact on reliability, fails to operate as expected on ground faults, or performs better than expected.

Resonant Grounded Substation

In 2021, SCE completed construction and commissioned a pilot install at Arrowhead Substation. In 2022, SCE plans to monitor the performance of the pilot install to determine the pilot's impact on reliability and its performance on ground faults.

Isolation Transformer REFCL Scheme

In June 2021, SCE installed and commissioned a pad-mounted isolation transformer on the Corsair 12 kV out of Stetson Substation circuit in Hemet, California. The installation was comprised of both overhead and pad mounted equipment. SCE also continued monitoring the pilot application of overhead equipment installed in December 2020 at Cal State 12 kV circuit in San Bernardino which subsequently identified an open-phase event. These activities helped SCE develop installation standards and operational procedures for these unique systems.

In 2022 SCE plans to initiate construction on a redesigned pad-mounted isolation bank in combination with ancillary pad-mounted equipment in a high-risk circuit location. Additionally, SCE will continue monitoring the performance of the two previous pilot installations. The 2022 pilot aims to utilize all underground equipment (pad-mounted and subsurface) to convert to the REFCL system. Completion of the project may extend into 2023, however SCE will strive to complete construction and commissioning in 2022.

5. Future improvements to initiative:

The pilot performances will inform plans for 2023 and beyond for the various REFCL initiatives above. SCE is also investigating how to streamline the configuration of these devices to rely less on supplier equipment, for which there could be supply failures, and more on SCE standard equipment. This not only simplifies the design but increases the availability of parts and reduces cost. And as described in its response to the 2021 WMP Progress Report Item SCE-21-06 in Section 7.1.2.1, at the end of 2021, SCE underwent a comprehensive and granular risk analysis to better understand wildfire mitigation deployment going forward, including REFCL. The resulting integrated grid hardening strategy will involve further evaluation of where REFCL will be most effectively deployed.

7.3.3.13 Pole Loading Infrastructure Hardening and Replacement Program Based on Pole Loading Assessment Program

1. *Risk to be mitigated / problem to be addressed:*
   The risk to be mitigated is overloaded poles due to, for example, added electrical equipment, degradation over time, or added load from third-party attachments (e.g., telecommunications lines), which can lead to ignition risks associated with pole failure.

2. *Initiative Selection*

Pole repairs or replacements are based on pole loading assessments conducted as part of SCE's PLP[145]. When a pole is assessed and found to exceed structural loading capabilities and not meeting adequate safety factors, that pole will be scheduled for remediation. For more details, including risk analysis and RSE calculations on this program please see Section 7.3.4.14.

3. *Region Prioritization*
   Remediation of poles in HFRA are prioritized based on GO 95 remediation time criteria for P1s, P2s, and P3s.

4. *Progress on initiative (amount spent, regions covered) and plans for next year:*
   SCE remediated approximately 1,300 distribution and transmission poles in 2020 and 1,000 poles in 2021 based on findings from PLP assessments and other inspection programs. In 2022, SCE plans to remediate approximately 500 distribution and transmission poles.

5. *Future improvements to initiative:*

SCE expects to remediate all pole overloading issues by 2025. SCE has approximately 230 poles in HFRA remaining for remediation in 2023-2025.[146]

7.3.3.14 Transformer Maintenance and Replacement

1. *Risk to be mitigated / problem to be addressed:*

Transformer failures can lead to ignition events. Transformer failures are typically interrupted by local transformer fusing and may not result in an ignition. Some transformers can fail catastrophically and create ignition risks due to flaming oil or falling sparks. Additionally, wildlife contacts may also occur at transformer installation locations creating ignition risk from falling sparks or hot debris produced during the fault event.

2. *Initiative Selection:*

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[145] SCE's PLP is a one-time program to assess the structural loading capabilities of the approximately 1.4 million wood, composite, and light weight steel poles in SCE's service area.
[146] The remaining install total may change due to ongoing data clean-up efforts.

SCE does not have a separate transformer maintenance and replacement program as a WMP initiative. Transformers are inspected and repaired or replaced based on inspection findings as part of overhead detailed inspections outside HFRA and as part of HFRI inspections in HFRA (IN-1.1). Targeted transformer replacements are also completed to remove distribution line transformers suspected of potential Polychlorinated biphenyls (PCBs) oil contamination.[147] Using meter data, SCE also proactively replaces transformers, identified to potentially have internal shorted turns.[148]

As of mid-2018, SCE standardized distribution overhead transformer designs to include ester-fluid which has higher flash/fire points than traditional mineral oil. The ester fluid properties are expected to reduce the ignition risk should a transformer tank rupture during a failure. These ester-fluid filled transformers are applied for new and replacement installations. Aged and overloaded transformers replacements are often included when performing other work activities. This work bundling generally involves pole replacements due to the labor efficiencies of installing a new transformer. Pole replacements which are required as part of covered conductor installation provide opportunities for updating transformers to ester-fluid designs when bundling the replacement work. In addition to performing these opportune transformer replacements, SCE applies its latest wildlife protection materials to relevant equipment with the pole replacement. These system hardening measures are intended to reduce certain EFF and CFO ignition drivers. To the extent transformer replacements are performed as part of other activities for which RSEs have been calculated (such as the WCCP), the benefits and costs are included in those calculations.

3. Region Prioritization:

Since transformer inspection and maintenance is included in the inspection programs mentioned above, it follows the same regional prioritization as HFRI and remediated according to respective GO 95 timelines.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

SCE does not account for quantity or costs of transformer inspections and maintenance separately, as they are routinely conducted as part of its detailed inspection programs. This approach will continue in 2022 as well.

SCE tracks the quantity and costs related to PCB replacements. In 2021, SCE replaced 206 PCB Transformers across our service territory. In 2022, SCE is SCE is aiming to replace approximately 300 PCB Transformers.

5. Future improvements to initiative:

SCE plans to continue to support transformers inspection and maintenance as part of the HFRI inspection program for the next 10 years and look for efficiencies in program execution over time.

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[147] PCBs are chemicals that have dangerous effects on the environment and human health. PCBs were used to manufacture many industrial applications such as transformers. Although no longer used in manufacturing, products containing PCBs still exist. Transformers and oil-filled electrical equipment filled with PCB oils with a concentration of greater than 50 ppm were banned by the Environmental Protection Agency after 1979, due to human health toxicity and bioaccumulation in the environment.

[148] As turns within the transformer short together, a permanent increase in voltage can be detected by SCE meters

7.3.3.15 Transmission Tower Maintenance and Replacement

1. Risk to be mitigated / problem to be addressed:

Transmission tower failures can lead to ignition events in the case of the transmission tower degrading in which the tower itself can fail down or drop conductor attached to the tower.

2. Initiative Selection

SCE considers Transmission tower maintenance to be a key part of SCE's role as the prudent operator of the grid, and not a standalone activity performed for wildfire prevention. Tower inspections and maintenance are included in transmission compliance-based detailed inspection and maintenance programs outside HFRA and included in HFRI Inspections and Remediations in HFRA (IN-1.2). These programs include inspection, repair, and replacements of towers, poles, conductor, and other transmission assets. To the extent transmission tower maintenance and replacements are performed as part of other activities for which RSEs have been calculated, the benefits and costs are included in those calculations.

3. Region Prioritization

Since transmission tower maintenance is included in the inspection programs mentioned above, it follows the same regional prioritization as HFRI and remediated according to respective GO 95 timelines.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

The costs of transmission tower inspections and maintenance are included in compliance and HFRI inspection and maintenance programs. This approach will continue in 2022.

5. Future improvements to initiative:

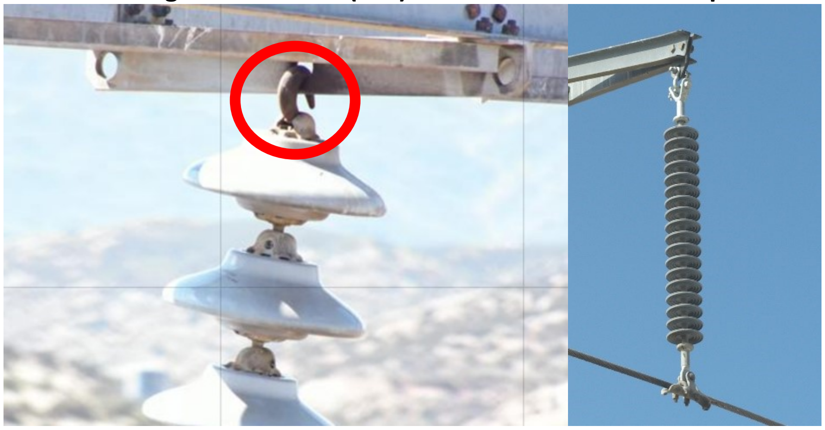
SCE will continuously evaluate the effectiveness of its inspection and maintenance programs. Any improvements made to compliance and HFRI programs would be implemented for this initiative as well.

7.3.3.15.1 C-Hooks Insulator Attachment Hardware Replacements (SH-13)

In 2021, SCE initiated a program to replace C-Hook insulator attachment hardware from transmission structures in HFRA. A C-Hook is a clamp that holds the insulator to the structure (see Figure SCE 7-54 below).

Figure SCE 7-54

Before-and-After Image of a C-Hook (left) and a New Hardware Replacement (right)



1. Risk to be mitigated / problem to be addressed:

C-Hook failure can lead to downed high voltage wire which can pose wildfire and public safety risks. The 2018 Camp Fire is believed to have been started by the failure of a C-Hook. The C-Hooks installed on SCE's system are aged and are expected to be deteriorated over time due to the excessive wear that occurs when a C-Hook rubs against the hanger plate of the tower. Due to their small size, C-Hooks are also difficult to inspect for degradation, even using aerial inspections, which increases the uncertainty of the probability of failure.

2. Initiative Selection:

Though C-Hooks are not part of SCE's construction standards, SCE inherited a limited number of C-Hooks from its past acquisition of Cal Electric. C-Hooks will be replaced with new hardware, insulators, and steel attachments. C-Hooks are not tracked in SCE's system of records because these are B-Material[149] items. In 2019, the Enhanced Overhead Inspections (EOI) program performed aerial captures of all Transmission structures in HFRA, with limited exception (e.g., access issues) and revised its inspection survey to identify C-Hooks as part of its aerial inspection program. For those structures where the inspector indicated a C-Hook was present, those structures were referred to Engineering for confirmation and replacement as a part of this activity.

The RSE estimated for this activity is low as SCE's risk analysis relies on historical incident data in SCE's service area and there are no records of failed C-Hooks in SCE's service area. However, given the inability to ascertain the hardware condition, lessons learned from the 2018 Camp Fire, the risks associated with C-Hook failure, and the relatively low costs, SCE is proactively replacing its remaining C-Hooks to be in

[149] B-Materials are minor component parts such as insulators, clamps, nuts, and bolts that SCE purchases in bulk and do not require detailed material accounting.

alignment with current standards and to mitigate against potential ignition. SCE did not consider alternatives due to all the reasons mentioned above.

3. Region Prioritization:

Between 2019 and 2021, SCE's aerial inspections identified approximately 230 transmission structures in HFRA which may have C-Hooks. Upon further assessment, it was determined that either 1) the structure was already in-scope for a project with an operating date of 2021 or earlier or 2) no C-Hook existed on the structure.[150] Both scenarios took those structures out of scope for C-Hook replacement. After the assessment was complete, SCE identified 53 C-Hooks that were not going to be replaced via an existing project, and thus were put into scope for replacement in 2021 and 2022. Some C-Hooks originally excluded because they were in-scope for projects with an operating date of 2021 or earlier were also brought back into scope, due to projects being pushed out beyond 2022.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

SCE is replacing a portion of the C-Hooks in its HFRA during planned maintenance work on the structures they are mounted on, or during other planned project-related work. Only the remaining C-Hook replacements are included in this WMP activity. SCE's strategy is simply to replace all C-Hooks with hardware in SCE's current construction standard, including insulators and shackles, as quickly as execution constraints allow.

In 2021, SCE replaced C-Hooks on 50 structures. In 2022, SCE will replace C-Hooks on 10 structures in SCE's HFRA and strive to replace up to 21 C-Hooks, subject to execution risks such as environmental clearance.

5. Future improvements to initiative:

Although SCE believes all C-Hooks have been inventoried within HFRA, SCE will continue to include a question in its inspection survey to identify whether additional C-Hooks are found upon completion of an aerial inspection. SCE will strive to replace all inventoried C-Hooks in 2022.

*7.3.*3.15.1.1 **Response to SCE Action Statement, 2021 WMP Additional Issue to Address in 2022 WMP**

The following is one of the Additional Issues as provided by OEIS in the Final Action Statement on SCE's 2021 WMP:

> ***"Issue:*** *SCE plans to replace all C-hooks in its service territory over the next 2 years. However, SCE's current estimate of C-hooks in its HFTD areas is based on statistical modeling, not inspections. Additionally, SCE does not detail how it is determining the order in which C-hooks are replaced. Therefore, it's not possible to determine if SCE is appropriately considering the condition of each of its C-hooks in determining the highest priority areas for replacement. C-hooks are difficult to inspect and can cause wildfires when ignored.*

[150] SCE will validate that this population of C-Hooks was removed in 2022. Any C-Hooks not removed as a part of other in-scope projects will be brought into scope and prioritized for replacement.

Remedy:

1) SCE must perform inspections of its HFTD territory to identify all C- hooks in HFTD zones or explain how SCE has already inventoried C-hooks within its territory through field inspections, including any supporting documentation. This inventory can be integrated into SCE's other transmission inspection programs and integrated into SCE's C-hook replacement plans.

2) SCE must detail how it's prioritizing order in which C-hooks are replaced

3) SCE must develop a plan for determining the condition of each of its existing C-hooks or demonstrate that it has an existing plan that addresses C- hook replacements. SCE must provide the details of this plan, including the timeframe for execution."

SCE's response to this Issue/Remedy is described below:

1) SCE's aerial inspection program began inspecting for C-Hooks across SCE's HFRA in 2019. SCE believes all C-Hooks in HFRA have been identified as a result of this effort. Since the C-Hooks themselves are relatively small, aerial teams continue to look for additional C-Hooks as part of the ongoing inspections. If any are found, they would be prioritized for replacement in 2022.

2) SCE performs the above step to identify all C-Hooks and replaces them as quickly as possible in consideration of construction and resource constraints.

3) Given the relatively low count of C-Hooks identified for replacement across SCE's HFRA, the inability to ascertain the hardware condition due to asset size, lessons learned from the 2018 Camp Fire, the risks associated with C-Hook failure, and the relatively low costs, SCE is proactively replacing its remaining C-Hooks to be in alignment with current standards and to mitigate against potential ignition. SCE expects to be complete with the C-Hook replacements by the end of 2022.

7.3.3.16 Undergrounding of Electric Lines and/or Equipment

7.3.3.16.1 Undergrounding Overhead Conductor (SH-2)

1. Risk to be mitigated / problem to be addressed:

Undergrounding existing overhead power lines can greatly reduce the risk of ignitions and outages associated with drivers such as wire contact with objects (e.g., vegetation, metallic balloons, debris, etc.) and wire-to-wire faults. In addition to those drivers, fault conditions can weaken and sometimes cause electrical stresses on hardware and insulators, which could lead to energized wire-down events or electrical arcing. Undergrounding is also effective at reducing risks associated in areas with limited egress routesand reducing the need for PSPS during extreme wind events. While the deployment of covered conductor may significantly increase the windspeed threshold for de-energization during a risk event, it does not completely prevent those de-energizations during extreme wind events, as undergrounding can.[151]

[151] Note that if the undergrounded circuit is connected to another portion of the circuit that experiences PSPS, the undergrounded portion would still be de-energized.

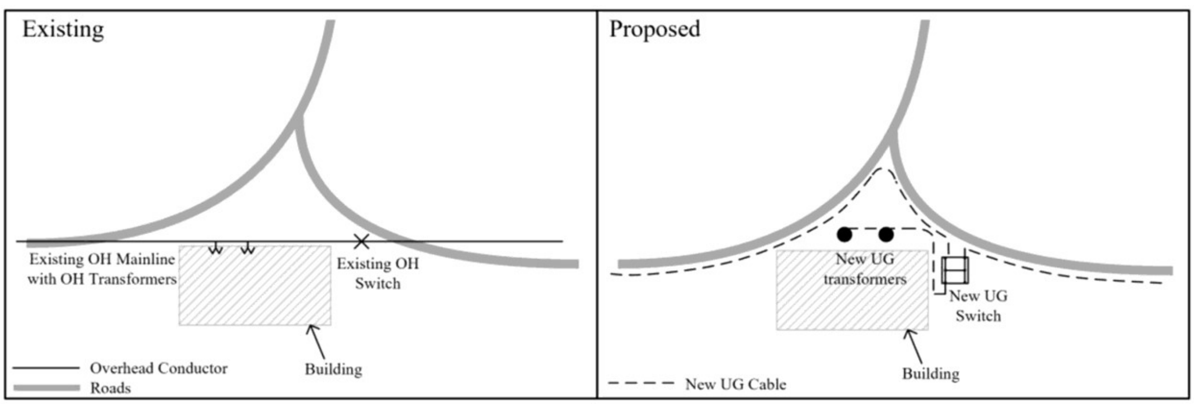
2. Initiative selection:

Undergrounding is a very effective mitigation for faults associated with overhead conductors, but it is not always cost-effective, feasible or timely to deploy, or efficient to maintain and repair. For instance, there are some areas with rocky terrain or soil erosion issues that are not conducive to undergrounding.

Moreover, when converting overhead circuit miles to an underground system, it is important to note that for each circuit there is a re-routing factor[152] to help ensure the reliability of the circuit is maintained or enhanced. Figure SCE 7-55 below illustrates why additional conductor length may be required when compared to existing overhead configuration. The figure shows a re-routing scenario for undergrounding where it is necessary to deviate from the existing overhead alignment and follow an existing road. Re-routing occurs when there are buildings/structures, natural barriers, civil and/or utility obstructions to bypass in order to underground according to SCE's standards. Additional cable, civil work, sub-surface structures, and/or equipment may be necessary when re-routing is needed for undergrounding.

Figure SCE 7-55

An Example Showing an Existing Overhead Configuration and Proposed Undergrounding Segment that Requires Additional Conductor Length



The RSE[153] for the undergrounding conversion of targeted circuit segments is medium compared to other wildfire mitigation programs. SCE pursues this mitigation despite its less favorable RSE, because the undergrounding specifically targets areas where risk concerns are sufficiently elevated to justify its implementation. In areas with limited egress, frequent fires, and/or extremely high winds that can exceed the thresholds of covered conductor, SCE considers undergrounding as a potential mitigation. See Section 7.1 for further discussion on this issue. The primary alternative to undergrounding is covered conductor. Covered conductor is the principal mitigation for most circuit segments where the benefits of undergrounding are not commensurate with the costs or the need for relatively quicker deployment to buy down as much risk as possible in the shortest amount of time. Please refer to Appendix 9.4 for more

[152] The re-routing factor accounts for additional conductor length required to perform the undergrounding work.
[153] For example, for each circuit mile of overhead conductor, on average 1.2 miles of conductor is required to underground the same circuit mile configuration. Note that the costs in the 2022 RSE calculation for undergrounding do not include the re-routing factor.

technical details such as design considerations and implementation process relating to the undergrounding work.

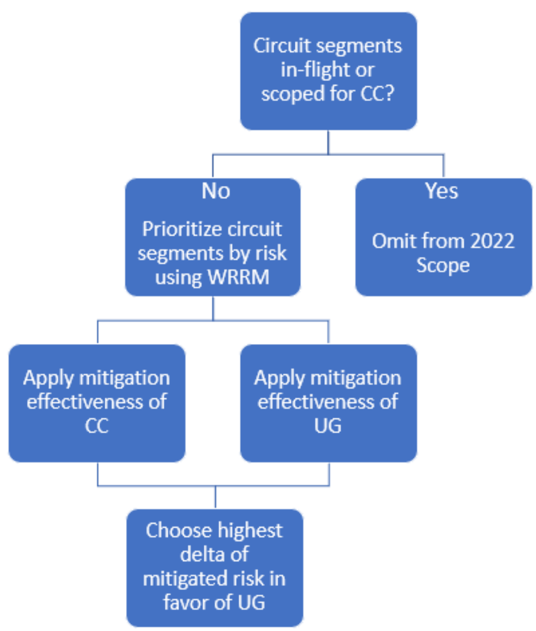
3. Region prioritization:

For 2022 scoping, SCE evaluated circuit segments based on multiple criteria including the wildfire risk score from the WRRM, PSPS impacts (including circuits that have experienced multiple PSPS events), terrain, grid topography, construction complexity associated with undergrounding, and cost. SCE also consulted with local districts and reviewed egress in areas where poles and overhead facilities may make it challenging to evacuate should a fire occur.

Figure SCE 7-56 below shows the prioritization process performed in 2020 for the targeted undergrounding 2022 plan year. The 2022 scoping analysis reviewed circuit segments that were not in-flight or scoped for covered conductors. SCE arrived at the 2022 scope by leveraging SCE's WRRM-produced FLOC level risk, broken down by sub-driver risks, and applied SCE's established mitigation effectiveness values for covered conductor and undergrounding. Applying the mitigation effectiveness of covered conductor and undergrounding to each unique FLOC allowed SCE to generate "mitigated risk" values for both options for each circuit segment. Each circuit segment was then assessed to determine the highest delta of mitigated risk between both mitigation options of undergrounding versus covered conductor. Local districts and SCE's ERM were consulted to identify and incorporate locations with known egress issues. This methodology helped inform SCE engineers evaluate all HFRA circuits to determine which would benefit most from undergrounding.

Figure SCE 7-56

Targeted Undergrounding Prioritization Process for 2022 Deployment



4. Progress on initiative (amount spent, regions covered) and plans for next year:

In 2021, SCE completed nearly six miles exceeding the program target of four miles. In 2022, SCE plans to complete 11 miles of targeted undergrounding and will strive to install up to 13 miles in SCE's HFRA, subject to resource constraints and other execution risks.

5. Future improvements to initiative:

Given the significant ignition and PSPS risk mitigation benefits and interest among external stakeholders to consider undergrounding, in 2021 SCE undertook an additional effort developing new tools to methodically identify qualitative risk factors to further expand its undergrounding scope. These factors include, but are not limited to, population egress, historical fire frequency, as well as those locations with extreme winds and/or dense tree cover to ultimately identify locations which may benefit from additional hardening such as targeted undergrounding. SCE intends to utilize these new tools and methods to identify locations for scoping enhanced hardening efforts, including undergrounding, in 2023 and beyond. SCE anticipates this may result in potentially hundreds of miles of additional targeted undergrounding to sufficiently address wildfire and PSPS risks. See SCE's Integrated Grid Hardening Strategy in Section 7.1.2.1 for more discussion on this topic.

7.3.3.17 Updates to grid topology to minimize risk of ignition in HFTDs

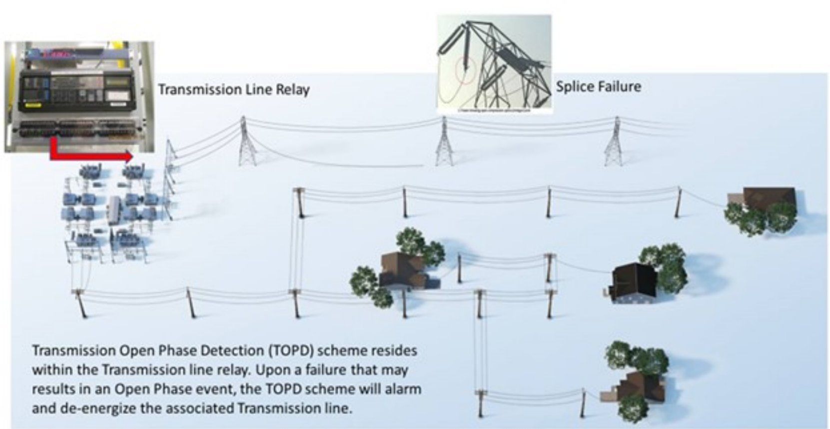
7.3.3.17.1 Transmission Open Phase Detection (SH-8)

1. Risk to be mitigated / problem to be addressed:

Transmission Open Phase Detection (TOPD) is a technology that allows de-energization of an open phase (broken conductor) before it could contact a grounded object resulting in a fault event. This technology reduces ignition risks associated with the high voltage transmission system. While the frequency of incidents remains relatively lower than those occurring on the distribution system, the consequence of energized down wire incidents on the transmission system can be high. Figure SCE 7-57 below shows an illustration of a transmission open phase detection scheme.

Figure SCE 7-57

Illustration of a Transmission Open Phase Detection Scheme



2. Initiative selection:

Open phase conditions refer to the scenario where one of the three phases is being physically disconnected on the transmission system. This could occur due to a loose cable, open phase broken conductor, or hardware/splice failure. An open phase condition that goes undetected may cause the energized conductor to drop to the ground. In 2019, SCE evaluated the effectiveness of the open phase detection scheme using real-time digital simulation. Test results indicated the technology works as intended, that is, TOPD was able to correctly identify all broken conductor testing events simulated. Given the favorable pilot results observed in 2020, SCE calculated an RSE for this initiative at the driver and sub-driver level.[154] Though the RSE was relatively low, SCE finds value in pursuing TOPD to mitigate the potentially high consequence of energized down wire incidents on the transmission system.

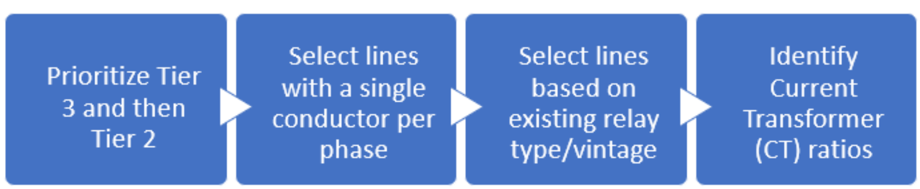
Undergrounding is an alternative effective against wire-down risks, but TOPD is a much lower cost solution since this work is performed on existing assets and requires minimal additional hardware.

3. Region prioritization:

In 2022, SCE will use the following criteria shown in Figure SCE 7-58 to deploy TOPD on transmission lines, considering risk and operational considerations. SCE targets Tier 3 followed by Tier 2 transmission lines that traverse through HFRA to deploy this new technology. Based on learnings from the past few years, the existing construction of multi-conductor transmission lines limits the ability to detect an Open Phase condition. Therefore, SCE only selects certain transmission lines that have single conductor per phase and certain type of relays that can harness this technology. This list was further narrowed down by considering the CT ratios and loading which are explained further in the lessons learned described below. Finally, engineering judgement and knowledge of existing relay schemes were used to identify the locations for 2022.

Figure SCE 7-58

TOPD Prioritization Process for 2022 Deployment



4. Progress on initiative (amount spent, regions covered) and plans for next year:

In 2021, SCE deployed the TOPD logic on an additional ten in-service lines. These lines in HFRA can accommodate the technology with minimal infrastructure upgrades. The open phase detection element is currently in the "alarm only" mode, which means the open phase detection logic sends an alarm when

[154] The RSE for this initiative is modeled as fully implemented for 2022 vs. "alarm" mode to account for full mitigation effectiveness.

an Open Phase event is detected; however, SCE plans to transition to "trip" mode, which automatically turns off circuits once the protection scheme has been fully validated.[155]

In 2022, SCE plans to deploy the open phase logic on an additional five transmission lines and strive to deploy open phase logic on up to 11 lines, subject to resource constraints and other execution risks. SCE will also continue to analyze the data collected from the previously installed TOPD pilots and make appropriate logic adjustments to optimize performance.

Lessons learned from TOPD focused on false positives. In 2020, the system detected a couple of false positive events related to a fault on a transmission line. This event resulted in the refinement of the logic scheme by incorporating a 0.7 second delay timer allowing the TOPD logic to not be susceptible to system transients. The deployment of TOPD across different regions is required to identify similar/new challenges with the security of the TOPD logic since each Transmission line will vary in complexity, such as: line Loading, number or terminals, CT ratios and frequency of faults within the region. All these factors play a role on the effectiveness of the TOPD.

From the 2021 efforts, SCE learned that TOPD provides seasonal coverage. For instance, factors such as CT ratios and seasonal loading profiles may impact the technology's ability to sense an open phase. CTs are used for transforming primary current into reduced secondary current. A CT ratio is the ratio of primary current input to secondary current output. The lower CT ratios provide greater sensitivity for an open phase.[156] Further, deploying this technology on transmission lines where sources come from hydro generation, as seen from the pilot in the Big Creek area, also impacted how readily the TOPD will be active.[157] SCE improved the way it targets and prioritizes the scope based on the lessons learned.

5. Future improvements to initiative:

By 2023, based on pilot learnings, SCE will create a standard based on the pilot results if successful, and will make the technology available for 220 kV transmission lines, which were specific to the voltage system tested in the pilot, for systemwide use. SCE may consider future pilots specific to the sub-transmission system. Most of the existing sub-transmission asset may require upgrades to accommodate TOPD.

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[155] SCE's protection engineering team does the validation of the sensitivity and security of the TOPD scheme. The number of false positives will determine if the TOPD is reliable for transition from Alarm to Trip mode.

[156] The components used to monitor the Transmission lines are CTs. The CT converts a primary current to secondary current that the relay is able to use for decision making. The TOPD scheme is a current-based algorithm and requires a minimum loading of current to be armed based on CT ratios. The higher the CT ratio, the more line loading that is required for the TOPD scheme to operate correctly.

[157] Hydro generation will only generate power when there are sufficient water levels. In the case of Big Creek, when the water levels are low, they do not generate any power. Therefore, the line loading for these specific lines is below the TOPD threshold making it difficult to distinguish an open phase event.

7.3.3.17.2 Legacy Facilities (SH-11)

1. Risk to be mitigated / problem to be addressed:

Legacy facilities primarily refer to high and low voltage equipment supporting hydroelectric operations. SCE performs enhanced inspections on these generation-related assets in HFRA to identify potential ignition risks (IN-5) and mitigate the ignition driver risks through system hardening (SH-11).

2. Initiative selection:

In 2020, SCE evaluated system hardening activities for Legacy Facilities that may provide additional wildfire risk reduction benefits, including:

- Low Voltage site hardening which assesses a variety of low voltage sites in HFRA for opportunities to reduce wildfire risk. This can be done by changing the site to solar/battery and removing secondary lines. It could also be accomplished by re-routing or installing covered conductor to reduce risk.

- Updating hydro control circuits which involves an assessment of eight distribution lines that feed generation facilities exclusively. SCE identified three projects that will be changed to a covered conductor and two projects that will be re-routed to a line already equipped with covered conductor and have their control circuits upgraded. Two other lines were affected by the Creek Fire and repaired so no further action was needed.

- Assessment of the grounding grid and lightning arrestors to help ensure that in the event of a lightning strike or electrical incident that the equipment can handle the voltage and release safely and not cause additional wildfire risk. See Figure SCE 7-59 below.

Figure SCE 7-59

Picture of Grounding Rods Installed as Part of the Grounding/Lightning Arrestor Projects

3. Region prioritization:

SCE selected the system hardening work by considering several factors including HFRA Tier, the legacy asset's age, last major overhaul date, operating voltage, unique asset characteristics, years since last assessment, and SME input.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

In 2022, SCE is working to address the remaining three hardening activities below:

Low Voltage site hardening: in 2021 SCE completed 10 assessments on a variety of sites and developed two project plans based on these assessments. The first plan is to remove a secondary line on the Big Creek 3 water tanks and install covered conductor on the distribution line. The second plan is to re-route and eliminate distribution lines on Big Creek 3 hydro controls. The construction for the second plan falls in the scope of updating hydro control circuits. SCE expects to complete low-voltage site hardening in 2022.

Updating hydro control circuits: the assessment for five of the hydro control circuits was completed in 2021. Three of the construction projects will install covered conductor,[158] and the other two will re-route and eliminate distribution lines. Construction projects will commence in 2022 and are expected to be finished in 2023.

Assessment of the grounding grid and lightning arrestors: in 2021 SCE completed 12 studies. Seven of those 12 studies recommend remediation work, such as installing lightning arrestors, repairing grounding grid, replacing dirt with asphalt and crushed rock which are less conductive than dirt. SCE completed three of those seven projects in 2021 and expects to complete the remaining four projects in 2022. Additionally, SCE plans to perform 13 studies in 2022. Remediation from those assessments would be performed in 2023.

5. Future improvements to initiative:

Data gathered from this activity will help develop more granular wildfire consequence data for SCE's generation assets. This activity is expected to conclude by the end of 2023.

7.3.3.17.3 Vertical Switches (SH-15)

The vertical switches function as switching points on circuits. The switching points include capabilities for sectionalizing, paralleling, and isolating circuits or circuit segments. Vertical switch designs have three bell crank operating systems which must remain in sync for consistent operation and to provide the intended performance rating and capabilities of the switch.

1. Risk to be mitigated / problem to be addressed:

Engineering analysis of legacy vertical distribution switches concluded that older switches may generate incandescent particles if not properly adjusted or not properly constructed. Additionally, a study revealed

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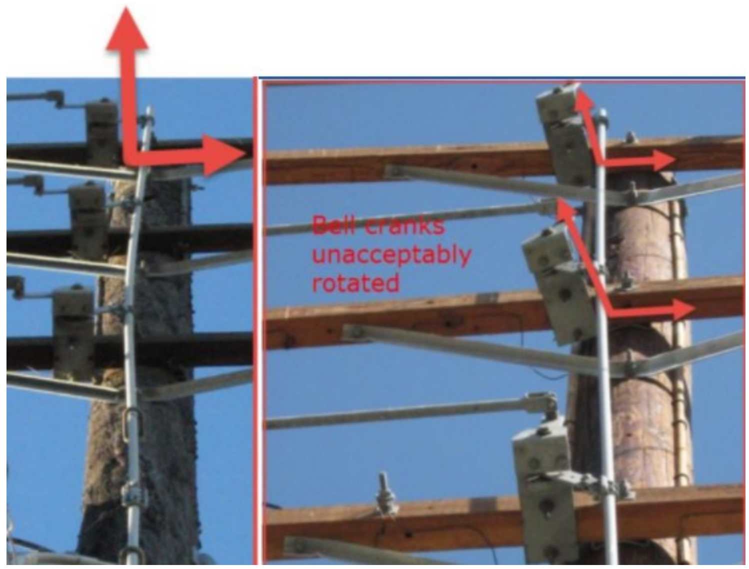
[158] The covered conductor miles are for distribution lines that solely serve the legacy facilities. These miles are not part of the WCCP scope included in SH-1.

that wooden crossarms, upon which these switches are mounted, may shrink over time potentially allowing the switch system to move out of alignment. A misaligned or improperly constructed switch may not perform nominally and within its ratings. Findings from vertical switch inspections performed in 2019 in HFRA reinforced the need to replace the vertical switch population. The findings identified misadjusted switches (see Figure SCE 7-60) and other construction issues that may negatively affect the wood crossarm based vertical switch systems.

Figure SCE 7-60

Examples of an Aligned Bell Crank (left showing 90° angle) and Misaligned Bell Cranks (right showing >90° angle)



More specifically, the mounting hardware for these legacy vertical switches clamp and bolt to the wood crossarms. If the wood crossarms change dimensions over time as the wood dries out for non-kiln dried crossarms, the mounting hardware may loosen and correspondingly cause the vertical switch contacts to be out of alignment potentially leading to failures. A concern with vertical switch failures is the production of sparks associated with misaligned contacts. If a vertical switch fails, arcing may generate sparks with sufficient heat content to reach the ground. For example, SCE has observed a vertical switch failure that was likely due to misalignment in the switch crossarm system. A repair order photo, as shown in Figure SCE 7-60 above, indicates that the bell cranks appeared to be fastened to the wooden crossarms by U-bolts which was an older standard, where through bolts instead are the present construction practice. U-bolt fastened bell cranks on wooden crossarms, may not support optimal switch operations, and may, in this case, have been the root cause of the switch failure that triggered incandescent particles when the switch was operated. An inspection that followed this failure located additional out of adjustment U-bolted vertical switch systems.

The replacement of wooden crossarm mounted with composite crossarm mounted vertical switches in SCE's HFRA may reduce arcing and spark shower events, and therefore reduce the risk of ignitions from equipment failure that can lead to wildfires.

2. Initiative Selection:

To reduce the above-mentioned risk, SCE is replacing the older vertical switches with new ones that are factory assembled onto composite crossarms. The new switch designs reduce the probability of incandescent particle generation and the challenges with construction consistency and wood deformations over time. SCE's vendor pre-mounts vertical switches onto SCE-approved composite crossarms prior to field installation.

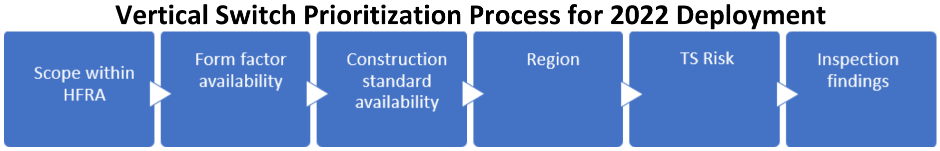
The estimated RSE for replacing vertical switches is low as it is a targeted mitigation for switch and crossarm failures, but given the relatively low cost of the program, SCE will perform this activity to reduce a known source of ignition risk. The absence of a historical ignitions associated with this risk driver does not mean an ignition will not occur in the future, especially considering the incandescent particles that can result from the asset's failure.

3. Region Prioritization:

In 2022, SCE will use the following criteria shown in Figure SCE 7-61 to select vertical switch replacements, considering risk and operational considerations: (1) scope within HFRA polygons, ensuring that scope is within Tier 3, Tier 2, and buffer perimeter to Tier 2; (2) form factor availability: SCE's current standards is composite crossarms so vertical switches that were built on wood arms needed to be updated to be built on composite arms. In 2022, SCE needs to get two versions (form factors) of vertical switches designed, tested, and approved to replace wood arm versions; and (3) construction standard availability: standards inform crews how to build. Standards are needed for the two form factors, but this cannot be done until design (step 3) is completed. Construction prioritization may be informed by (4) region for efficiencies, (5) Technosylva risk scores, and (6) inspection findings.

Figure SCE 7-61

Vertical Switch Prioritization Process for 2022 Deployment



4. Progress on initiative (amount spent, regions covered) and plans for next year:

In 2021, SCE focused on switch development, scoping, planning, and material receipt, and replaced vertical switches at 16 sites in HFRA. Directional shifts for the vertical switch program due to an unfavorable 2021 GRC decision reduced the project scope for 2021 from 30 to 22 locations, resulting in approximately a 25% reduction. Of the reduced work scope, 16 locations were completed. SCE did not achieve the 2021 WMP goal target of replacing vertical switches at 20 locations primarily due to winter storm-related resource constraints. Additionally, some of the work was deprioritized due to the decision, and a few devices were cancelled which contributed to SCE not achieving the 2021 program target.

In 2022, SCE will focus on switch development, scoping, planning, and material receipt, and will seek to replace vertical switches at 15 sites in HFRA, and up to 25 sites. Note that some switches intended for replacement in 2021 are now scheduled for replacement in 2022 (e.g., due to storm).

5. Future improvements to initiative:

SCE will incorporate feedback from field observations of Vertical Switch construction into training documents for e-crews on how to build these switches to enable better construction for future installments.

In 2023, SCE will focus on scoping, planning, material receipt, and installation of the remaining seven sites. SCE expects to complete the vertical switch replacement activity in 2023.

7.3.4 Asset Management and Inspections

7.3.4.1 Detailed inspections of distribution electric lines and equipment

SCE performs detailed inspections of distribution facilities as part of its routine practices in compliance with Commission orders. SCE's routine detailed inspection program of its overhead distribution facilities is referred to as its ODI program. This program is part of SCE's portfolio of standard inspection activities. SCE performs ODI throughout its service area in compliance with GO 165.[E17]

1. *Risk to be mitigated / problem to be addressed:*

Degradation of equipment and structures as part of wear and tear during normal operations and due to external factors, such as weather or third-party caused damage, increases the probability of in-service malfunction or failure which can have safety and service reliability impacts. GO 95[E16] provides guidance on overhead electric line construction standards and GO 165[E17] provides guidance on the minimum timing for inspections and maintenance that SCE is required to comply with. SCE performs inspections that go beyond the GO 95[E16] and GO 165 [E17] requirements as described in Section 7.3.4.9.1.

2. *Initiative selection:*

To identify asset conditions that may lead to malfunction or failure, and to meet regulatory requirements, SCE's Distribution Inspection and Maintenance Program (DIMP) performs visual detailed inspections of overhead distribution assets. Within DIMP, SCE performs ODI to identify above-ground asset conditions that may lead to malfunction or failure, and to comply with GO 165[E17] requirements, SCE performs ODI on assets in HFRA and non-HFRA. ODI entails detailed ground-based visual inspections conducted by qualified inspectors. Issues identified during ODI are prioritized for remediation and remediations are completed within compliance timelines. This program is driven by compliance requirements and supports wildfire risk reduction. In 2022, SCE's compliance driven inspections within HFRA follow the same type and scope of inspection that SCE uses to perform its distribution HFRI inspections as discussed in Section 7.3.4.9.1 (IN-1.1), which includes both a ground and an aerial inspection of the structure. As a result, SCE has included these inspections within the RSE calculation for Section 7.3.4.9.1 (IN-1.1). As discussed further below, the cadence for risk-informed and compliance-driven inspections within HFRA differs. In addition, SCE will be performing ground distribution inspections on streetlight only poles to meet GO 165[E17] requirements.

3. *Region prioritization:*

SCE inspects each structure within HFRA once every three years through the distribution ODI program which exceeds the GO 165[E17] requirements of once every five years. These inspections meet the compliance requirements and timelines of GO 165[E17] requirements. Standard ODI inspections continue to be performed in SCE's non-HFRA. In HFRA, ODI compliance scope is combined with HFRI and AOC inspections which is described in Section 7.3.4.9.1 (IN-1.1) below.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

In 2021, SCE's ODI program conducted 35,413 inspections within its HFRA as a result of compliance due dates using the same inspection process as its HFRI inspections. In 2022, as part of its ODI program, SCE plans to inspect approximately 13,000 compliance-due structures within its HFRA using the same process as its HFRI inspections. This scope is included in the target for IN-1.1. The recorded/forecast compliance-due inspections and results (Priority 1 (P1) and Priority 2 (P2) findings) over the 2020-2022 WMP period are summarized below in Table SCE 7-18. Priority 1 conditions are either completed or made safe within 72 hours for HFRA or non-HFRA. Priority 2 (P2) issues are lower risk and therefore may be resolved within six months for Tier 3 or 12 months for Tier 2 within HFRA. The number of compliance due inspections performed per year has decreased as a portion of the structures that were originally required to be inspected pursuant to compliance timelines were captured as part of the HFRI inspection scope.

Table SCE 7-18

Overhead Distribution Compliance-Due Inspections and Resulting Remediations in HFRA

Year	Compliance	P1	P2
2020 Actual	56,895	80	5,362
2021 Actual	35,413	32	5,178
2022 Plan	13,000	TBD	TBD

5. Future improvements to initiative:

SCE will continue to meet the requirements associated with GO 165[E17] and GO 95.[E16] Detailed inspectionsperformed in HFRA are being enhanced as described below in Sections 7.3.4.9.1 (IN-1.1) and 7.3.4.3.1 (IN-8).

7.3.4.2 Detailed inspections of transmission electric lines and equipment

SCE performs detailed inspections of SCE's overhead transmission electric system in compliance with regulatory requirements as part of SCE's portfolio of standard inspection activities including GO 165,[E17] the North American Electric Reliability Corporation (NERC), Western Electricity Coordinating Council(WECC) rules and regulations, and the California Independent System Operator's (CAISO) Transmission Control Agreement.

1. Risk to be mitigated / problem to be addressed:

Degradation of transmission equipment and structures as part of wear and tear during normal operations and due to external factors such as weather or third-party caused damage increases the probability of in-service malfunction or failure which can have safety and service reliability impacts. CPUC, NERC, WECC and CAISO regulatory requirements drive the type and frequency of inspections to be performed. SCE performs inspections that go beyond the regulatory requirements, as described in Section 7.3.4.11.1 (IN-1.2).

2. Initiative selection:

To identify asset conditions that may lead to malfunction or failure, and to meet regulatory requirements, SCE's Transmission Inspection and Maintenance Program (TIMP) performs visual detailed inspections of overhead transmission and sub-transmission assets. These inspections are conducted by qualified inspectors every three years. GO 95[E16] provides guidance on overhead electric line construction standards and GO 165[E17] provides guidance on the minimum timing for inspections and maintenance for which SCE is required to comply. In 2022, SCE's compliance driven inspections within HFRA follow the same type and scope of ground inspection that SCE uses to perform its transmission HFRI inspections as discussed in Section 7.3.4.11.1 (IN-1.2), which includes both a ground and an aerial inspection of the structure. As a result, SCE has included these inspections within the RSE calculation for Section 7.3.4.11.1 (IN-1.2).

3. Region prioritization:

SCE inspects its entire service area over the span of three years. Resource allocation and work prioritization is driven by GO 165[E17] compliance requirements. Circuits are selected for inspection when they are due based on the last inspection date. Compliance inspections in HFRA are combined with HFRI of transmission assets which is described in more detail in Section 7.3.4.11.1 (IN-1.2).

4. Progress on initiative (amount spent, regions covered) and plans for next year:

In 2021, SCE's TIMP program conducted 6,436 inspections within its HFRA as a result of compliance due dates using the same inspection process as its HFRI inspections. In 2022, as part of its TIMP program, SCE plans to inspect 2,600 compliance-due structures within its HFRA using the same process as its HFRI inspections. This scope is included in the target for IN-1.2. The recorded/forecast compliance-due inspections and results (P1 and P2 findings) over the 2020-2022 WMP period are summarized below in Table SCE 7-19. The number of compliance due inspections performed per year has decreased as a portion of the structures that were originally required to be inspected pursuant to compliance timelines were captured as part of the HFRI inspection scope.

Table SCE 7-19

Overhead Transmission Compliance-Due Inspections and Resulting Remediations in HFRA

Year	Compliance	P1	P2
2020 Actual	9,717	0	2,475
2021 Actual	6,436	1	1,002
2022 Plan	2,600	TBD	TBD

5. *Future improvements to initiative:*

Detailed inspections performed in HFRA are being enhanced as described in Sections 7.3.4.3 and 7.3.4.11.1. SCE will evaluate the need for adjustments in scope and methods for this activity over the next three to 10 years.

7.3.4.3 Improvement of inspections

7.3.4.3.1 Inspection and Maintenance Tools (IN-8)

Section 7.3.7 describes SCE's efforts to enhance the quality and consistency of its wildfire risk mitigation initiative data, including development of a centralized cloud-based data repository and data platform that integrates information from disparate sources. As part of these efforts, SCE has initiated technology solutions for inspection work and data management to support inspectors in the back office and in the field with improved processes and information. The software solutions aim to better integrate the Aerial and Ground inspection business processes for both Distribution and Transmission, as well as provide information and analytics on field assets across the data collection, inspection, and remediationprocesses into a single digital platform. In the maintenance/remediation area, SCE will continue implementing software to gain efficiency and productivity, incorporate risk-based inspection plans and field execution, achieve better visibility to system hardening projects (e.g., covered conductor circuit miles) from planning to installation, and improve asset management functions in HFRA.

1. *Risk to be mitigated / problem to be addressed:*

Inspection processes are conducted through various decentralized, non-integrated systems that have limited scheduling and work management capabilities across the inspection processes. The current systems are a customized patchwork to meet near-term needs given the urgency of wildfire mitigation, but these manual workarounds are not sustainable, especially given the volume, size, and type of data (such as images). In addition, they can introduce greater risk of human error, data consistency issues and process inefficiencies. As such, these technology solutions for inspection work and data management are intended to improve our ability to plan, schedule, and execute inspection work, reduce data errors, and meet current and future data needs.

2. *Initiative selection:*

The selected portfolio of technology projects will continue with implementing the current solution for a single digital platform to support end-to-end Aerial and Ground inspection processes for Distribution and Transmission, which includes:

- Collection of asset data (images, video, LiDAR, meta data, etc.,) and work management of the end-to-end inspection process
- Integration with systems of record (e.g., SAP)
- Accessing and inspecting structures and completion of structure inspection surveys in the field
- In-application creation of notifications for issues identified
- Incorporation of advanced technologies including assisted and augmented reality as well as AI/ML models (e.g., detect the type of asset, condition and severity) to reduce human error, improve the consistency and quality of inspections, improve inspection efficiency, and improve data quality

Alternatives to the current approach include:

- Continuing with a disparate set of solutions for each of the individual inspection programs. SCE decided against this approach because it would continue to require manual-intensive efforts to combine data across applications and programs to see a consolidated picture, and to coordinate across programs for greater efficiency. It would also result in continued data errors due to these manual efforts.
- Develop custom solutions for each of the programs on a common tool versus implementing a cloud platform. SCE decided against this approach because it would require much more time and effort to develop custom functions that are already available on a platform. We would not get the benefits of new capabilities that are released regularly on a platform, nor the ability to utilize capabilities developed by the partner community associated with the platform.

Enablement of AI/ML-assisted business processes are expected to enhance SCE's ability to mitigate wildfire risk. As an example, SCE has incorporated AI/ML models for asset defect detection and hazard identification in the Aerial Inspection processes to contribute to decreased time for problem identification and increased confidence in risk/issue detection. In addition, the use of AI/ML will allow SCE to gain new insights from collected data that are not easily revealed using traditional algorithms and analysis techniques.

Additional technology projects will provide a Geospatial view of work assignments and is part of the enterprise Geospatial system, and integrate with real-time inspection, notification, and work order data from the SCE enterprise work management applications (e.g., SAP). Besides making the necessary changes to the enterprise system, it also includes deployment of iPads to support Distribution and Transmission field crews and inspectors. Once deployed, the improvements will replace the current longer-cycle time processes with a digital solution and reduce the cycle time for inspections, notifications, and remediation. In addition to improved efficiency, the solution will also help with performance managementand training by providing the ability to monitor scheduled field work and capture user data related to the field personnel performing each activity.

SCE mapped this enabling activity to the activities it enables, as noted in Table SCE 4-11. A portion of this enabling activity's costs are thus included within the RSE calculations for each of its enabled activities. Namely, distribution ground (relatively high RSE) and aerial (medium RSE) inspections and remediations (IN-1.1) and transmission ground (medium RSE) and aerial (medium RSE) inspections and remediations (IN-1.2).

3. *Region prioritization:*

The inspection capabilities are prioritized to support the HFRI Inspections that will be performed both from the ground and aerially (using drones and helicopters) in SCE's HFRA. The maintenance capabilities will be also prioritized to support HFRI Inspections.

4. *Progress on initiative (amount spent, regions covered) and plans for next year:*

SCE is implementing the inspection and maintenance tools in a phased approach, focusing on building minimum viable products to increase near-term capabilities while also developing foundational capabilities that will drive long-term benefits to its wildfire mitigation programs. Below, SCE summarizes its efforts over this plan period.

2020 Activities

- Replaced and improved upon interim tools deployed for EOI through implementation of the Inspection Application for Distribution Ground inspections
- Held discovery workshops for the consolidation of aerial and transmission ground processes onto the single technology platform
- Developed and implemented the first release for aerial inspections
- Assisted photo capture capabilities which were integrated into the distribution ground inspection application, improving the quality and consistency of the photos captured
- Implemented AI/ML models in an advisory mode for the aerial program to evaluate the quality of the images captured by vendors, to detect and read the pole tag from the image (validating that the photos are linked to the correct asset), and to detect the condition of the pole and cross arm
- Developed a scope mapping and risk-based scheduling tool providing GIS map-based visualization to improve prioritization, scheduling, and execution of work in the field

- Developed and pilot tested the remediation mobile field tool with field crews

2021 Activities

- Improved the performance of the AI/ML image quality algorithms and implemented into the production data flow
- Deployed pole tag detection algorithm on the field iPad device for ground inspections, in addition to running against the aerial inspection photos, validating that the photos/inspections are linked to the correct asset
- Developed and deployed AI/ML asset condition detection models for poles and crossarms and integrated into the inspection process workflow. These models identify potential condition issues that are verified by the inspectors. Initial development of AI/ML models for insulator and transformer condition detections were completed in 2021 and will finalized and implemented within the inspection process in 2022.
- Continued iterative development of aerial inspection functionality for both distribution and transmission on the common platform. Completed successful pilots with plans to use new functionality for 2022 aerial inspections.
- Implemented first release of the Transmission ground inspection functionality on the common platform with plans for pilot usage in Q1 2022
- Deployed the mobile Field Crew application for transmission remediations

2022 Activities (Planned)

- Transition Transmission Ground inspection process to the single digital platform with at least 75% of inspectors trained to use the tool by year end (2021 rollover)
- Iterative development and release of additional functionality to meet evolving business needs for the aerial and transmission ground inspection processes (2021 rollover)
- Continued development of additional AI/ML models targeted at the most frequent and highest risk problems in order to identify issues that a human may miss as well as identify potential remediations in a more timely manner
- Design capability for the legacy Distribution Ground inspection application in 2022 to transition to a single digital inspection platform in a future year

- Deploy scope mapping tool with GIS visualization to Distribution Planning and Engineering users to improve efficiency of executing the work that is geographically located near each other (2021 rollover)
- Initiate the design and development for distribution and transmission poles visualization and bundling features to improve the overall efficiency
- Software and iPad deployment of the mobile field tool to allow for greater mobility and additional capabilities to improve the efficiency of data capture
- In support of remediation efforts, conduct assessment to identify enhancements for Field Crew application, and evaluate applicability of enhancements by year-end 2022

5. *Future Improvements to initiative:*

After the completion of the planned 2022 scope of capabilities, SCE will evaluate the need for additional capabilities and enhancements to see if adjustments in scope and/or methods are necessary over the next three to ten years. Potential scope SCE has identified that may lead to future improvements include the following:

- Adapting technology tools for changes in business process related to inspections and remediations (e.g., 360-degree overhead distribution ground and aerial inspection in a single visit)
- Adding additional inspection types to the platform, such as post-failure asset inspections and post-construction asset inspections. Arbora is a single, scalable vegetation management solution based on an integrated platform for all vegetation programs. This will allow SCE and its contract partners to more effectively coordinate and execute vegetation management work, supporting an improved operating model for optimizing activities across work stages in support of the annual performance goals.
- InspectForce is a common inspection management solution to support all inspection types (aerial and ground for Transmission and Distribution, post failure and post construction asset inspections, etc.). This will establish a foundation for sharing work and information across inspections and will improve the effectiveness and speed of inspections, data quality and record accuracy and ensure that information is available, accessible and timely to support wildfire mitigation activities.

7.3.4.4 Infrared inspections of distribution electric lines and equipment (IN-3)

IR Inspection of Energized Overhead Distribution Facilities and Equipment (IN-3)

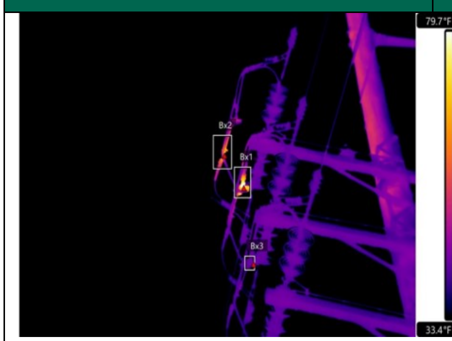
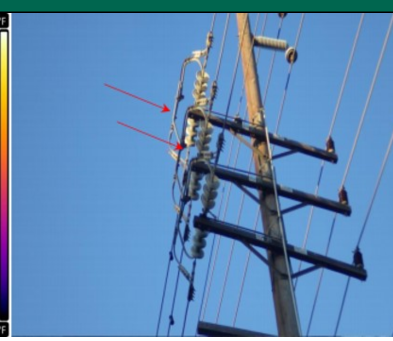
In 2022, SCE intends to complete IR inspections along all its distribution overhead lines in HFRA that were not inspected in 2021.

1. *Risk to be mitigated / problem to be addressed:*

Deteriorated connection points on electrical equipment such as conductors, insulators, splices or connectors can cause localized hot spots that over time can lead to failures if left unmitigated and pose ignition risks. These conditions are often not visible to the human eye and can go undetected during detailed visual inspections as shown below in Figure SCE 7-62 below.

Figure SCE 7-62

Distribution Infrared (IR) Inspection of a 16kV Circuit

Thermal Imagery	Standard Imagery
	

2. *Initiative selection:*

SCE had benchmarked methods to evaluate distribution overhead lines and learned that PG&E implemented a successful program that utilized IR technology to detect thermal differences and identify hot splices and connectors that can be leading indicators of asset failure. SCE piloted IR inspections of energized distribution lines and equipment in 2017 and 2018 to help reduce the risk of conductor failure. Following the pilot, SCE deemed it prudent to inspect all distribution facilities in HFRA over a two-year cycle using IR technology.

In 2021, SCE initiated another two-year cycle for this initiative for distribution facilities in HFRA. SCE is continuing this program in 2022 and will complete the second year of the most recent two-year cycle. An alternative that was considered was the reliance on detail distribution inspections. However, these inspections rely on visual inspection only, which would leave those ignition hazards that are not visible to the naked eye undetected.

The RSE for this initiative is relatively low due to the number of ignition events that are associated with conductor and connector failures. However, given the increasing risk of potential wildfires associated with downed wire incidents, the relatively low cost of IR inspections on distribution circuits, and the risk that would remain on the system without this technology being applied, it is important to continue to perform IR inspections on our distribution system in HFRA.

3. Region prioritization:

Circuits in Tier 3 and Tier 2 HFRA are inspected every other year. Structures within the circuits are grouped by district which are then prioritized by risk to be inspected with the highest 50% of the districts being inspected in the first year of the two-year cycle and the remaining 50% of the districts being inspected in the second year of the two-year cycle. Risk is calculated by multiplying the POI by the Technosylva consequence followed by the summation of the risk scores for each structure in the district. The sum of the risk scores for each district are then ranked highest to lowest, with the highest half performed within the first year, and the second half during the second year.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

The recorded and forecast volume of distribution IR inspections for 2020, 2021, and 2022 are outlined below in Table SCE 7-20.

Table SCE 7-20

Distribution Infrared (IR) Inspections

Year	Plan	Recorded	Comments
2020	4,410	5,900	The 2020 goal was to inspect 50% of overhead distribution circuit miles in HFRA. This 50% was based on the second year of the two-year cycle that began in 2019. In 2020, SCE exceeded the goal by completing inspections of 5,900 circuit miles. The goal was exceeded due to the addition of 1,454 circuit miles inspected as part of the EDFI/AOCs[159] effort, which are areas SCE identified in mid-2020 that posed increased fuel-driven and wind-driven fire risk primarily due to elevated dry fuel levels.
2021	4,408	4,410	In 2021, SCE initiated a new two-year cycle. The 2021 goal was to inspect 50% of overhead distribution circuit miles in HFRA, which SCE met by completing 4,410 circuit miles.

[159] Expedited Dry Fuel Initiative (EDFI) was the name of the program in 2020 which has since been renamed as Areas of Concern (AOCs) and is discussed in more detail in Section 7.3.4.9.1.

Year	Plan	Recorded	Comments
2022	4,408	TBD	For 2022, the second year of the two-year cycle, the goal is to inspect the remaining percent of overhead distribution circuit miles in HFRA or approximately 4,400 overhead distribution circuit miles.

5. *Future improvements to initiative:*

SCE will evaluate the continued need for this program beyond 2022 and if adjustments in scope and methods are necessary for this activity over the next three to ten years.

7.3.4.5 Infrared inspections of transmission electric lines and equipment (IN-4)

Infrared Inspection, Corona Scanning, and High-Definition Imagery of Energized OverheadTransmission Facilities and Equipment (IN-4)

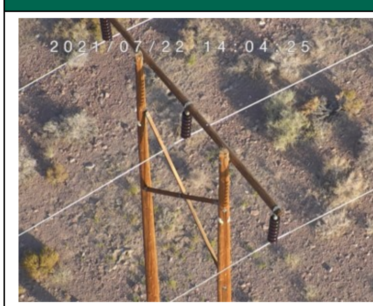
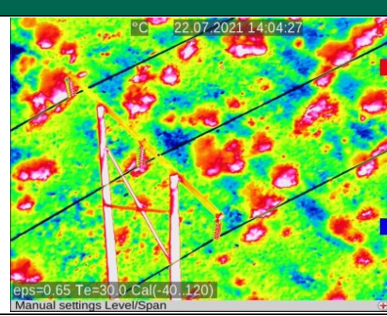
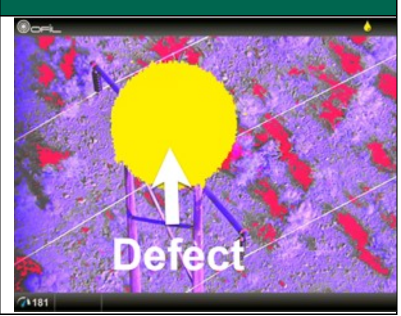
SCE plans to perform IR and corona inspections for 1,000 transmission circuit miles per year aspart of this activity in and adjacent to HFRA.

1. *Risk to be mitigated / problem to be addressed:*

   Deteriorated connection points on electrical equipment such as conductors, insulators, splices, or connectors can lead to failures and pose ignition risks. These conditions are not visible to the human eyeand therefore cannot be detected during detailed inspections. Figure SCE 7-63 below shows an example of a defect that was captured by a corona scan that could not be detected during a visual or IR inspection.

Figure SCE 7-63

Midway-Vincent No 1 & No 2 500kV Lines

Visual	Infrared (IR)	Corona Scan
		

2. *Initiative selection:*

In 2019, SCE started a program to perform IR and corona inspections of its overhead transmission system to detect thermal abnormalities that are leading indicators of faults. This program was started because in prior years (pre-2019) SCE experienced a number of splice failures. Helicopters (see Figure SCE 7-64 below) are used for these inspections due to the long distances between structures and because these assets are frequently located on rugged terrain.

Figure SCE 7-64

SCE Helicopters

SCE Helicopter	Mounted with IR & Corona Camera
	

Although the RSE for this initiative is low due to the low number of observed connector splice failures on transmission lines in HFRA, given the potential for catastrophic ignitions related to transmission assets and the relatively low cost of these inspections, this program was deemed prudent. In addition, this is currently the only proven method to detect deteriorated connection points that may otherwise not be captured during visual inspections. As discussed in Section 7.3.4.5.1 below, in 2022, SCE will deploy additional enhanced inspection methodologies on its transmission system in HFRA, including more robust scanning of conductor, X-ray of splice locations, and the removal of conductor to perform laboratory analysis which will help address ignition hazards not captured during visual inspection.

3. *Region prioritization:*

The circuit miles inspected for this activity in 2020 were prioritized based on ignition consequence risk scores using the Reax model. In 2021, SCE used the Technosylva consequence and POI scores to prioritize the highest risk transmission circuit miles in and adjacent to its HFRA.

For 2022 scope, SCE will continue to use Technosylva consequence and POI scores to prioritize the transmission circuit miles in HFRA that have not been inspected in 2021. However, SCE will also perform an inspection on the highest risk circuits, regardless of the last inspection according to the 4 x 4 matrix concept referenced in Section 7.3.4.11.1. The final scope and prioritization may be adjusted based on operating constraints including but not limited to circuit loading and ambient temperature.

4. *Progress on initiative (amount spent, regions covered) and plans for next year:*

The forecasts and recorded volumes of transmission IR and corona inspections for 2020, 2021 & 2022 are outlined below in Table SCE 7-21.

Table SCE 7-21

Transmission Infrared (IR) Inspections and Corona Scanning

Year	Plan	Recorded	Comments
2020	1,000	1,178	Exceeded WMP goal of completing 1,000 transmission circuit miles and identified one P1 and three P2 conditions. Because individual circuits may traverse in and out of HFRA, some of the high-risk circuits inspected, 1,005 miles were in HFRA and 173 miles were located outside of HFRA. Although fires in 2020 caused some delays in inspections due to restrictions on helicopter flights and SCE resources being diverted to fire response and recovery, SCE was able to meet its 2020 WMP goal of inspecting 1,000 transmission overhead circuit miles.
2021	1,000	1,046	Exceeded WMP goal of completing 1,000 circuit miles and identified three P2 conditions. In 2021, SCE's goal was to perform IR and corona inspections on 1,000 transmission overhead circuit miles in and around SCE's HFRA.
2022	1,000	TBD	In 2022, SCE will continue with the goal to perform 1,000 transmission overhead circuit miles in and around SCE's HFRA.

5. *Future improvements to initiative*:

SCE will evaluate the results of the current program to determine appropriate scope and methods for this activity over the next three to ten years.

7.3.4.5.1 Transmission Conductor and Splice Assessment (IN-9)

SCE is adding enhanced Transmission conductor and splice inspections methods (LineVue, X-Ray and Conductor Sampling) in HFRA to complement existing inspection processes to help prevent future ignitions.

1. *Risk to be mitigated / problem to be addressed:*

SCE identified 57 transmission wire down events that occurred in the last five years throughout the SCE service territory, with most failures attributed to conductor and splices. Conductors and splices can fail due to age, weather, contact from object, and other factors that can lead to wire downs. To reduce transmission conductor wire down events, SCE plans to use enhanced inspection methods to identify anomalies and any underlying issues in order to replace/remediate conductors and/or splices that have a higher probability of failure. In addition, these methods help to capture issues that may not be visibly apparent to the human eye or other inspection technologies.

2. *Initiative selection:*

LineVue, X-Ray and Conductor Sampling, as shown below in Figure SCE 7-65, were chosen for their enhanced inspection methods of finding anomalies which are not apparent or visibly exposed.

- LineVue determines the deterioration of the steel core cross-sectional area of the conductor steel core and detects any localized breaks or corrosion pits on the steel wires and loss of zinc galvanized layer. Alternatives for LineVue that SCE considered included IR inspections, Ultraviolet (UV) inspections, HFRI inspections, and Aerial Transmission Inspections. However, these inspections rely on visual indicators, heat signatures, or partial discharges (signs which are only present when the equipment is close to failure) to find severe anomalies. Therefore, SCE found it prudent to perform LineVue inspections to help identify anomalies which are not visibly apparent or exposed such as conductor steel core and splice corrosion/deterioration.

- X-Ray is used on conductor splices to verify proper installation as well identify broken strands or deformities. X-Ray inspections are more effective than visual inspections in identifying these issues given the difficulty in seeing internal issues or improper termination installations. Ground inspections were considered as an alternative however the inability to view any internal issues within a splice could potentially lead to low accuracy and it can be difficult for crews to reach the necessary locations. Aerial inspections were also considered as an alternative but similar to ground inspections, are less effective in identifying any internal issues.

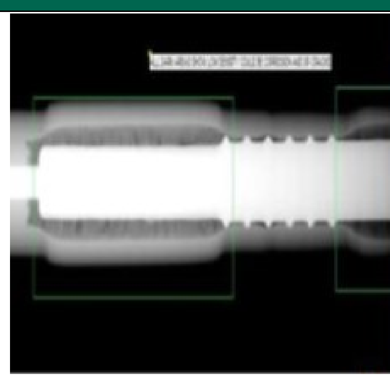
- Conductor core sampling is an in-depth inspection performed on a 15-foot conductor section in a laboratory to determine the current health of conductor and estimates the component end-of-life. Currently, there are no viable alternatives to conductor core sampling. As part of this initiative selection, SCE evaluated practices throughout the industry and understands this activity to be widely utilized.

Not only do these activities help identify issues on the system, all three of these methods help gather more detail and data which are expected to be utilized in the future for an asset health index. The enhanced inspection methods LineVue and X-Ray can be performed either energized or de-energized. However, Conductor Sampling must be performed de-energized as an outage is required in order to safely remove the conductor.

Although this nascent activity has a low RSE, SCE expects additional data will be gathered over time to further inform the efficacy of this activity and SCE's understanding of the health of its transmission conductor and splices, and how this activity complements transmission IR inspections. These enhanced inspections methods look deep in the conductor/splice core and can help determine the rate of degradation since anomalies are found at their early stages. SCE has utilized LineVue, X-Ray and Conductor Sampling in the past, however only on a small scale and for the purposes of a few small projects. These small projects were successful in helping to determine the health of conductors and splices. For example, regarding LineVue, 38 lines were inspected and two were found to be in poor health and three in marginal health.

Figure SCE 7-65

Transmission Conductor and Splice Assessment

LineVue	X-Ray	Conductor Sampling
		
Utilizes a magnetic flux to detect the degradation of the steel core of the conductor.	Takes an internal image of the splice which is used to determine degradation due to corrosion/improper installation.	Tested for strength, elongation, torsional ductility, remaining zinc, visual, wrap and breaking loss.

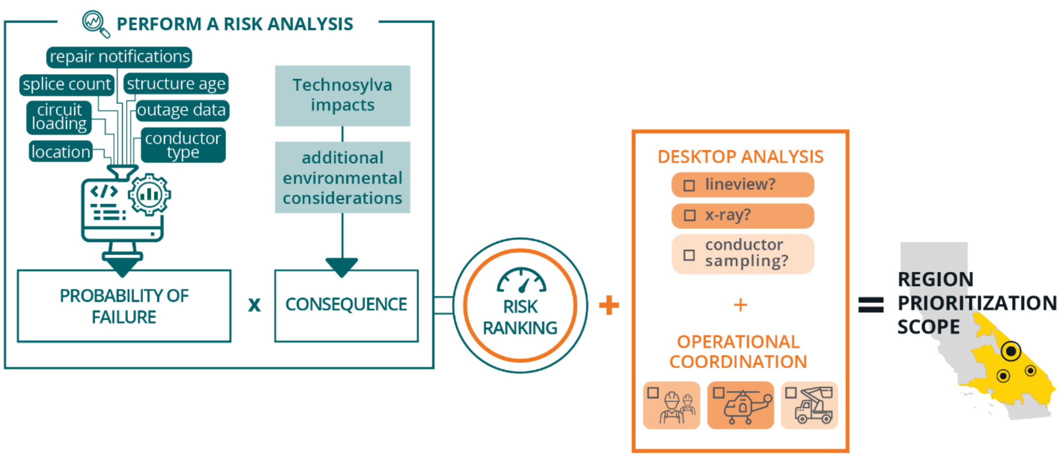
3. *Region prioritization:*

As outlined below in Figure SCE 7-66, SCE built a risk model to evaluate risk across transmission structures to help prioritize transmission inspections. This model utilizes various data elements, including structure age and location, circuit loading, splice count, conductor type, outage data and repair notifications. SCE then incorporated Technosylva consequence impacts, and an environmental multiplier composed of atmospheric corrosivity and historical fire maps, to calculate and rank risk across assets.

In 2022, inspections are first prioritized in the order of the risk ranking by structures, followed by a desktop analysis to determine whether LineVue, X-Ray or Conductor Sampling should be utilized. For example, X-Ray is only performed on splices. Coordination is then needed with SCE's Air Operations team to determine availability of helicopters to perform LineVue and/or X-Rays, and with SCE's Transmission team to determine availability of bucket trucks for Conductor Sampling. Finally, a field inspection is performed with either LineVue, X-Ray or Conductor Sampling to identify if any anomalies or underlying issues are present. While locations for LineVue, X-Ray and Conductor Sampling are selected based on risk analysis, consideration is also given to operational feasibility and locations that offer specific learnings (e.g., sampling conductor in an area with a relevant and recent event).

Figure SCE 7-66

Transmission Conductor and Splice Prioritization



4. *Progress on initiative (amount spent, regions covered) and plans for next year:*

   For 2022, SCE will inspect 75 spans with LineVue, inspect 50 splices with X-Ray, and obtain five conductor samples. SCE will strive to inspect up to 150 spans with LineVue, inspect up to 70 splices with X-Ray, and obtain up to 15 conductor samples, subject to execution constraints.[160] These activities will all occur within SCE's HFRA.

5. *Future improvements to initiative:*

   As this is a new initiative, SCE will learn from its initial deployments and incorporate any lessons learned and enhancements into future year efforts.

[160] A span is defined as one phase from one structure to another. A splice is defined as one splice. A conductor sample is defined as a 15-foot segment of conductor.

7.3.4.6 Intrusive Pole Inspections

This is a traditional inspection program SCE performs in compliance with GO 165.[E17]

1. *Risk to be mitigated / problem to be addressed:*

The strength of wood poles can diminish over time due to insect infestation or material deterioration, increasing the probability of structure failure, which is a safety hazard given the electrical equipment supported by the poles and proximity of these poles to the public.

2. *Initiative selection:*

The IPI program is a preventative program designed to identify deteriorated poles that may require remediation to meet with GO 95[E16] requirements, while maintaining the safety of personnel, public and environment. The IPI program was established in accordance with GO 165,[E17] to evaluate SCE's wood poles using visual and internal examination of the poles (by drilling into the pole and testing the extracted wood) to identify damage or decay, analyze the remaining strength of the pole and determine remediation required. As an industry practice approved by the Commission, the program performs remedial treatments during intrusive inspections to prevent poles from deteriorating and to extend the useful lives of the poles. Remediations resulting from IPI include installation of steel stubs to increase pole strength and pole replacement. GO 165[E17] requires intrusive inspections for all poles at least 15-years in service or older and with no prior intrusive inspection, to be completed using a 10-year cycle. If the pole has passed the initial intrusive inspection within the first 25-years of age, GO 165[E17] requires subsequent intrusive inspections on a 20-year cycle. SCE completes intrusive inspections on a 10-year cycle, which is in line with industry benchmarking and is approved by the Commission. Additionally, pole asset attributes are verified and/or updated to ensure system data integrity related to in field assets and/or mapping. Lastly, in accordance to GO 95 [E16] Rule 44.2, the IPI program fulfills requests to provide intrusive test results for ongoing construction and addition of facilities that necessitates pole loading. Though SCE does not calculate RSEs for compliance programs which must be undertaken regardless of RSEs, SCE supports risk-informed evaluation of compliance requirements in collaboration with the Commission. This traditional program is not driven by wildfire risk reduction and has consistently been approved in SCE GRCs.

3. *Region prioritization:*

Inspections are performed annually across SCE's service area. SCE utilizes a 10-year grid approach to maintain operational and resource allocation efficiencies and compliance throughout the system. Small portions of annual work are prioritized to address constrained poles unable to be inspected previously for various reasons (e.g., unable to access and/or obstructions). Additionally, GO 95 Rule 44.2[E16] ad hoc inspections are performed through the IPI program annually as requested in conjunction with construction activities.

4. *Progress on initiative (amount spent, regions covered) and plans for next year:*

The forecasts and completions for transmission and distribution intrusive pole inspections for 2020, 2021, and 2022 are outlined below in Table SCE 7-22.

Table SCE 7-22

Intrusive Pole Inspections

Year	Plan	Recorded
2020	143,600	146,621
2021	143,600	144,122
2022	143,600	TBD

5. *Future improvements to initiative:*

There are no improvements currently planned. SCE will evaluate the continued need for this program. If adjustments in scope and methods are necessary for this activity over the next three to ten years, SCE will present them to the Commission in its GRCs.

7.3.4.7 LiDAR inspections of distribution electric lines and equipment

At this time, SCE does not directly collect LiDAR for the purpose of inspecting distribution lines and equipment. Historically, LiDAR data has been collected by individual departments for specific needs i.e., vegetation management, survey, etc. As of 2021, the scope, schedule, and cost of procuring LiDAR data for SCE has been consolidated through the centralized inspections organization. In 2021, LiDAR data was collected by the inspections department for the vegetation management, engineering, and electric asset data departments for their unique needs. To directly mitigate wildfire ignition risk, the vegetation management organization utilized 2021 LiDAR datasets to inspect vegetation grow/fall-in encroachment risks to identify priority notifications. In 2022, T&D is investigating opportunities to utilize the already collected LiDAR for other inspection capabilities. SCE uses LiDAR as part of its inspection programs described in Section 7.3.4.9.1 below. Use of LiDAR for inspecting vegetation encroachment and clearance is described in Section 7.3.5.7.

7.3.4.8 LiDAR inspections of transmission electric lines and equipment

At this time, SCE does not directly collect LiDAR for the purpose of inspecting transmission lines and equipment. Historically, LiDAR data has been collected by individual departments for specific needs i.e. vegetation management, survey, etc. As of 2021, the scope, schedule, and cost of procuring LiDAR data for SCE has been consolidated through the centralized inspections organization. In 2021, LiDAR data was collected by the inspections department for the vegetation management, engineering, and electric asset data departments for their unique needs. To directly mitigate wildfire ignition risk, the vegetation management organization utilized 2021 LiDAR datasets to inspect vegetation grow/fall-in encroachment risks to identify priority notifications. In 2022, T&D is investigating opportunities to utilize the already collected LiDAR for other inspection capabilities. SCE uses LiDAR as part of its inspection programs described in Section 7.3.4.11.1 below. Use of LiDAR for inspecting vegetation encroachment and clearance is described in Section 7.3.5.8.

7.3.4.9 Other discretionary inspection of distribution electric lines and equipment, beyond inspectionsmandated by rules and regulations[161]

7.3.4.9.1 Distribution HFRI Inspections and Remediations (IN-1.1)

To effectively target wildfire risks, SCE has undertaken distribution asset inspection programs in its HFRA that go beyond compliance requirements. In its 2020 WMP, SCE presented two separate activities fordistribution enhanced inspections – ground based HFRI inspections (previously IN-1.1 in SCE's 2020 WMP)and aerial HFRI inspections (IN-6.1 in SCE's 2020 WMP). Given these activities have the same drivers andapproach and the findings from these inspection programs are consolidated for remediation work, SCE combined these into one activity (IN-1.1) in its 2021 WMP Update. SCE also presented Distribution Remediations (previously SH-12.1 in SCE's 2020 WMP) within this activity (IN-1.1) in its 2021 WMP Update. For this 2022 WMP Update, SCE has maintained the distribution aerial and ground inspection and remediation consolidation in this activity (IN-1.1).

In 2022, SCE will continue its ground inspection program of distribution structures in addition to those required by GO 165[E17] and that represent the highest risk based on POI and consequence. SCE is continuing a more comprehensive inspection program for its distribution overhead facilities in HFRA to detect equipment anomalies and mitigate ignition risks that cannot be detected during compliance-driven programs alone. SCE will also continue to complement its ground-based inspections in HFRA with aerial inspections using helicopters and drones to provide a 360-degree view of the assets to detect equipment/structure conditions which could lead to faults and ignitions.

Ignition risks identified through these HFRA inspections will be remediated in accordance with CPUC requirements. In addition to inspecting our electrical assets, we also regularly inspect SCE telecommunications equipment within HFRA and perform associated remediations.

1. *Risk to be mitigated / problem to be addressed:*

   Normal wear and tear and deterioration of overhead structures and assets such as poles, crossarms, transformers, fuses, conductors, etc., increases the probability of failures and faults and the associated risk of ignition associated with electrical infrastructure. This coupled with climate change and the increasing magnitude of wildfires requires broader and more ignition-focused inspection

[161] Unmanned Aerial Operations Training (OP-3 in SCE's 2020 WMP) was previously a WMP activity and was discussed in this section the 2020 WMP. SCE consolidated the description of training efforts within the "Adequate and trained workforce for service restoration" initiative, and now will include a write-up of Unmanned Operations Training within SCE Emergency Response Training (DEP-2) activity in SCE's 2021 WMP. Please refer to Section 7.3.10.1for more details.

methods beyond traditional compliance requirements to reduce wildfire risk associated with electrical infrastructure.

In 2019, SCE's Distribution EOI program validated that the requirements, scope, and frequency of compliance-driven grid patrols and ODI were insufficient in detecting a large number of potential hazards, that if not remediated would increase the risk of wildfire ignition in HFRA. Moreover, some equipment conditions or deterioration, such as woodpecker damage to the top of crossarms, deteriorated electrical connections on top of transformers, and missing/deteriorated insulator pins, are not visible during detailed inspections from a ground-based perspective.

2. *Initiative selection:*

Detailed inspections serve as one method of identifying potential equipment failures or foreign objects that may contact equipment and result in an ignition. The Commission has recognized this principle and determined that periodic detailed inspections are an effective mitigation. Accordingly, GO 165[E17] requires that utilities perform a detailed inspection of their overhead assets at least once every five years. However, there is also a risk that equipment or structure degradation will occur between compliance cycle inspections. Such degradation is often due to natural wear and tear or emergent events such as weather or third party-caused damages.

In addition, GO 165 [E17] requirements are based on safety and reliability, not necessarily addressing all potential ignition risks, and could typically be performed using ground inspections. To address ignition risks more comprehensively, based on the learnings from SCE's 2019 EOI effort and given the fact that wildfire risk has increased in recent years, SCE determined that more frequent and ignition-focused risk inspections should be conducted in HFRA beyond GO 165[E17] requirements. SCE also determined that aerial inspections could meaningfully supplement ground-based inspections to identify deterioration or unfavorable asset conditions that are not visible from the ground. The added fire-risk inspection criteria includes pre-established questions inspectors must address that are based on fault, near misses, and ignition analyses to help identify equipment conditions or attributes that potentially increase wildfire risks. SCE launched its HFRI inspections in 2020 based on lessons learned from its 2019 EOI effort and improved risk modeling. SCE conducts HFRI Inspections in its HFRA both from the ground and aerially (using drones and helicopters) to provide a 360-degree view of the assets. Ground inspections help detect equipment/structure conditions that are difficult to identify via aerial inspections (e.g. aerial inspections do not inspect spans), such as damaged conductor and missing cotter keys (see Figure SCE 7-67, and

Figure SCE 7-68 below). Aerial inspections help detect equipment/structure conditions that are difficult to identify via ground inspections, such as switchblade alignment issues (see Figure SCE 7-69, and

Figure SCE 7-70 (below). In 2022, SCE plans to initiate performing some ground and aerial inspections concurrently to improve the customer experience, execution efficiency and reduce the environmental footprint.

To identify equipment or structure degradation that occurs between compliance cycles due to natural wear and tear or emergent events such as weather or third party caused damages that could lead to a potential ignition risk, HFRI inspections are performed more frequently than the requirement of once every five years. The frequency of inspections varies by the location-specific-risk within SCE's HFRA and emergent conditions. HFRI inspections result in notifications if remediations are necessary. The notifications are prioritized based on estimated severity and impact, and higher priority notifications are remediated faster. The prioritization approaches for inspections and remediations are described in the next section. Remediations can be repairs to the existing assets or replacements depending on asset condition. If risk analysis deems any asset type to be high risk, these are replaced as well. For example, SCE replaces wood crossarms with composite crossarms where feasible to increase resistance to wear and tear or damage.

Figure SCE 7-67

Damaged Primary Conductor on a 12kV Circuit

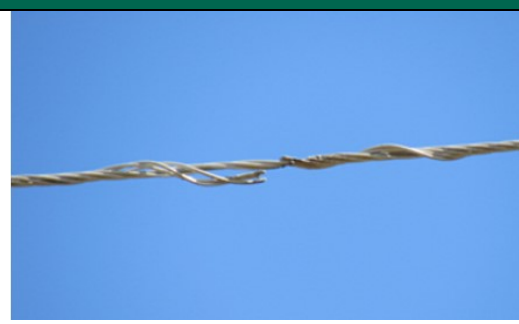
Distant	At Close Range
	

Figure SCE 7-68

Damaged Primary Conductor (left) and Missing Cotter Key (right)

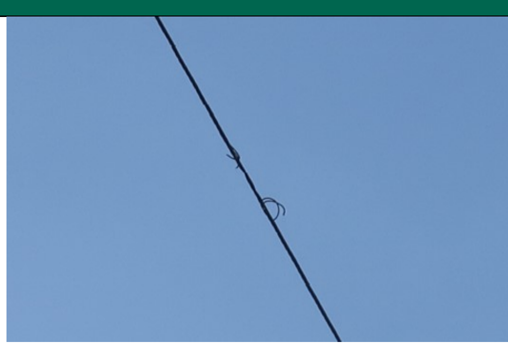
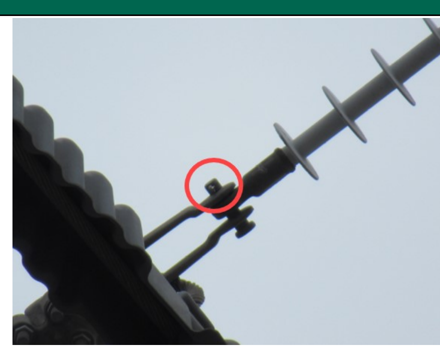
Damaged 12 kV Primary Conductor	Missing Cotter Key on a 12kV Circuit
	

Figure SCE 7-69

Drone (left) and SCE Helicopter (right)

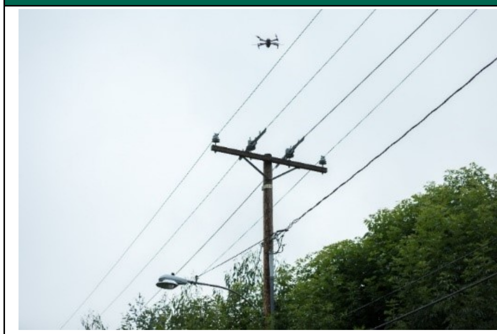
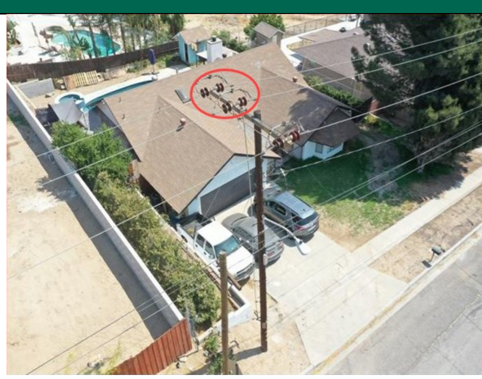
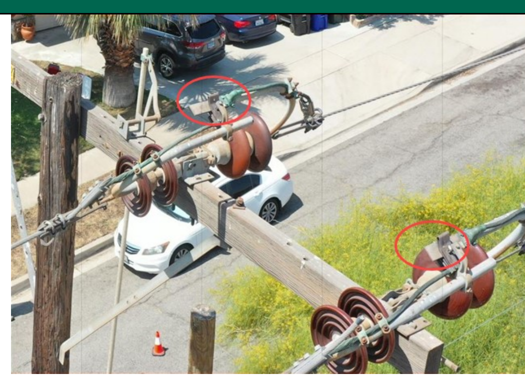
Distribution Aerial Inspection (Drone)	SCE Helicopter
	

Figure SCE 7-70

Distribution Switchblade Alignment Issue (Drone Capture)

Distant	At Close Range
	

SCE has continually enhanced its HFRI inspections based on the latest data and ignition risk analysis. For example, in 2020, SCE's Fire Science team identified 17 AOCs in its HFRA, which are areas that posed increased fuel-driven and wind- driven fire risk primarily due to elevated dry fuel levels. This threat can be magnified during periods of high wind, high temperatures and low humidity, as forecasts predicted for Fall 2020 in Southern California. The AOC inspections can also be used to inspect high-risk lines before peak Santa Ana events later in the year to capture any defects that may have occurred intra-year or identification of any new fire risks not previously captured as part of the original HFRI inspections. The methodology used to identify the AOCs was based on several factors, including fire history, weather conditions, fuel type, exposure to wind, and egress, among others. Further details on the risk models can be found in Section 7.3.3.

In 2021, SCE improved its AOC inspections by implementing both a Summer and a Fall AOC program. The Summer AOC effort identified 12 areas where there was risk of a fuel-driven fire, five of which were identified as significant risk and were the focus of additional inspections. The 2021 Fall AOC effort was very similar to the 2020 AOC exercise, and indeed many of the same areas were identified (11 areas). Additionally, SCE conducted Fall AOC pre-patrols. The pre-patrol consisted of a slow vehicle-based (where possible) patrol which looked for P1 conditions, mid-span clearance conditions (e.g., vegetation in lines or potential wire slap) and Communication Infrastructure Provider (CIP)/third party hazardous conditions. The analyses for these AOCs included all Distribution, Transmission, and Generation structures associated with whole circuits and the surrounding topographical area in the identified AOCs.

SCE determined that ground and aerial inspections and the associated remediation work in the AOCs were necessary to mitigate ignition risk and reduce the consequence risk of fuels-driven and wind-driven fires. To mitigate the potential risk, SCE accelerated inspections, remediation and vegetation trimming and removal in the identified AOCs. Besides identifying equipment-related hazards, these inspections also help with collecting valuable data regarding asset conditions that can be analyzed, stored, evaluated, and used for risk modeling and asset management activities. Notifications in AOCs are placed on a compliance remediation timeline with the highest risk notifications accelerated to be completed before fire season. In order to identify the highest risk notifications, a risk ranking methodology is utilized for AOCs, made up of four core dimensions which including pending work on structures, time function, probability of ignition and Technosylva consequence score. The Notification Risk Ranking Methodology can be further focused for each AOCs season based on specific dimensions that visualize that season's driver. In 2022, SCE again plans to implement both a Summer and a Fall AOC program (including a Fall pre-patrol).

For 2022, the RSE calculations were calculated separately for distribution ground and distribution aerial inspections and remediations, with scores of relatively high and medium, respectively. Accordingly, SCE determined that it was prudent to continue to engage in this activity beyond compliance-driven requirements and frequency in order to proactively identify potentially hazardous conditions and appropriately mitigate ignition risks in SCE's HFRA.

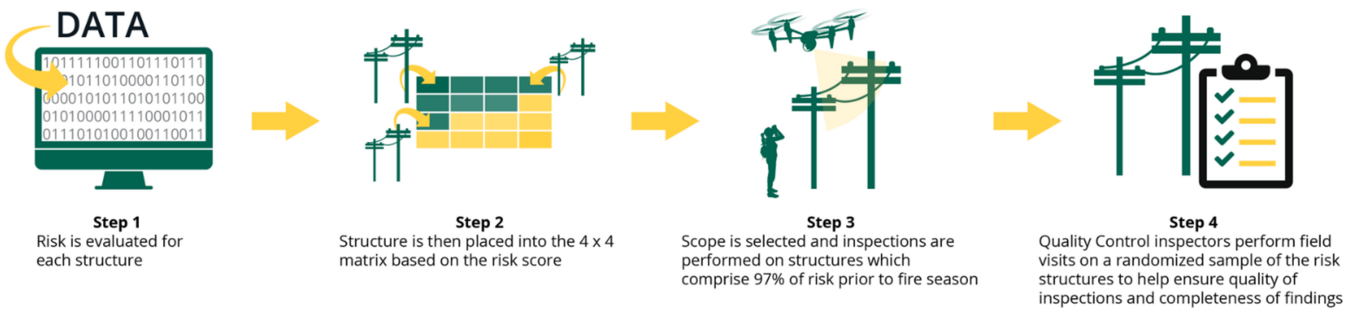
3. Region prioritization:

As risk levels vary across SCE's HFRA, a targeted quantitative approach is being deployed to balance risk reduction, resource availability and costs. Structures are prioritized for inspection based on POI and consequence. In determining the 2022 inspection scope, SCE incorporated the latest risk modelling as well as the need to reserve execution capacity for emergent AOCs. While the 2021 scope for inspections was based on the Technosylva WRRM Version 5.1 consequence model, the 2022 scope is based on the WRRM Version 6.0. For a description of the benefits of using the Technosylva Version 6.0, see Section 7.3.6.3. SCE has updated its 4 x 4 matrix, with one dimension of the matrix representing four levels of POI risk and the other dimension representing four levels of consequence, using the output of WRRM Version 6.0. SCE's overall methodology from 2021 remains the same, where each structure was scored and mapped to a box in the matrix based on its

POI and consequence. The highest risk structures (i.e., those mapped to the red boxes) will be inspected in 2022 as shown in Figure SCE 7-71 and Figure SCE 7-72 below.

Figure SCE 7-71

Evaluation of Risk for Distribution



Although the distribution 4 x 4 matrix has a different selection for what falls within the annual frequency when compared to transmission, both strategies achieve similar levels of relative risk (POI x consequence) as well as providing coverage for a similar level of marginal risk. Said another way, the different selections are driven by the fact the shape of the risk curves between transmission and distribution are not equivalent and therefore we can achieve similar risk buydowns at different marginal points. Marginal risk is identified by finding the highest risk structure that is not included in the annual risk frequency (i.e. the "first one out") and comparing those between both asset classes to ensure we are deploying our mitigations effectively (within the limitations of our 4 x 4 framework).

The percentage in the top row within each cell of the 4 x 4 matrix represents the percentage of structures within the population. The percentage in the bottom row within each cell of the 4 x 4 matrix represents the percentage of risk made up by those structures within the population. In addition, any structures due for a compliance inspection in 2022, regardless of which box they are mapped to, will be included in 2022 scope.

Figure SCE 7-72

Visualization of Risk Analysis for Distribution

Probability of Ignition	Consequence: Level 4	Consequence: Level 3	Consequence: Level 2	Consequence: Level 1	
Level 1	1.9%	0.3%	0.1%	0.1%	**% of Structures**
	0.2%	1.1%	3.3%	10.1%	**% of Risk**
Level 2	4.7%	0.8%	0.5%	0.4%	
	0.2%	1.4%	4.1%	13.9%	
Level 3	9.0%	1.9%	1.3%	1.0%	
	0.2%	1.6%	5.8%	18.0%	
Level 4	41.7%	12.8%	12.0%	11.3%	
	0.2%	1.8%	8.3%	29.7%	

Legend: Inspection Frequency

Red = Every Year

Green = Every Three Years

P1 issues require remediation as soon as the issue is discovered, either by fully remediating the condition or by temporarily repairing the equipment or structure to allow for follow-up corrective action. Examples of P1 issues include vegetation touching lines, broken crossarms or insulators, burned connectors, or wires laying on crossarms. Priority conditions are either completed or made safe within 72 hours for HFRA or non-HFRA.P1 notifications are unplanned activities, also referred to as breakdown maintenance, and include the repair of SCE equipment and structures that are severely damaged, compromised or have failed while in service. P2 issues are lower risk and therefore may be resolved within six months for Tier 3 or 12 months for Tier 2 within HFRA. Examples of P2 issues include vegetation near lines, deteriorated crossarms or splices, or insufficient pole depth. Priority 3 (P3) issues do not require near-term remediation as they do not pose material safety, reliability,or fire risks, and will either be repaired or re-evaluated at or before the next detailed inspection. P3 issues generally require remediation within 60 months pursuant to GO 95, Rule 18.[E18] Examples of P3 issues include missing items such as reflector strips, ground moldings, guy wire guards, or high voltage signs.

4. *Progress on initiative (amount spent, regions covered) and plans for next year:*

In 2020, SCE's goal to inspect 165,000 structures by ground and air as identified in the First Change Orders Report filed September 11, 2020 was exceeded. Ground inspections were completed on 199,050 structures which included inspections in AOCs as identified in the Second Change Order Report and compliance due inspections in HFRA. Aerial inspections were completed on a total of 168,017 structures.[67] Ground and aerial both inspected a total of 157,136 structures for a complete 360-degree view. In 2021, SCE's goal to inspect 163,000 structures by ground and air was exceeded. Ground inspections were completed on 179,683 structures which included HFRI, AOC, and compliance due inspections in HFRA. Aerial inspections were completed on a total of 180,264 structures. Ground and aerial inspections were performed on a total of 172,385 structures for a complete 360-degree view.[162] Table SCE 7-23 and Table SCE 7-24 below, summarizes 2020 and 2021 progress and 2022 plans for IN-1.1.

Table SCE 7-23

Distribution Ground Inspections

Year	Plan	Recorded	Comments
2020	165,000	199,050	Exceeded WMP goal of completing approximately 165,000 inspections as outlined in SCE's First Change Order Report. The completed inspections count of 199,050 includes HFRI (112,665), AOCs (29,490) and compliance (56,895) in HFRA.
2021	Between 163,000 and 198,000	179,683	Exceeded WMP goal of completing approximately 163,000 inspections. The completed inspections count of 179,683 includes HFRI (130,673), AOCs (13,597) and compliance (35,413) in HFRA.
2022	Between 152,000 and 182,000	TBD	Approximately 139,000 risk-informed inspections, approximately 13,000 to meet compliance due dates (since ODI in HFRA has been consolidated into this activity and includes an additional 2,000+ for ground streetlight only pole inspections), and 30,000 in AOCs (because this AOCs scope is related to risks that are not identified at the time of filing this WMP update, the number of inspections will likely vary from what is estimated here.)

Table SCE 7-24

Distribution Aerial Inspections

Year	Plan	Recorded	Comments
2020	165,000	168,017	Exceeded WMP goal of completing approximately 165,000 inspections.
2021	Between 163,000 and 198,000	180,264	Exceeded WMP goal of completing approximately 163,000 inspections. The completed inspections count of 180,264 includes AOCs (30,336) in HFRA.

[162] The completed inspection count for aerial includes inspections where further research is required to associate the structure number to the images. It also includes inspections based on images that were captured in 2020 and 2021 with the inspections completed in the first week of January.

Year	Plan	Recorded	Comments
2022	Between 150,000 and 180,000	TBD	Approximately 150,000 risk-informed inspections and 30,000 in AOCs (because this AOCs scope is related to risks that are not identified at the time of filing this WMP, the number of inspections will likely vary from what is estimated here).

5. Future improvements to initiative:

As described in SCE's 2020 and 2021 WMPs, lessons learned included:

- Helicopters have the capability to capture images faster than drones, but drones provide certain benefits that helicopters cannot as drone inspections reduce the amount of noise our customers experience, and drones can obtain closer proximity to the structures that can allow for better picture resolution.

- To compliment inspection process in 2021, SCE utilized the Grid Resiliency Viewer, and the AI/ML models to review photographs received from the helicopter and drone vendors. The AI/ML models were used to detect certain conditions on poles and cross-arms and to evaluate the photo quality of photos received from drone and helicopter vendors. These models assisted SCE inspectors in organizing and prioritizing their review of the photos that led to more efficient identification of conditions requiring remediation. These practices will continue to be applied in 2022.

In 2021, SCE vendors collected LiDAR data for the sole purpose of obtaining accurate latitude/longitude information of SCE structures. Due to last year's efforts, asset inspections and its vendors can now use the latitude/longitude information captured last year and utilizing GPS coordinates, accurately identify structures for image capture. In addition, SCE is exploring potential solutions that will allow for the visualization of collected LiDAR that could potentially enhance the inspection process and may also help to mitigate risks (e.g. structural issues, conductor tension, etc.) to the organization.

In 2022, dependent on union agreements, SCE will begin to test a new approach to the 360-degree overhead distribution (33 kV and below) ground and aerial inspections consisting of performing a singular inspection in the field. In previous WMP years, ground and aerial inspections took place during separate time periods and by separate resources. The new approach will be to perform a ground and aerial inspection during a single field visit. This singular overhead distribution aerial and ground inspection approach is expected to improve the customer experience, reduce the environmental footprint, streamline the notification process, improve employee and contractor safety, and create cost efficiencies. During the initial roll out of the new approach, poles that have both distribution and transmission assets will need to be visited twice due to the inspectors not having dual qualification of the varied voltage classes. Based on the lessons learned from the approach for overhead distribution inspection, SCE will consider possible changes to transmission inspections in 2023 and beyond. A quality review of a pre-determined percentage of overhead distribution aerial and ground inspections will be performed to help ensure consistency, inspector aptitude, and efficiency.

Beyond 2022, SCE will continue to evaluate risk prioritization methodology for inspections based on lessons learned and SCE's Integrated Grid Hardening Strategy as discussed in Section 7.1.2.1. SCE will also continue to evaluate the appropriate scope and methods for this activity based on then-current risk modeling and analysis and further explore ways to evolve from compliance-driven remediations to risk-based remediations.

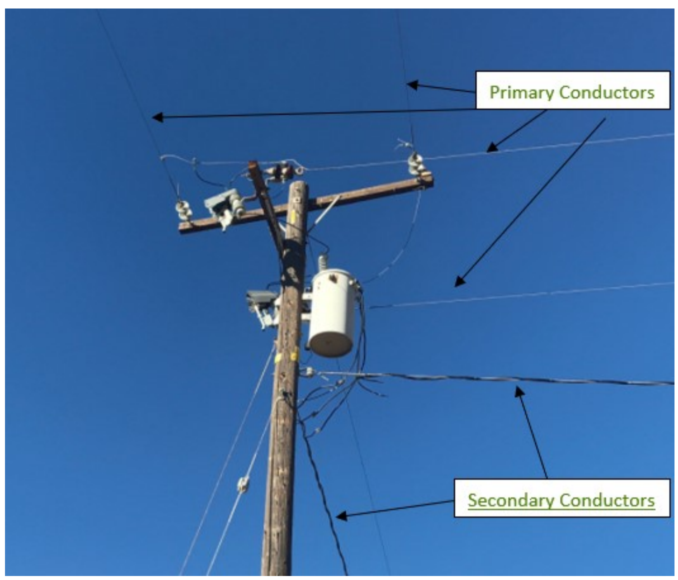
Secondary Conductor Pilot

In 2022, SCE is exploring mitigation strategies for secondary conductor, which is conductor that branches off transformers fed by the primary conductor to service lower voltages such as residential loads as shown in Figure SCE 7-73 below. SCE has approximately 750,000 poles system-wide (120,000 in HFRA) that support overhead secondary conductor, of which approximately 200,000 poles (40,000 in HFRA) only support secondary conductor.

Figure SCE 7-73

Secondary Conductor

Secondary Conductor Branches Off Transformers Fed By the Primary Lines to Serve Lower Voltages



Many ignitions from secondaries are typically lower risk in terms of consequence, such as the number of acres burned, given that they are often closer to customers, typically in areas with fire breaks (e.g., roadways) and maintained vegetation (e.g., customers' front and back yards). Furthermore, most secondary conductors and service drops have a covering that reduces the likelihood for potential ignitions. Since 2019, the largest CPUC-reportable event in SCE's HFRA caused by a secondary conductor is 200 acres, which is significantly less than the maximum sizes of fires associated with transmission and distribution primary conductor. The average CPUC reportable fire since 2019, that involved secondary conductors is 0.05 acres.

SCE observed approximately 30% of CPUC-reportable ignitions in HFRA were related to secondary conductors in 2020 and 2021. Although secondaries are typically lower consequence risk as described above, it is important for SCE to analyze the higher risk consequence areas to ensure that ignitions do not occur from secondary conductors (especially due to the increase SCE has seen from 2019). In order to determine what type of mitigations to target at these high consequence locations for secondary conductors, SCE evaluated the risk drivers associated with these ignitions. This analysis determined that EFF and CFO were the main drivers of secondary caused ignitions, primarily caused by bare connectors, vegetation, and wildlife contact. Based on this analysis, SCE plans on targeting high consequence locations to mitigate these risk drivers, subject to resource constraints.

While most secondaries in HFRA are in lower consequence areas, 16,000 poles are in the top 25% of consequence risk and SCE is prioritizing proactive mitigation work on these poles. A risk assessment is being performed utilizing vegetation data and location of secondary-only structures in HFRA, to identify potential areas to perform proactive secondary trimming or other mitigations.

A number of mitigations were deployed in 2021 after observing an increasing trend in ignitions associated with secondary conductor in 2020. These mitigations included implementing a temporary solution to tape exposed secondary voltage connectors and replacing all high fire open wire bare secondaries with multiplex conductor. Additionally, SCE's Reliability Operations Center is leveraging algorithms to identify potential overload, energy theft, loose connections, damaged insulation, and other issues on secondaries based upon voltage signals from smart meters.

Notifications were created to replace all identified high fire open-wire bare secondaries with multiplex conductor within a three-year timeframe. Also, the distribution inspection checklist was revised to add questions that focus on secondary issues, to identify connector damage in span, exposed connector and vegetation.

In 2022 SCE intends to inspect and trim vegetation around approximately 700 secondary structures and to tape connectors on approximately 3,000 secondary structures in SCE's HFRA, subject to resource constraints and other execution risks. SCE is also developing a secondary connection covering to replace temporary taping and evaluating a breakaway that disconnects and de-energizes service and secondary connector at predetermined mechanical load, which prevents ignitions if the wires fall due to fallen trees or excessive winds.

7.3.4.9.1.1 Response to SCE Action Statement, 2021 WMP Additional Issue to Address in 2022 WMP

The following is one of the Additional Issues as provided by OEIS in the Final Action Statement on SCE's 2021 WMP:

> ***Issue****: SCE's existing drone inspection pilot programs appear to show promising results as an effective and cost-effective method of inspection. However, SCE does not provide details as to how it intends to move forward with its drone inspection programs.*
> ***Remedy****: SCE should evaluate its drone pilot program and assess the potential for broader use of an investment in drones. SCE should determine whether the results of the pilot program provide support for broader application of drone inspections, continuation of the existing program, or termination of the drone inspection effort.*

SCE's response to this Issue/Remedy is described below:

Drones are used in SCE's HFRI inspections and during PSPS restoration efforts (see Section 7.3.8.1) (DEP-2). Consideration is being taken to utilize drones on a more frequent basis going forward. Additionally, as described in Section 7.1.5, SCE utilizes drones for several applications and continues to evaluate its broader use for wildfire mitigation efforts. SCE developed the advanced UAS demonstration project to study the feasibility, effectiveness, and efficiency of using drones in flying BVLOS missions and to closely monitor a rapidly evolving regulatory environment in the UAS space.

7.3.4.10 ***Generation High Fire Risk-Informed Inspections and Remediations in HFRA (IN-5)***

In 2022, SCE is continuing its inspection program of relevant generation-related assets in HFRA, including powerhouses, substations, and low-voltage ancillary assets to identify remediations to reduce the risk of wildfire ignition. As inspections themselves do not reduce wildfire risk unless followed by appropriate and timely remediations, SCE, similar to its 2021 WMP Update, is presenting Generation Remediations (formerly SH-12.3 in SCE's 2020 WMP) within this activity.

1. *Risk to be mitigated / problem to be addressed:*

   Deterioration of electrical equipment associated with power generation facilities that pose the same fault and ignition risks described in the Distribution HFRI Inspection program (IN-1.1). Because SCE's generation facilities are often located in or near heavily forested areas, wildfire propagation in these areas could affect critical power generation infrastructure and equipment. Focus, in HFRA, has increased on the deterioration of electrical equipment including how the equipment appears visually.

2. *Initiative selection:*

In March 2019, SCE began to inspect all electrical lines, equipment, and wiring associated with generation infrastructure, including secondary and control lines feeding ancillary generation assets in HFRA. These inspections included ignition-focused assessments of low-voltage ancillary assets and their associated overhead lines, supporting structures, and any exposed wiring and/or threats from vegetation that require additional mitigation. In addition, high-voltage facilities were inspected to help ensure that all overhead connections from the last inspection(s) of transmission and distribution structures had been evaluated and assessed for vegetation clearance buffers, using relevant criteria from transmission and distribution inspections. In 2020 and 2021, SCE continued to inspect generation-related assets and worked towards integrating this inspection program into its current inspections routines to streamline field efforts.

Once asset deterioration or other corrective actions are identified during inspections, timely remediations of these conditions are imperative to reduce the probability of faults and potential ignitions and thus achieve the ignition driver reduction benefits.

This activity follows the best practices of distribution and transmission inspections and therefore no alternatives were considered. Because there are a limited number of assets in scope for this initiative, SCE has included costs of this program in the same RSE calculation for Distribution HFRI Inspections (IN-1.1) and Remediations.

3. Region prioritization:

Generation HFRI Inspections are performed on each asset every other year in HFRA Tier 2 and 3, with prioritization given to Tier 3. Regarding Tier 3, 60% is performed during the first year of the two-year cycle and the remaining 40% in the second of the two-year cycle due to resource constraints. In 2022, SCE will begin the first year of the two-year cycle. The total workload of the two-year cycle, comprised of both Tier 2 and 3, is split evenly with half in the first year and the remaining the following year.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

In 2020, SCE conducted a risk assessment and determined that the Big Creek area should complete both the 2020 and 2021 planned inspections by year-end 2020 given its higher risk profile and amount of vegetation. After reviewing findings from Big Creek, we determined that inspections on Big Creek assets should be done over a two-year period going forward. As such, we inspected approximately 50% of these assets in 2021 and in 2022 we expect to inspect the remaining approximately 50%. Table SCE 7-25 below summarizes 2020 and 2021 recorded and 2022 plans for IN-5.

Table SCE 7-25

Generation Inspections

Year	Plan	Recorded	Comments
2020	200	268	Exceeded 2020 goal of inspecting 200 assets; participated in the AOC Inspections that brought 11 inspections forward from the 2021 plan and re-inspected 20 assets.
2021	181	232	Exceeded 2021 goal of inspecting 181 assets; participated in the AOC Inspections that added 45 inspections.
2022	190	TBD	SCE's 2022 goal is to inspect approximately 50% of identified assets based on current schedule.

5. Future improvements to initiative:

Over the next three years (2022-2024) SCE will re-evaluate and determine the frequency of these Generation asset inspections based on the previous year's results. SCE will also review remediation trends to identify common/reoccurring issues and develop projects, plans and processes that could minimize future occurrences. Over the next ten years (2022-2032) SCE will continue to review this program for ways to improve effectiveness and efficiency including looking into fully incorporating WMP inspections into its existing O&M inspections program.

7.3.4.11 Other discretionary inspection of transmission electric lines and equipment, beyond inspection mandated by rules and regulations

7.3.4.11.1 Transmission HFRI Inspections and Remediations (IN-1.2)

In its 2020 WMP, SCE presented two separate activities for its transmission inspections: Transmission Risk- Informed Inspections (previously IN-1.2 in SCE's 2020 WMP) and Transmission Aerial Inspections (previously IN-6.2 in SCE's 2020 WMP). Given these activities have the same drivers and approach and the findings from these inspection programs are consolidated for remediation work, SCE combined these activities into one activity (IN-1.2) in its 2021 WMP update. Moreover, as inspections themselves do not reduce wildfire risk unless followed by appropriate and timely remediations, SCE, in its 2021 WMP Update presented Transmission Remediations (previously SH-12.2 in SCE's 2020 WMP) within this activity.

In 2022, SCE will continue its ground inspection program of transmission structures in addition to those required by GO 165[E17] and that represent the highest risk based on POI and consequence. SCE is continuing a more comprehensive inspection program for its transmission overhead facilities in

HFRA to detect equipment anomalies and mitigate ignition risks that cannot be detected during compliance-driven programs alone. SCE will also continue to complement its ground-based inspections in HFRA with aerial inspections using helicopters and drones to provide a 360-degree view of the assets to detect equipment/structure conditions which could lead to faults and ignitions.

Ignition risks identified through these HFRA inspections will be remediated in accordance with CPUC requirements. In addition to inspecting our electrical assets, we also regularly inspect SCE telecommunications equipment within HFRA and perform associated remediations.

1. Risk to be mitigated / problem to be addressed:

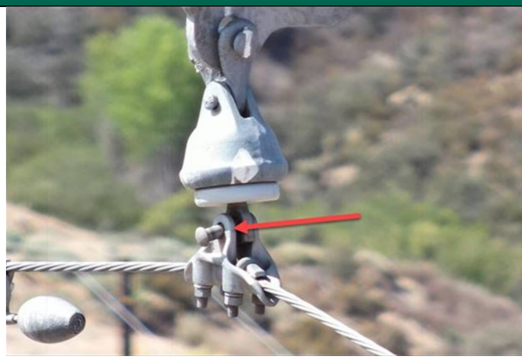
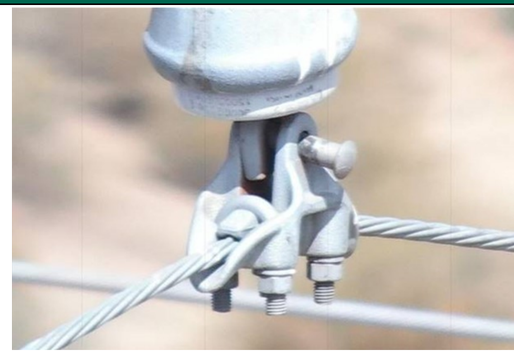
Similar to the discussion on distribution structures in IN-1.1, the deterioration of transmission (and sub-transmission) structures and equipmentcan lead to faults and ignitions that can have similar impacts as the risks associated with distribution structures. SCE's Transmission EOI program in 2019 demonstrated that the requirements, scope and frequency of compliance-driven grid patrols and overhead detailed inspections were insufficient in detecting a large number of potential hazards that, if not remediated, would increase the risk of wildfire ignition in HFRA.

2. Initiative selection:

Inspections identify conditions in need of remediation. Those conditions are then prioritized, and items are remediated before they fail and cause a fault. SCE performs routine inspectionsof SCE's overhead transmission electrical system in compliance with GO 165.[E17] However, in 2019 SCE realized the need to shift towards more risk-informed inspections and accordingly has increased its normal inspection population in HFRA. Aerial inspections are typically performed at the same locations as ground inspections and provide a 360-degree view of the assets to detect equipment/structure conditions that are difficult to identify via ground inspections, such as missing cotter keys, which could lead to faults and ignitions (see Figure SCE 7-68 above and Figure SCE 7-74 below). This initiative also helps collect valuable data regarding asset conditions that can be analyzed, stored, evaluated, and used for risk modeling and asset management activities. Once the need for corrective actions is identified during inspections, timely remediations of these conditions are imperative to reduce the probability of faults and potential ignitions and thus achieve the ignition driver reduction benefits.

Figure SCE 7-74

Transmission Missing Cotter Key (Drone Capture)

Distant	At Close Range
	

SCE continually enhances its HFRI inspections based on the latest data and ignition risk analysis. As described in SCE's Second Change Order Report, prior to the start of the 2020 fire season, SCE's Fire Science team identified 17 AOCs in its HFRA, which are areas that pose increased fuel-driven and wind-driven fire risk primarily due to elevated dry fuel levels. This threat can be magnified during periods of high wind, high temperatures and low humidity, as forecasts predicted for Fall 2020 in Southern California. The methodology used to identify the AOCs was based on several factors, including fire history, weather conditions, fuel type, exposure to wind, and egress, among others. Further details on methodology and risk can be found in Section 7.3.6.3.

The AOCs inspections can also be used to inspect high-risk lines before peak Santa Ana events later in the year to capture any defects that may have occurred intra-year or identification of any new fire risks not previously captured as part of the original HFRI inspections.

SCE continued AOCs inspections in 2021 and made improvements by implementing both a Summer and a Fall AOC program. The Summer AOC effort identified 12 areas where there was risk of a fuel-driven fire, five (5) of which were identified as significant risk and were the focus of additional inspections. The 2021 Fall AOC effort was very similar to the 2020 AOCs exercise, and indeed many of the same areas were identified (11 areas). Additionally, SCE conducted Fall AOCs pre-patrols. The pre-patrol consisted of a slow vehicle-based (where possible) patrol which looked for P1 conditions, mid-span clearance conditions (e.g., vegetation in lines or potential wire slap) and CIP/3rd party hazardous conditions. The analyses for these AOCs included all Distribution, Transmission, and Generation structures associated with whole circuits and the surrounding topographical area in the identified AOCs.

SCE determined that ground and aerial inspections and the associated remediation work in the AOCs were necessary to mitigate ignition risk and reduce the consequence risk of fuels-driven and wind-driven fires.

To mitigate the potential risk, SCE accelerated inspections, remediation and vegetation trimming and removal in the identified AOCs. Besides identifying equipment-related hazards, these inspections also help with collecting valuable data regarding asset conditions that can be analyzed, stored, evaluated, and used for risk modeling and asset management activities. Notifications in AOCs are placed on a compliance remediation timeline with the highest risk notifications accelerated to be completed before fire season. In order to identify the highest risk notifications, a risk ranking methodology is utilized for AOCs, made up of four core dimensions which including pending work on structures, time function, probability of ignition and Technosylva consequence score. The Notification Risk Ranking Methodology can be further focused for each AOCs season based on specific dimensions that visualize that season's driver. In 2022, SCE plans to implement both a Summer and a Fall AOCs program (including a Fall pre-patrol).

Similar to distribution remediations, planned maintenance work identified through HFRA inspections is comprised of repairs to SCE's equipment and structures recorded as P1 and P2 items (i.e., level 1 and level 2). These repairs can be performed by qualified electrical workers for electrical assets and cable splicers for telecom assets and completed based on the established due date. P1 notifications are unplanned activities, also referred to as breakdown maintenance, and include the repair of SCE equipment and structures that are severely damaged, compromised or have failed while in service. P1 conditions are either completed or made safe within 72 hours for HFRA or non-HFRA. P2 issues are lower risk and therefore may be resolved within six months for Tier 3 or 12 months for Tier 2 within HFRA.

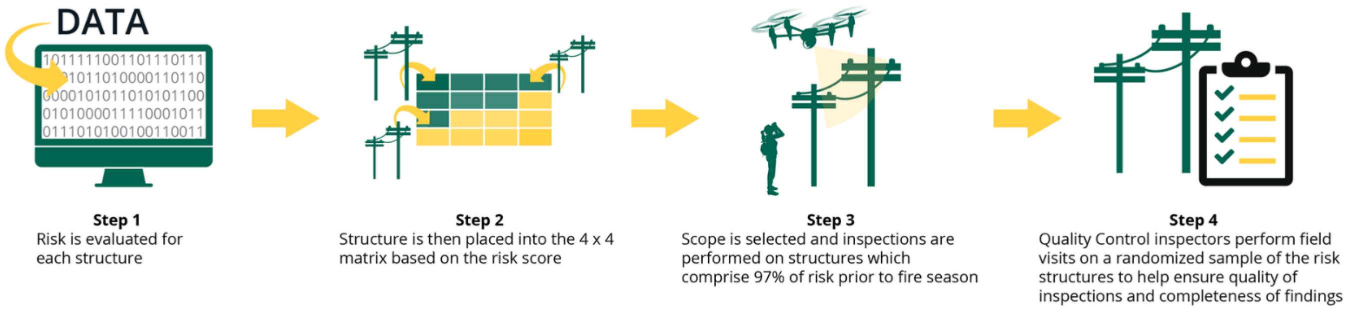
For 2022, RSE scores were calculated separately for transmission ground and transmission aerial inspections and remediations. The RSE scores for each were relatively medium in comparison to other initiatives. Accordingly, SCE determined that it was prudent to continue to engage in this activity beyond compliance-driven requirements and frequency in order to proactively identify potentially hazardous conditions and appropriately mitigate ignition risks in SCE's HFRA.

3. *Region prioritization:*

As risk levels vary across HFRA, a targeted quantitative approach is being deployed to balance the costs of inspections and the potential catastrophic fire risk associated with transmission asset failures. Structures are prioritized for inspection based on POI and consequence. The 2022 scope for inspections was based on the Technosylva WRRM 6.0 consequence model. For a description of the benefits of using the Technosylva WRRM 6.0 model, see Section 7.3.6.3. The POI models for transmission and sub transmission assets that were developed in 2021 have been updated and were utilized to determine the 2022 scope. SCE created a 4 x 4 matrix with one dimension of the matrix representing four levels of POI risk and the other dimension representing four levels of consequence. Each structure was scored and mapped to a box in the matrix based on its POI and consequence. The highest risk structures (i.e., those mapped to the red boxes) will be inspected in 2022 as shown in Figure SCE 7-75 and Figure SCE 7-76 below.

Figure SCE 7-75

Evaluation of Risk for Transmission



Although the transmission 4 x 4 matrix has a different selection for what falls within the annual frequency when compared to distribution, both strategies achieve similar levels of relative risk (POI x consequence) as well as providing coverage for a similar level of marginal risk. Said another way, the different selections are driven by the fact the shape of the risk curves between transmission and distribution are not equivalent and therefore we can achieve similar risk buydowns at different marginal points. Marginal risk is identified by finding the highest risk structure that is not included in the annual risk frequency (i.e. the "first one out") and comparing those between both asset classes to ensure we are deploying our mitigations effectively (within the limitations of our 4 x 4 framework).

The percentage in the top row within each cell of the 4 x 4 matrix, represents the percent of structures within the population. The percentage in the bottom row within each cell of the 4 x 4 matrix, represents the percent of risk made up by those structures within the population. In addition, any structures due for a compliance inspection in 2022 will be included in 2022 scope.

Figure SCE 7-76

Visualization of Risk Analysis for Transmission

Probability of Ignition	Consequence: Level 4	Consequence: Level 3	Consequence: Level 2	Consequence: Level 1
Level 1	3.5% 0.2%	0.4% 0.8%	0.2% 2.1%	0.2% 7.1%
Level 2	7.8% 0.4%	2.4% 1.6%	1.3% 4.2%	0.9% 11.2%
Level 3	12.5% 0.4%	4.5% 1.9%	3.2% 5.6%	1.9% 15.2%
Level 4	25.9% 0.3%	11.5% 2.0%	12.1% 7.4%	11.1% 39.7%

% of Structures (upper value in each cell)
% of Risk (lower value in each cell)

Legend: Inspection Frequency
Red = Every Year
Green = Every Three Years

4. Progress on initiative (amount spent, regions covered) and plans for next year:

In 2020, ground inspections were completed on 35,561 structures which includes inspections in AOCs as identified in the Second Change Order Report, HFRI inspections, and compliance due inspections in HFRA. Aerial inspections were completed on a total of 31,381 structures.[163] Ground and aerial inspections were both performed on a total of 30,666 structures for a complete 360-degree view. In 2021, ground inspections were completed on 20,815 structures which includes HFRI inspections, AOC inspections, and compliance due inspections in HFRA. Aerial inspections were completed on a total of 20,799 structures.[163] Ground and aerial inspections were both completed on a total of 19,983 structures for a complete 360-degree view. Table SCE 7-26 and Table SCE 7-27 below summarizes 2020 and 2021 progress as well as 2022 plans for IN-1.2.

[163] The completed inspection count for aerial includes inspections where further research is required to associate the structure number to the images. It also includes inspections based on images that were captured in 2020 and 2021 with the inspections completed in the first week of January.

Table SCE 7-26

Transmission Ground Inspections

Year	Plan	Recorded	Comments
2020	33,500	35,561	Exceeded 2020 goal of approximately 33,500 inspections identified in the First Change Orders Report filed September 11, 2020 (SCE increased its original goal of approximately 22,500 ground-based inspections to approximately 33,500 inspections). The completed inspections count of 35,561 includes HFRI (22,590), AOCs (3,254) and compliance (9,717) in HFRA.
2021	Between 16,800 and 22,800	20,815	Exceeded WMP goal of completing approximately 16,800 inspections. The completed inspections count of 20,815 includes HFRI (13,547), AOCs (832) and compliance (6,436) in HFRA.
2022	Between 16,000 and 19,000	TBD	Comprised of approximately 13,500 risk-informed inspections, approximately 2,500 compliance inspections, and approximately 3,000 AOC inspections (because this AOC scope is related to risks that are not identified at the time of filing this WMP, the number of inspections will likely vary from what is estimated here) based on current schedule.

Table SCE 7-27

Transmission Aerial Inspections

Year	Plan	Recorded	Comments
2020	33,500	31,381	Nearly met target of approximately 33,500 inspections.
2021	Between 16,800 and 22,800	20,799	Exceeded WMP goal of completing approximately 16,800 inspections. The completed inspections count of 20,799 includes AOCs (3,111) in HFRA.
2022	Between 16,000 and 19,000	TBD	Comprised of approximately 16,000 risk-informed inspections and an allowance for approximately 3,000 AOC inspections (because this AOC scope is related to risks that are not identified at the time of filing this WMP, the number of inspections will likely vary from what is estimated here) based on current schedule.

In 2022, SCE will utilize drones predominantly with a limited number of helicopters due to the higher quality of images captured by drones. There are times when helicopters must be utilized which is dictated by service roads being washed out/non-passable, personnel cannot reach the structure due to terrain or vegetation, or personnel believe there is a safety risk getting to the structure. All attempts are made to reach the structure but there is a percentage of scope that is recognized as difficult to access.

Similar to lessons learned in 2020, SCE discovered that there are benefits for aerial to begin even earlier in the year to align with ground inspections. In 2021, aerial inspections mobilized towards the end of the 1st quarter 2021/beginning 2nd quarter. In comparison, in 2022, SCE intends to begin its aerial inspections in the beginning of the 1st quarter to allow sufficient time for operational planning. In addition, SCE will continue to revise the survey questions to include variations and additional options. Finally, SCE will be utilizing AI/ML in 2022, to reduce human error, improve the consistency and quality of inspections, improve inspection efficiency and speed, and improve data quality.

In 2021, SCE vendors collected LiDAR data for the sole purpose of obtaining accurate latitude/longitude information of SCE structures. Due to last year's efforts, asset inspections and its vendors can now use the latitude/longitude information captured last year and utilizing GPS coordinates, accurately identify structures for image capture. In addition, SCE is exploring potential solutions that will allow for the visualization of collected LiDAR that could potentially enhance the inspection process and may also help to mitigate risks (e.g. structural issues, conductor tension, etc.) to the organization.

Regarding the AOC program in 2021, SCE had a target number of inspections, however the specific structures to be inspected were defined immediately before the AOC summer readiness effort. As a result, this required operations to re-plan their scheduled work to allow for higher priority AOCs. A lesson learned from this was to provide visibility earlier into the detailed structures within the expected AOCs which will help to plan more efficiently. To provide visibility and operationalize in 2022 and beyond, SCE anticipates that the areas in scope for AOCs remain similar from the previous year to the next unless there has been a significant event or change to the conditions. This concept allows SCE to estimate the future years work based on the previous for planning purposes. In mid-October 2021, the existing and incremental AOC scope was shared with operations to plan their 2022 inspection work. The incremental scope was based on structures from the previous year's AOCs that is not part of the 2022 HFRI nor 2022 Compliance scope. In mid-March of 2022 and mid-May of 2022, the AOCs for Summer 2022 and Fall 2022 will be finalized respectively based on any significant events or condition changes before the start of the readiness season efforts.

5. Future improvements to initiative:

As noted above, SCE is utilizing AI/ML capabilities and the images collected from captures to help bring attention to potential notifications faster regarding structures, equipment, and apparatus. Images collected are immediately scanned utilizing AI/ML technology to quickly identify potential P1 and P2 notifications which are reviewed and validated by inspectors. Beyond 2022, SCE will continue to evaluate risk prioritization methodology for inspections based on lessons learned and in alignment with SCE's new Integrated Grid Hardening Strategy as discussed in Section 7.1.2.1. SCE will also continue to evaluate the appropriate scope and methods for this activity based on then-current risk modeling andanalysis and further explore ways to evolve from compliance-driven remediations to risk-based remediations. As described in Section 7.3.4.9.1, dependent on union agreements, SCE will begin to test a new approach to the 360-degree inspection method for overhead distribution. Based on the lessons learned from the approach for overhead distribution inspection, SCE will consider possible changes to overhead transmission inspections in 2023 and beyond.

7.3.4.12 Patrol inspections of distribution electric lines and equipment

This program is part of SCE's general portfolio of inspection activities. SCE performs patrol inspections of SCE's overhead distribution electric system in compliance with GO 165.[E17]

1. Risk to be mitigated / problem to be addressed:

A patrol inspection is a simple visual inspection that is designed to identify obvious structural problems or hazards.

2. Initiative selection:

SCE performs patrols of SCE's overhead distribution electric system in compliance with GO 165.[E17] GO 165[E17] requires SCE to perform an annual patrol inspection of all overhead distribution electric assets that are in SCE's HFRA. Though SCE does not calculate RSEs for compliance programs which have to be undertaken regardless of RSEs, SCE supports risk informed evaluation of compliance requirements in collaboration with Energy Safety and the CPUC.

3. Region prioritization:

Annual Patrols are performed on structures within specified grids in HFRA throughout SCE's service area. The patrols are prioritized such that HFRA patrols are completed in the first half of the year. In 2022, SCE intends to patrol all accessible HFRA grids by 05/31.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

SCE completed annual grid patrol of its distribution electric system assets in 2021. SCE plans to inspect all required grids in 2022. SCE has engaged contractors to perform the grid patrol inspections to free up capacity among its inspectors and allow them to focus on detailed inspections.

5. Future improvements to initiative:

There are no current plans for improvements; however, SCE will continue to evaluate changes to the methods and data collections tools to improve theefficiency and risk mitigation of patrol inspections.

7.3.4.13 Patrol inspections of transmission electric lines and equipment

This program is part of SCE's portfolio of inspection activities. SCE performs patrol inspections of SCE's overhead transmission electric system in compliance with GO 165[E17], NERC, WECC rules and regulations and CAISO's Transmission Control Agreement.

1. *Risk to be mitigated / problem to be addressed:*

A patrol inspection is a visual inspection that is designed to identify potential risk associated to structure.

2. *Initiative selection:*

SCE performs patrol inspections of SCE's overhead transmission electric system in compliance with GO 165[E17], NERC, WECC and CAISO rules and regulations. Though SCE does not calculate RSEs for compliance programs which have to be undertaken regardless of RSEs, SCE supports risk informed evaluation of compliance requirements in collaboration with Energy Safety and the CPUC.

3. *Region prioritization*:

Resource allocation and work prioritization is driven by compliance requirements. Compliance patrol inspections are performed at the same time as transmission HFRI inspections. For circuits that traverse both in and out of HFRA, SCE may separately inspect the assets of circuits outside of the HFRA to complete the patrol inspection.

4. *Progress on initiative (amount spent, regions covered) and plans for next year*:

SCE completed annual grid patrol inspections of all circuits (which includes HFRA), and associated structures, in 2021. SCE plans to perform the same in 2022. Patrol (routine) inspections are performed each year and are visual assessments that are performed at the ground level or via aircraft, for the purpose of identifying, prioritizing, and recording obvious discrepancies. Detailed inspections are performed every third year and are more careful visual assessments performed in close proximity to or while upon a structure for the purpose of identifying, prioritizing, and recording discrepancies. This activity includes performing minor or temporary repairs during the inspection and any special technical evaluation as required.

5. *Future improvements to initiative:*

SCE will continue to evaluate changes to the methods and data collections tools to improve the efficiency and risk mitigation of patrol inspections. SCE currently records completion of transmission patrol inspections by circuit. In 2022, SCE plans to evaluate the recording of patrol inspections on a structure basis versus a circuit basis that could enhance the granularity of the data being collected for each structure.

7.3.4.14 Pole loading assessment program to determine safety factor

SCE's Pole Loading Program (PLP) was initiated in 2014, ended in 2021[164], and was a comprehensive program to assess pole loading of all poles in SCE's service area (HFRA and non-HFRA) for GO 95[E16] safety compliance. Poles that do not meet minimum safety factor requirements are either repaired or replaced depending on the outcome of the assessment. Although PLP improves safety and reliability including reducing ignition risks associated with pole failure from overloading, PLP is primarily a compliance program and not one driven by wildfire risk reduction. The PLP's goal was to assess the structural loading capabilities of the approximately 1.3 million wood, composite, and light weight steel poles in SCE's service area.

1. Risk to be mitigated / problem to be addressed:

The risk to be mitigated is overloaded poles. A pole can be overloaded due to, for example, added electrical equipment, degradation over time, or added load from third-party attachments such as telecommunications lines.

2. Initiative selection:

The PLP program was created to identify poles that do not meet the safety factor requirements of GO 95[E16] and SCE's internal design and constructions standards for repair or replacement. The program was designed to verify that structural integrity of existing poles is sufficient to withstand anticipated loads, including wind loads in high wind areas. PLPs are undertaken to meet GO 95[E16] compliance. Though SCE does not calculate RSEs for compliance programs which have to be undertaken regardless of RSEs, SCE supports risk informed evaluation of compliance requirements in collaboration with Energy Safety and the CPUC.

3. Region prioritization:

Assessments of poles in HFRA are prioritized. GO 95[E16] establishes the minimum loading requirements for overhead supply and communication lines. SCE has adopted wind load design standards that exceeds the GO 95[E16] minimum requirements. In 2020 and 2021, poles located in HFRA were prioritized over poles in non-HFRA.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

SCE has completed over 1.3 million pole assessments since 2014.[165] The figures for 2020 and 2021 are summarized below in Table SCE 7-28.

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[164] SCE's Pole Loading Program was completed in 2021. A small number of HFRA poles will be assessed in 2022.
[165] Originally projected as 1.4 million pole assessment in 2014, however after further review with consolidated data sources in 2020, the number was revised to 1.3 million.

For 2020 and 2021, SCE provided status updates on PLP assessments completed in HFRA in its quarterly reports and informed that SCE was nearing the end of PLP assessments. SCE formally ended the vendor field collections regarding PLP in 2021. In 2022, some limited field collections will continue as carried out by our internal partners in planning. There are some limited carryover assessments (consisting largely of poles with no latitude/longitude coordinates) that will be further assessed/investigated by local planning departments. These carryover assessments may turn out to be data errors with no actual poles in the field. Should poles be found, they will be assessed and remediated, as applicable. Pursuant to Commission direction, SCE will continue remediating pole overloading issues through 2024.

Table SCE 7-28

Pole Loading Assessment Program

Year	Plan	Recorded
2020	1,205	1,216
2021	1,041	780 (261 not needed)

Although SCE did not record PLP assessments for all the poles in its initial 2021 plan, SCE did review all the locations. In some cases, a PLP assessment was not needed due to a variety of factors, including pole replacements via other programs (e.g., storm, covered conductor, etc.). While the stand-alone PLP assessment program is winding down, moving forward, SCE's practice is to pole load poles associated with applicable capital improvement projects to help ensure appropriate loading.

5. Future improvements to initiative:

Given that this program has ended, there are no future improvements to this initiative. SCE expects to finish all pole loading assessments by the end of 2022 and will continue to remediate pole loading issues identified by PLP assessments through 2025. Remediation of poles for 2022 and beyond include approximately 500 poles as outlined in Table SCE 7-29 below. After the PLP program, a small team will remain through February 2022, followed by one individual to oversee the completion of the remaining assessments through the end of 2022.

Table SCE 7-29

2022 Pole Remediations

Type	Forecast
Distribution High-Fire	427
Transmission High-Fire	91

7.3.4.14.1 Response to SCE Action Statement, 2021 WMP Additional Issue to Address in 2022 WMP

The following is one of the Additional Issues as provided by OEIS in the Final Action Statement on SCE's 2021 WMP.

Issue: *In 2020, SCE fell far short of its target for pole loading assessments. SCE forecasted completing 1,205 pole loading assessments but in actuality completed only 29 percent (or 345) of its assessments.*
Remedy: *SCE should detail how it has addressed or will address each the issues that prevented SCE from completing pole loading assessments.*

SCE's response to this Issue/Remedy is described below:

Although it was reported that SCE only completed 345 assessments in 2020, it was clarified that the correct amount completed in 2020 was 1,216, which exceeded the WMP goal of 1,205 pole loading assessments. As mentioned in the Final Action Statement on SCE's 2021 WMP Update on Page 62, "SCE reported performing approximately 1,200 pole loading assessments in its HFRA."

7.3.4.15 Quality assurance / quality control of inspections

In 2022, SCE continues its independent QA/QC initiative conducted on a sample of distribution, transmission, and generation structure inspections in HFRA.[166]

1. Risk to be mitigated / problem to be addressed:

Since 2019, the work scope and complexity of incremental inspections of overhead lines, structures, and equipment in HFRA (IN-1.1 and IN-5) have evolved. QC provides a second level of defense by identifying degrading equipment, third party damage, conductor clearances or other infractions that may have been missed while performing the SCE overhead inspections program

[166] The inspection QA/QC initiative was discussed as WMP activity IN-2 in SCE's 2020 WMP. As this activity is formalized and operationalized, it will be discussed in this section and remain a part of SCE's WMP but will not have program targets specifically tracked by SCE to monitor wildfire mitigation implementation.

inspections. Each QC finding is monitored through closure. The results are summarized and shared with the respective organizations each month to drive performance improvement and prevent reoccurrence. In addition, monthly reporting is used to identify trends to improve performance.

2. Initiative selection:

SCE deemed it important to institute a formal risk-based QC initiative that relied on statistical sampling to identify work errors and target corrective actions including improving training and tools. The QC program helps to ensure that inspections conform to the requirements of SCE's inspection programs by evaluating the results of the inspection after the fact. Since this initiative has been operationalized and does not directly mitigate ignition risk, but rather promotes effectiveness of inspection programs, SCE has not calculated an RSE for this initiative.

The quality program identifies trends to drive continuous improvements in the inspection programs described in IN-1.1, and IN-5, which in turn reduces the probability of equipment failure and ignitions when issues identified by those activities are remediated. SCE's QC inspection program helps drive continuous improvement and is deemed effective when it identifies non-conformance with SCE standards, determines causes of non-conformance,or implements necessary corrective actions. SCE follows the progress of the formal action plans to corrective actions, which can include such things as changes implemented to inspection processes, training, etc. to continuously improve the inspection programs based on QC findings.

3. Region prioritization:

Inspection samples are being conducted and prioritized based on a combination of quality program ranking and risk of structure (using Technosylva). Each QC program is reviewed and scored to determine the quality ranking. The QC programs are categorized into four quality groups, Very High, High, Medium, and Low.

The risk of structure is determined by categorizing the Technosylva risk scores. The Technosylva scores are also categorized into four risk of geography groups, Very High, High, Medium, and Low. The intersection of Risk of Program and Risk of geography determines the Confidence Level and Confidence Interval used to calculate the inspection sample. Applying this method provides a focus on performing an increased number of inspections for higher risk programs as well as an increased higher amount of inspection in areas with a higher risk of geography

4. Progress on initiative (amount spent, regions covered) and plans for next year:

The quality program results for WMP activities in 2021 are outlined below in Table SCE 7-30. In 2022, using a quality risk-based sampling methodology, SCE is targeting to perform 3,000 quality inspections on distribution, transmission, and generation structures.

Table SCE 7-30

2021 WMP Quality Inspections Through 12/31/21

Program	Inspected	NC Structures	Structure Quality Rate	Findings
Overhead Detailed Inspections	4,701	363	92%	431
Transmission Inspections	742	12	98%	16
Generation Inspections	120	8	93%	8
Total	**5,563**	**383**	**93%**	**455**

Nonconforming structures are structures that have at least one actionable finding identified during the quality review or inspection. Depending upon the complexity of the structure, there can be several items that can lead to a finding of nonconformance.

5. Future improvements to initiative:

SCE's QA/QC inspection program will continue to be evaluated as it matures over time. Future quality program enhancements may include such things as updated program rankings, sampling methodologies and expansion of quality programs into other wildfire activities.

7.3.4.16 Substation Inspections

Substation Failure Modes and Effects Analysis (FMEA)[167]

In 2020, SCE undertook a study to help identify potential sources of ignition from major substation assets and develop recommendations for substation equipment inspections and maintenance (IN-7 in SCE's 2020 WMP). This study concluded in 2020 and recommended three actions in the inspection space: continue the installation of Circuit Breaker Online Monitoring (CBOLM), prioritize inspections of oil-filled CBs in HFRA substations through the Oil Circuit Breaker Analysis (OCBA) program, and increase Predictive Maintenance Assessment (PMA) inspections on approximately 40 HFRA substations

[167] The Substation FMEA initiative was discussed as WMP activity IN-7 in SCE's 2020 WMP. This activity concluded at the end of 2020 and will no longer be an activity in the 2021 WMP.

identified in the FMEA. 2021 has served as the planning year to perform the appropriate study, plan work and subsequently execute.

1. *Risk to be mitigated / problem to be addressed:*

Through 2019, SCE's wildfire mitigation strategies and programs were more focused on SCE's overhead distribution system largely because of historical ignition sources being predominately associated with overhead distribution facilities. Historically, SCE has experienced few instances of substation fires spreading beyond the substation premises. Given the increasing risk of catastrophic wildfires, SCE is continuing to assess in 2022, all potential sources of ignition associated with electrical equipment, including substation facilities, for completeness of review of ignition probability drivers. In addition, changes including the reprioritization of the OCBA program, increasing PMA cycles and the continuing of implementing CBOLM devices were made to help reduce potential equipment failures within HFRA identified through the FMEA.

2. *Initiative selection:*

In 2020, prior to incurring any costs associated with wildfire mitigation activities at substations, SCE completed a study to assess the risks of substation equipment failure, whether failure could lead to an ignition, and determine if current inspection and maintenance standards are adequate to identify equipment failures proactively. The purpose of this study was to develop recommendations for substationequipment inspection and maintenance based on qualitative analysis of probability and consequence of failure and associated ignition. SCE did not calculate an RSE for this initiative as it cannot reduce wildfire risk as a standalone item but can inform wildfire risk analysis when used for field inspections and maintenance activities. In 2022, SCE will increase the frequency of PMA inspections from five years to two years for approximately 40 HFRA substations which were identified through the FMEA study. SCE will also continue the installation of CBOLM devices as well as prioritizing existing oil equipment inspections through the OCBA program.

3. *Region prioritization:*

For these programs, substations located within HFRA boundaries are given priority. Within the OCBA program, priority is first given to the HFRA equipment, however equipment condition, diagnostic results and/or known issues will also be taken into consideration when assessing priority order. Regarding PMA, priority is given to the HFRA substations including substations identified within the FMEA. For CBOLM, prioritization is given to HFRA substations, followed by larger/more critical distribution voltage substations, especially those with elevated number of interruption events, and finally by transmission voltage stations.

4. *Progress on initiative (amount spent, regions covered) and plans for next year:*

In 2021, SCE began implementing the recommendation of installing CB online monitoring devices, which provide for numerous improvements. These include, for example, the ability to continuously monitor CBs in lieu of increased maintenance, which reduces the time required to perform diagnostics and also helps ensure employee safety by reducing the amount of switching performed by field personnel. Additionally, this support equipment & substation performance and can help to prevent system failures within HFRA substations. SCE also continued the implementation of the OCBA program (prioritization of oil-filled CB inspections) as recommended in the FMEA. Prioritizing HFRA oil filled CBs helps address the more severe samples and mitigate oil equipment failures. In 2021, we performed data system changes in order to increase the frequency of PMA inspections from every five years to every two years for HFRA substations identified in the FMEA with execution beginning in 2022. Anticipated benefits in 2022 for this recommendation includes more visibility to equipment condition which should help identify and reduce potential failures.

5. Future improvements to initiative:

In 2020, SCE completed the FMEA study and based on the findings, SCE will be increasing the frequency of PMA at approximately 40 substations which are primarily in HFRA. The additional PMA inspections are anticipated to occur starting in 2022. Beyond 2022, SCE plans on continuing the prioritization of OCBA inspections until all oil CBs are replaced. SCE will also continue installing CBOLM devices and continue the PMA inspections at HFRA substations every two years. SCE will incorporate any lessons learned in its deployments of these strategies in 2022 into future year’s activities.

7.3.5 Vegetation Management and Inspections

The following is one of the Additional Issues as provided by OEIS in the Final Action Statement on SCE's 2021 WMP.

2021 WMP Additional Issue to Address in 2022 WMP:

> ***Issues****: SCE adequately details future capabilities, research, and improvements under the reoccurring SCE's 2021 WMP Update header "Future improvements to initiative." However, SCE does not provide a timeline for the implementation or exploration of these improvements.*
> ***Remedy****: When discussing future improvement to VM initiatives in SCE's 2021 WMP Update header "5) Future improvements to initiative," SCE must provide expected timelines for exploration, development, and implantation of the improvement(s).*

SCE's response to this Issue/Remedy is described below:

Please see each vegetation management initiatives update header "5) Future improvements to initiative", for the response to the remedy.

The following is one of the Key Areas for Improvement as provided by OEIS in the Final Action Statement on SCE's 2021 WMP.

2021 WMP Progress Report Item SCE-21-09:

> ***Issue:*** *Need for quantified vegetation management (VM) compliance targets. In Table 12, SCE only defines quantitative targets for 8 of 20 VM initiatives. Energy Safety is statutorily required to audit SCE when a "substantial portion" of SCE's VM work is complete; without quantifiable targets in the WMP and subsequent reporting on those targets in the Quarterly Data Report (QDR) and Quarterly Initiative Update (QIU), Energy Safety cannot fully realize its statutory obligations.*
> ***Remedy:*** *SCE must:*
> *Define quantitative targets for all VM initiatives in Table 12.*
> *If quantitative targets are not applicable to an initiative, SCE must:*
> 1. *Fully justify this,*
> 2. *Define goals within that initiative, and*
> 3. *Include a timeline in which it expects to achieve those goals.*

SCE's response to this Issue/Remedy is described below:

Please see each vegetation management initiatives update header "4) *Progress on initiative (amount spent, regions covered) and plans for next year*", Table 5.3- 1 and Appendix 9.9Table 12 in for the response to the remedy.

7.3.5.1 Additional efforts to manage community and environmental impacts

SCE has processes in place to mitigate the customer and environmental impact of its vegetation management activities.

1. Risk to be mitigated / problem to be addressed:

Planned or pending vegetation management can create disturbances or otherwise impact communities and/or the environment in which the work is performed, especially when affected communities lack awareness about the vegetation management work scope.

2. Initiative selection:

SCE has processes in place to mitigate the customer and environmental impacts of its vegetation management activities and thus address the risk of unanticipated constraints to executing our work in a timely fashion. When vegetation mitigation is necessary, SCE's standard process is to leave a door hanger at the time of inspection, typically within 1-2 months prior, with information on the work to be performed and contact information for questions or concerns. Additional notification is then provided by the mitigation contractor 1-3 days in advance of the vegetation work. The purpose is to provide multiple opportunities for the customer to ask questions or express concerns. Further, SCE also makes note of individual customer requests for items such as advance phone calls or appointment requests before conducting work and notates the work records accordingly to accommodate customers as much as possible. Any interim supplemental inspections and corresponding mitigations follow a similar process. For SCE's Dead & Dying Tree Removal (formerly Drought Resolution Initiative (DRI)) and HTMP, SCE additionally sends a certified letter to customers before any work is performed. The above notification processes do not apply if the inspection identifies an imminent threat to public safety – these are typically remediated within 24 hours, which does not allow for advance notification.

For all situations,when the customer objects to the work being performed, SCE or its contractors will engage in phone calls or in-person visits to explain the reason for the work, evaluate the risk associated with a different mitigation, and attempt to come to mutual agreement. SCE staffs at least one ISA-certified arborist in each district across its service area to address such concerns. In cases where the safety risk cannot be mitigated without superseding the customer's wishes, SCE will exercise its legal right to protect its infrastructure and community safety with the support of local law enforcement and/or fire authorities. Additionally, in some cases the customer engagement process may take enough time that the tree grows into the electrical facilities or otherwise becomes an imminent public safety risk. If that occurs, the necessary mitigation is then prioritized to occur within next 24 hours, and additional notification may not be made.

For new or expanded initiatives that are expected to have significant public impact, SCE meets with the affected agency, city, county, and/or the homeowner associations, as applicable, as well as schedules and attends public meetings, and prepares and distributes educational materials. Public activities may also include the use of targeted social media campaigns to increase the local public's awareness of vegetation management work taking place in the community. More targeted engagement activities may also be warranted, such as coordinating field visits with certified arborists employed by local agencies to demonstrate SCE's program and the risk mitigation approach. Any of these of community engagement activities may also occur based on the passing of new local regulations or increased customer inquiries. Community initiatives are supported by vegetation management operational experts (existing labor) and the outreach and/or materials are provided by SCE's Corporate Communication team. Based on the feedback from this outreach, SCE may manage impacts to the community by, for example, adjusting the pace of vegetation work to limit the number of pruning crews or the hours worked. However, local agency and customer demands may delay critical vegetation management activities and schedules.

Prior to conducting vegetation mitigation activities, SCE conducts an environmental review, obtains any required environmental permits, and performs any necessary environmental field support. SCE leverages GIS layers that integrate with its work management tools to identify environmentally sensitive areas, automating the process where feasible. An environmental review includes SCE's environmental department to review the work activities for potential disturbance to protected natural and cultural resources and identification of environmental protection measures. In some cases, field surveys to assess for biological and cultural resources at the work site are performed. Environmental permitting or agency consultations, as applicable, are also performed as part of the environmental review phase to obtain appropriate agency authorizations prior to performing vegetation work, except in instances where there is an imminent threat to public safety. Additionally, SCE provides vegetation contractors with annual training on environmental requirements and procedures and may supplement that with ad hoc training for specific projects where reinforcement is prudent.

As required in work subject to environmental conditions, environmental field support may include (1) deployment of environmental specialists to conduct pre-activity surveys prior to the start of work to identify protected biological and cultural resources; and/or (2) conducting field monitoring during work activities, such as monitoring nesting birds, waterways, or archaeological sites.

Environmental and public land agency permits can take three to 12 months, or longer, to obtain depending on the scope of work (e.g., new and enhanced programs) and the type of environmental review and permitting required. The environmental review and permitting timeframes may delay necessary vegetation management activities and schedules. For example, hazard trees needing removal that are located within the Yosemite Toad habitat in Sierra National Forest might be on hold for over one year. However, given SCE's commitment to environmental compliance, work is not performed without appropriate review or permitting unless it has progressed to an imminent threat to public safety. SCE strives to work with individual communities and environmental permitting agencies to identify ways to reduce or eliminate barriers to scheduled vegetation management. Managing community impacts and environmental compliance is fundamental to SCE's work in this area, and as such, there are no feasible alternatives to this initiative. SCE did not perform risk analysis or calculate an RSE for this activity as it does not directly mitigate wildfire or PSPS risks but supports other vegetation management activities.

3. Region prioritization:

For the initiatives described previously, prioritization is based on communities with increased mitigation activities, such as hazard tree assessments and the need to obtain deeper trims, and those that have historically required greater engagement to overcome community resistance.

SCE prioritizes efforts to manage environmental compliance by integrating schedules of environmental/agency permitting timeframes, bundling of permit package submittals, pursuing programmatic agency permitting, and regularly engaging agencies with upcoming work activities.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

In 2020, SCE conducted an extensive marketing campaign to reach customers and share information about its upcoming wildfire mitigation work, including vegetation management. Despite the impacts of COVID-19 in 2020 and 2021, SCE was able to participate in numerous engagements with communities and USFS Region Agencies representing National Forests. SCE determined that these engagements were appropriate based on prior attendance and feedback along with resource constraints. Communications that would typically occur in person were transitioned to phone or web based. In addition, SCE's environmental experts performed environmental evaluations for approximately 218,000 work points[168] in 2020. Across all vegetation management programs, SCE's environmental experts performed environmental evaluations for more than 253,000 work points in 2021. In Q4 2021, SCE met its target by releasing a Public Map Viewer, which is a public access work schedule on sce.com to communicate when and where our line clearing activities are planned to occur. This map-based schedule is intended to provide customers and agencies with additional notification for when SCE vegetation crews are expected to be working in targeted areas.

In 2022, SCE will continue to explore expanding its overall customer service evaluation effort to measure customer interactions associated with its vegetation management work, such as including more vegetation management-specific questions in its Voice of the Customer surveys. Voice of the Customer surveys commenced in March 2021 and will continue through the end of 2022 and future years. SCE is working on translating qualitative customer service feedback into meaningful metrics so as to establish a performance baseline to improve its customer interactions. SCE will also continue its efforts to improve its software and data capabilities to integrate data across various vegetation management programs and bundle vegetation management work, which can result in fewer visits to customers' properties and lesser impacts to the community.

5. Future improvements to initiative:

As technology develops, SCE will continue to seek opportunities to integrate vegetation management work with electrical construction and maintenance activities, to further reduce customer impact.

To provide reasonable assurance that SCE continues to comply with environmentally sensitive areas, SCE will continue to manage contractors in accordance with environmental compliance plans and perform post-work validations in partnership with the SCE environmental department. In 2023, SCE will attend partner agency meetings to enhance agency engagement and further demonstrate environmental compliance. As a result of the agency meetings and collaboration, SCE may provide and adjust plans for environmental oversight, crew deployment, and/or work practices.

7.3.5.1.1 Response to SCE Action Statement, 2021 WMP Additional Issue to Address in 2022 WMP

The following is one of the Additional Issues as provided by OEIS in the Final Action Statement on SCE's

[168] SCE defines a work point in WMP Chapter 7.3.5 as a physical location at which work is required, and that location would require multiple trees and or/required trims.

2021 WMP.

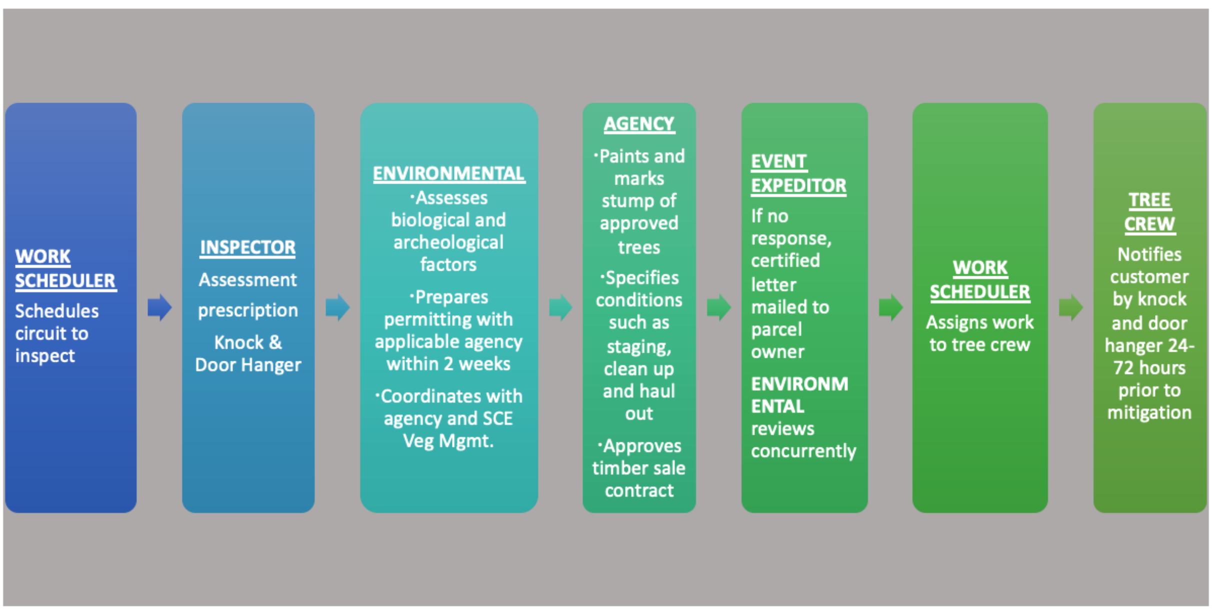
Issue: In Section 7.3.5.1, SCE does not provide detail regarding its customer, agency, and government vegetation management notification process.
Remedy: Provide a visual description (e.g., flow chart, decision tree etc.) of customer, agency, and government notifications for vegetation management activities and emergency work. Include the methods of notification(s) (e.g. phone calls, emails, door hangers, etc.) and sequences of notification(s).

SCE's response to this Issue/Remedy is described below:

Figure SCE 7-77 explains the step-by-step customer notification process SCE navigates to mitigate customer and environmental impacts caused by vegetation management activities.

Figure SCE 7-77

Vegetation Management Customer Notification Process



**Emergency work will follow a similar process with exception of agency permitting. Agencies are notified after emergent work is completed due to the 24-hour time constraint.*

7.3.5.2 Detailed inspections and management practices for vegetation clearances around distribution electrical lines and equipment

SCE discusses both distribution and transmission practices in this section. SCE performs annual inspections and trimming for clearance around conductors in accordance withapplicable regulations such as GO 95 [E19], PRC 4293[E22] and SCE's Transmission Vegetation Management Plan and Distribution Vegetation Management Plan. Independent parties perform QA reviews and QC inspections to validate work quality and adherence to internal program and regulatory requirements.

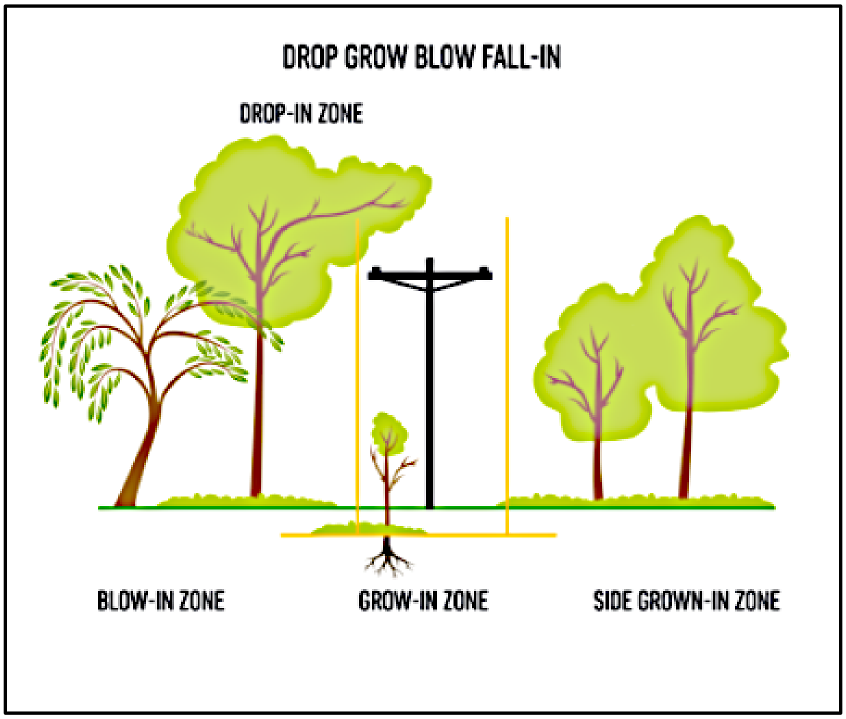
1. Risk to be mitigated / problem to be addressed:

The primary risk to be mitigated is vegetation contact with energized equipment. For line voltages between 2.4 kV to 69 kV, vegetation can create a risk to SCE facilities when the vegetation is located in grow-in zones (i.e., beneath the energized equipment), blow-in zones (i.e., within general blow-in proximity to energized equipment), drop-in zones (where tree limbs overhang energized equipment), and side grow-in zones (i.e., adjacent to energized equipment).

Below, see Figure SCE 7-78 "Drop Grow Blow Fall-In" which depicts a scenario where a tree limb poses a drop-in risk to energized equipment.

Figure SCE 7-78

Drop Grow Blow Fall-In

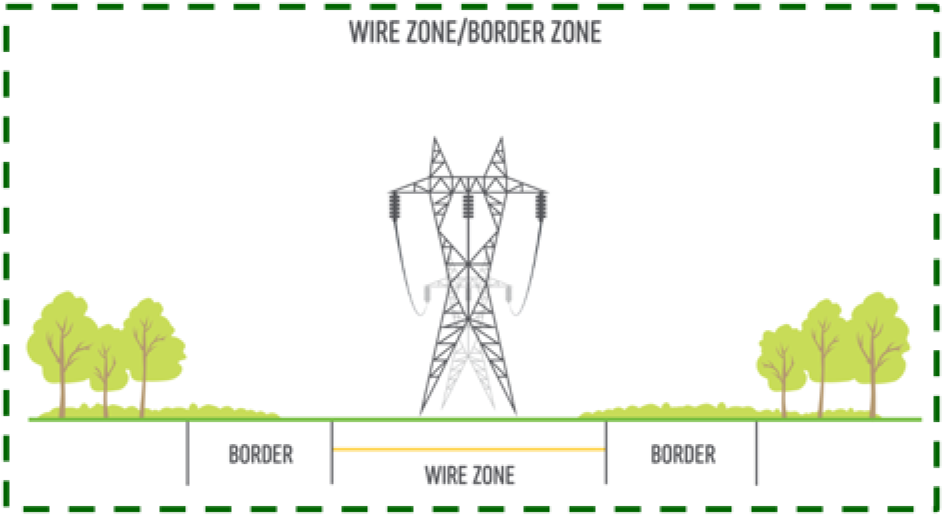


For transmission line voltages greater than 115 kV, SCE has a "wire-zone" which is defined as the area directly beneath the conductors and includes the distance of the conductors at maximum sway condition (line dynamics). Vegetation within this zone has the potential to grow-in and fall-in which creates risk to SCE equipment and facilities.

Figure SCE 7-79 "Wire Zone/Border Zone" depicts the areas which SCE seeks to clear directly below transmission wires.

Figure SCE 7-79

Wire Zone / Border Zone



2. Initiative selection:

SCE inspects all distribution and transmission lines for vegetation encroachment and clearances at least once per year. Inspections are performed by SCE's vegetation management contractors to verify that clearance requirements are in accordance with regulatory requirements and SCE's program standards, and that clearance will be maintained until the next annual inspection cycle. SCE also inspects most of its tree inventory along distribution and transmission lines approximately six months following the planned annual inspection to ensure system compliance with regulations and identify any vegetation encroachments that may have grown faster than expected at the time of the annual inspection.

During the inspections, pre-inspectors designate which trees need to be trimmed (or in some instances, removed) to maintain the required clearance distances from energized conductor. In HFRA, SCE strives to maintain expanded clearances of 12 feet for distribution lines, and 30 feet for transmission lines. However, where customer refusals, agency restrictions or other operational constraints exist, SCE's routine line clearing work includes maintaining (for a full annual inspection cycle) at least the required 4 feet clearance within HFRA for distribution lines and the required 10 feet clearance within HFRA for transmission lines. Additionally, within the wire-zone, fast-growing species are targeted for removal if the species has the capability to encroach into the wire zone at tree maturity.

Although risk analysis guides some line clearance activities, the line clearance scope is driven by regulations[169]. Therefore, SCE does not calculate an RSE for routine compliance-based line clearing. Please see Section 7.3.5.20 for further discussion on the risk modeling associated with expanded line clearing activities.

[169] See CPUC's GO 95 Rule 35[E19] and PRC 4293[E22].

3. Region prioritization:

To facilitate routine detailed inspection of vegetation around distribution and transmission lines and equipment, SCE divides its service area geospatially into approximately 2,700 Grids. SCE's inspections are scheduled such that each of these Grids in SCE's service territory is inspected annually. Inspection schedules for the grids take into account resource availability, appropriate allocation of work throughout the year, permitting lead times and permit availability, and challenges with access to worksites based on seasonal weather conditions.

Vegetation management activities to maintain clearance distances from transmission and distribution lines and equipment are conducted throughout SCE's entire service area on an annual basis. Because inspections are performed annually, region prioritization is typically driven by the need to ensure inspections and mitigations can be performed in the expected time frame. SCE considers the need to maintain consistent resource volumes, seasonal access, expected vegetation growth within a 12-month cycle, and NERC transmission requirements.

SCE schedules higher risk HFRA locations for inspection in the months leading up to peak fire season to the extent that resources are available, and it is feasible to schedule the work during this time period. SCE has begun to implement a TRI model which ranks probability of ignition based on species, locations, etc. and Technosylva consequence scores into detailed vegetation management inspections and hazard tree program schedules.[170] SCE plans to use this model to initiate discussions on potential modifications to frequency of vegetation inspection based on specific vegetation characteristics. For 2022 and beyond, SCE will continue to refine risk modeling inputs, such as species data and outage information, which inform SCEs TRI modeling.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

In its HFRA in 2020, SCE inspected approximately 470,000 trees adjacent to distribution lines and approximately 180,000 trees adjacent to transmission lines and met its regulatory requirements of inspecting all FERC-jurisdiction lines. In its HFRA in 2021, SCE inspected approximately 600,000 trees adjacent to distribution lines and approximately 190,000 trees adjacent to transmission lines and met its regulatory requirements of inspecting all FERC-jurisdiction lines.[73] The volume of work in 2022 for distribution is expected to be similar to 2021 for annual inspections. The volume of work in 2022 for transmission is expected to be 100,000 annual inspections, as SCE has a seen a reduced tree inventory in transmission. SCE's goal is to perform inspections of SCE's entire tree inventory in HFRA in 2022 in accordance with vegetation management's annual work plans, barring access, permitting, or other constraints.

To improve the overall effectiveness of these mitigations, commencing in late 2020 and continuing through first quarter of 2021, SCE held quality performance meetings with all pre-inspection and pruning contractors to identify additional measures that can be implemented to improve the overall quality of

[170] For a more detailed discussion of the TRI model, please refer to the Vegetation Management section on Quality Control and Assurances.

vegetation work, the clearance distances obtained and documented in the database, specifically when GO 95, Rule 35[E19], Appendix E, enhanced clearances are not achieved, to understand why enhanced clearances could not be achieved.

In 2021, SCE also implemented an enhanced palm program which will help drive improved system reliability by mitigating vegetation-caused outages caused by palm contacts. This program focused on improving inspectors' prescriptions to permanently remove the risk and provide necessary support to obtain customer approval. In 2021 and 2022, SCE will continue evaluating the effectiveness of using LiDAR on distribution infrastructure for off-cycle patrols and potential QC activities. See Section 7.3.5.7 on Remote Sensing Inspections of Vegetation Around Distribution Lines and Equipment.

5. Future improvements to initiative:

Currently, detailed vegetation inspections around distribution lines and equipment are performed manually by inspectors on foot patrols. Detailed inspections for SCE's Bulk Electric System are performed using a combination of LiDAR and manual foot patrols by inspectors. SCE is currently exploring the feasibility of supplementing the Distribution inspection practices with LiDAR or other remote sensing data, as described in Section 7.3.5.7, for distribution lines. SCE considered the use of remote sensing technology using drones to perform inspections to determine clearance of the vegetation to conductors. Remote sensing can be used for asset management and inspections to provide useful photographic evidence to help detect asset issues and failure. However, for vegetation management, SCE found that this technology was limited regarding measurement software needed to determine clearance of vegetation to conductors.

In 2023, SCE will continue the development and implementation of its integrated vegetation management platform, which will be key to continuing detailed inspections and management of vegetation around distribution lines. The enhanced field tools will provide visibility to all mitigations that need to be performed, independent of the mitigation driver. Additionally, it will provide better data about how emergent work relates to SCE's tree inventory and its trim cycle. Continuous improvement efforts will also build on current analyses to determine which trees and/or conditions are causing safety hazards and/or require more frequent mitigation due to species, geography, trim distance achieved, etc. The development and implementation of the integrated vegetation management platform, Arbora, will also drive more efficient scheduling and deployment of resources. See Section 7.3.5.19 for more discussion of Arbora, including timelines for implementation.

7.3.5.3 Detailed inspections and management practices for vegetation clearances around transmission electrical lines, and equipment

SCE's vegetation inspection program for transmission is the same as that for distribution lines. Please see the description above in Section 7.3.5.2.

7.3.5.4 Emergency response vegetation management due to red flag warning or other urgent climate conditions

As part of mitigating increased wildfire risk, SCE performs incremental vegetation inspections and remediations in certain locations within its HFRA during the fire season.

1. Risk to be mitigated / problem to be addressed:

Weather conditions such as high wind or extended heat during periods of low fuel moisture have greater potential to generate significant fire events if an ignition occurs. In 2020, numerous fires occurring across the state during the summer months were driven by dry fuels. As a result, in 2020, SCE identified 17 AOCs in its HFRA, which posed increased fire risk, and targeted those areas for incremental vegetation management inspections. The same 17 areas were targeted for 2021.

2. Initiative selection:

As described in SCE's second Change Order Report, filed December 11, 2020, in order to mitigate the potential risk posed by dry fuels during fire weather conditions, SCE identified 17 AOCs based on 1) the last time the area has burned, 2) fire history [frequency and seasonal occurrence], 3) vegetation type and amount, 4) then-current and expected fuel and weather conditions, 5) impact to communities and SCE infrastructure, and 6) circuit health and performance. SCE used the identification of AOCs to modify the prioritization of its HFRI inspection scope. The outcome of this risk-informed modification to SCE's HFRI resulted in accelerated inspections, remediation and vegetation trimming and removal in the identified areas. See Section 7.3.4.9.1 (IN-1.1) for greater detail of SCE's HFRI inspections. SCE also risk-ranked the AOCs based on a combination of the probability and consequence of wind-, fuel-, and topography- driven fire potential. These efforts helped mitigate the increased ignition probability and consequence associated with dry fuel. Area selection in 2021 was based on the same selection criteria as 2020. Please see Section 7.3.4.9 for the RSE information on HFRI.

SCE also modifies its vegetation management activities during RFW periods to help mitigate potential risks, including pausing non-emergency work in HFRA (e.g., use of chainsaws) that has the potential to cause sparks, and instead working in non-HFRA areas. Additionally, for any PSPS events during high fire risk days, vegetation management crews are on standby to mitigate any vegetation-related ignition risks identified during PSPS pre- or post-patrols. SCE also performs incremental vegetation management work in preparation for Santa Ana wind events as described in Section 7.3.5.11. SCE did not develop an RSE for vegetation management protocols during RFW periods because they support the safe and prudent performance of vegetation management work and are not specific wildfire initiatives.

3. Region prioritization:

Emergency response vegetation management inspections and mitigations are targeted to the locations that experience specific increased wildfire risks conditions such as specific AOCs associated with elevated dry fuel levels. These AOCs are identified due to a combination of factors such as age of the fuels, current and forecasted state of fuel moisture, and the area's subjectivity to fire during periods of high wind, high temperatures and low humidity. As explained above, the AOCs were risk-ranked to prioritize the work. SCE also implements its response to RFW whenever an RFW is in effect within SCE's HFRA.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

Vegetation management inspectors in 2020 performed additional inspections across 2,000 circuit miles in the AOCs in October 2020, resulting in approximately 700 work records expedited for mitigation. Additionally, vegetation management crews performed vegetation clearances for approximately 600 more structures identified by Electrical Inspectors in these AOCs. Vegetation management inspectors in 2021 performed inspections across 2,000 circuit miles in the AOCs, resulting in approximately 400 trees expedited for mitigation. Additionally, vegetation management crews performed vegetation clearances for approximately 300 more structures identified by Electrical Inspectors in these AOCs. SCE identified AOCs and, for 2021, prioritized non-exempt Pole Brushing work for these areas. SCE will re-evaluate AOCs and supplemental work will continually be evaluated in future years depending on risk profiles and other unforeseen circumstances and adjust as needed. In 2022, SCE will inspect and clear (where clearance is needed) approximately 26,400 poles in identified Areas of Concern (AOC), with the exception of poles for which there are customer access or environmental constraints.

5. Future improvements to initiative:

As more vegetation management is performed across SCE's HFRA, the need for incremental work such as responding to dry fuels during fire season or PSPS patrol-driven mitigations are expected to decrease, as scheduling adjustments have been made to inspect higher risk areas pre-fire season. SCE is considering incorporating LiDAR technology for more efficient identification of vegetation issues in targeted higher risk locations. In 2023, SCE plans to continue feasibility studies for satellite technology that may be a viable solution. The viability of this technology would be a companion to LiDAR in higher risk areas, and also allow SCE to re-allocate resources, such as ground inspectors, to other AOCs.

7.3.5.5 Fuel management (including all wood management) and reduction of "slash" from vegetation management activities

SCE reduces slash (e.g., cut limbs and other woody debris) from vegetation management activities by chipping and hauling the material away to be disposed or recycled by pruning/removal contractors.

7.3.5.5.1 Response to SCE Action Statement, 2021 WMP Additional Issue to Address in 2022 WMP:

The following is one of the Additional Issues as provided by OEIS in the Final Action Statement on SCE's 2021 WMP.

> ***ISSUE***: *QR Action-SCE-28 required SCE to provide a copy of its study to "determine the best use of fuel reduction." However SCE inadvertently stated in its First Quarterly Report that the study would be complete by year-end 2020; SCE intends to complete by year-end 2021.*
> ***REMEDY***: *SCE shall provide a copy of its study to "determine the best use of fuel reduction" as an attachment to the 2022 WMP Update.*

SCE's response to this Issue/Remedy is described below:

SCE and its consultant EPRI continue to work to complete the study referenced above, to examine the best practices for fuel reduction. The expected completion date of the study is Q1 2022. SCE will provide a copy of the final report once completed.

1. Risk to be mitigated / problem to be addressed:

Vegetation management activities produce woody debris that can act as fuel around or near electrical equipment increasing the probability for ignition and spread of wildfire. Weeds or brush growing near electrical equipment poses similar hazards.

2. Initiative selection:

SCE's pruning/removal contractors abide by standard cleanup and disposal expectations for work sites. Removal and disposal of debris generated during SCE vegetation management activity, except as requested by the customer (e.g., for firewood or mulch) or where logistical constraints exist (e.g., steep slope with no vehicular access), is typically performed the same day. For example, where possible, all debris post prune or removal is chipped with trailer chippers and hauled away from the work site. In some cases, debris is moved the following day due to project volume or is not removed at all due to logistical constraints. Where logistical constraints exist, for example, within Forest Service areas, SCE will work to mitigate the potential fuel risk by scattering the debris according to best management practices or any existing fuel management plan applicable to the work site. Concerted efforts are made to rake up and dispose of green or freshly removed leaves and work sites are to be left in a condition consistent with the condition prior to vegetation management activity.

SCE's weed abatement program focuses on SCE-owned property and transmission ROWs, keeping them clear of brush and other live fuel plants. Similarly, SCE's Pole Brushing program abates vegetation around poles as specified in Section 7.3.5.5.2 below.

Reducing slash from vegetation management initiatives is a standard, prudent practice that is conducted in the course of vegetation management activities. SCE's weed abatement activities are required by California Government Codes, County and Local ordinances. SCE has been executing both activities for years. They are not specifically wildfire mitigation initiatives and thus do not have an RSE associated with them.

An alternative to SCE's standard clean-up practices would be to keep all generated debris onsite and leave the responsibility on the landowner for clean-up and fuel management. SCE continues to reduce slash in order to mitigate foreseeable risks with allowing debris to collect.

3. Region prioritization:

This work is performed for all of SCE's service area in accordance with its annual schedule.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

In 2020 and 2021, SCE followed all standard operating procedures and removed slash from job sites where applicable. At the end of 2020, SCE procured a consultant to conduct a study to determine best practices for fuel management. Results of the study are expected to be published in 2022 Q1. The study will provide options for fuel management best practices within SCE's ROWs and USFS property. Through 2022, SCE will review and analyze the results of the study, and where feasible, implement additional regionally appropriate fuel management practices. Additionally, SCE has partnered with the USFS on an implementation path for sustained fuel management measures, e.g., putting in low-growing "utility-friendly" vegetation to manage undesirable tree species growth or expanding use of alternative debris management methods such as utilization of ruminant animal grazing.

SCE has completed a pilot project for use of ruminant animals (i.e., goats) to maintain low-growing shrubs and brush in District 50 (Shaver Lake) in Q4 2021. SCE is assessing the cost efficiency and effectiveness of this pilot. Depending on the results, SCE may look to expand utilization of ruminant animals in other parts of the service territory.

5. Future improvements to initiative:

In 2023, SCE will continue the development and implementation of the IVM practices. SCEs IVM activities being explored include adding environmentally sound and cost-effective means to promote desirable, stable, low-growing vegetation that are resistant to undesirable tree species. These methods can include a combination of chemical, biological, cultural, mechanical, and/or manual treatments. The use of these methods can potentially provide long-term cost efficiencies and reduce the risk of outages and fires while improving wildlife habitat.

SCE is also considering re-planting efforts in SCE's fee-owned parcels, which includes re-populating more native and compatible plant species within Transmission ROWs. SCE plans to start a pilot for this effort in Q1 2022.

7.3.5.5.2 Pole Brushing

SCE removes vegetation around distribution poles to create 10-foot radial (when attainable) and eight-foot vertical clearance on selected poles in HFRA.

1. Risk to be mitigated / problem to be addressed:

Vegetation at the base of poles and structures can provide the fuel needed to convert a spark from equipment failure into a fire. This vegetation can also support fire propagation, especially during dry and windy conditions. Additionally, even where the equipment is not the source of the ignition, brush surrounding a pole may catch fire and damage electric assets, impeding power restoration and reconstruction efforts. Cal. Pub. Res. Code § (PRC) 4292[E21] and related regulations[171] require utilities in certain areas and at certain times to "maintain around and adjacent to any pole or tower which supports a switch, fuse, transformer, lightning arrester, line junction, or dead end or corner pole, a firebreak which consists of a clearing of not less than 10 feet in each direction from the outer circumference of such pole or tower."

2. Initiative selection:

The pole brushing program removes vegetation at the base of distribution poles to reduce the chance of ignition and/or fire spread due to a spark or contact with failed equipment. This activity goes beyond the minimum regulatory requirements in PRC 4292[E21] (and related regulations) that call for pole brushing to be performed on specific poles with "non-exempt"[172] equipment installed. Application of fire retardant at the base of the poles was initially considered but was determined not to be a practical and effective or environmentally friendly alternative. When considered safe, herbicides and growth retardants are used where permitted to help limit vegetation growth.

The RSE for this initiative is relatively high due to the low cost of implementation and the risk-reducing benefits of targeting fuel removal at the base of SCE's distribution poles.

3. Region prioritization:

SCE's first priority is to complete brushing on those poles required to be brushed under PRC 4292 [E21] in SRAs. Second, SCE prioritizes poles in AOC within HFRA. Third, SCE focuses on all other poles identified in HFRA with non-exempt equipment and highest potential wildfire consequence. While SCE is prioritizing scheduling these activities in the first half of the year, actual completion dates will be based on access and operational efficiency.

Beyond that, because pole brushing is performed annually and is subject to availability of resources to perform the work, SCE considers operational efficiency as a major driver in prioritizing other categories of poles to brush. Other categories of poles SCE will strive to brush include: poles identified for HFRI inspections pursuant to the methodology discussed in Sections 7.3.4.9.1 and 7.3.4.11.1; poles with exempt equipment and potential wildfire consequence greater than or equal to 300 acres; and poles with non-exempt equipment and potential wildfire consequence less than 300 acres.

See Figure SCE 7-80 below which represents the SCEs categorization of its pole brushing program.

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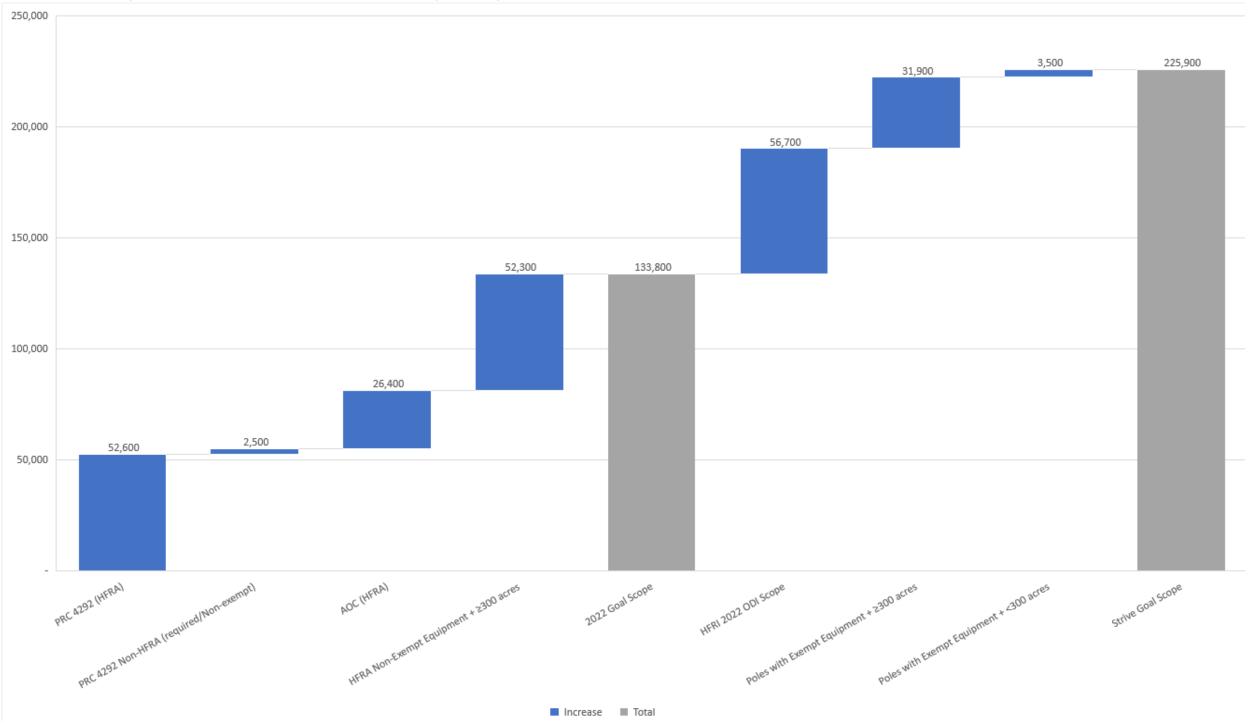
[171] See 14 Cal. Code of Regs. §§ 1252-1255.[E24]

[172] Non-exempt" equipment refers to the type of equipment described in PRC 4292 [E21] on poles that the statute requires to be brushed.

Figure SCE 7-80

SCE's Categorization of Pole Brushing Program



4. Progress on initiative (amount spent, regions covered) and plans for next year:

SCE's goal in 2020 was to perform pole brushing on approximately 200,000 to 300,000 distribution poles. SCE brushed approximately 230,000 poles. SCE's goal in 2021 was to perform pole brushing on a minimum of 200,000 distribution poles. SCE experienced challenges with access constraints and the ability to retain crews, and SCE brushed approximately 163,000 poles. Prior years' WMP goals were measured by the total population of poles brushed and did not differentiate those poles subject to the compliance requirements of PRC 4292 [E21] and those poles not subject to the statutory requirements.

Following Energy Safety's direction in the 2022 WMP Guidelines, SCE has created separate pole brushing goals for 2022 that will be specific as to which poles are subject to PRC 4292[E21] and which poles are not. SCE recalibrated its approach for 2022 to brush all non-exempt PRC 4292 [E21] poles in SRAs, all poles in AOC within HFRA, all poles within HFRAs that have the same type of equipment as the non-exempt PRC 4292 [E21] poles and have a wildfire consequence of greater than 300 acres burned in eight hours, and, as a strive goal, additional poles identified by risk models and other SCE initiatives, such as HFRI, which demonstrate the highest risk.

In 2022, SCE has identified 55,100[173] poles subject to PRC 4292.[E21] However, to adequately address wildfire risks, SCE expands its pole brushing population to include higher risk poles in HFRA that are exempt from PRC 4292.[E21] More specifically, in addition to compliance requirements, SCE will target brushing 26,400 poles in AOCs, and 52,300 poles in HFRA locations with the same type of equipment outlined in PRC 4292 [E21] and related regulations, but which are not within the SRAs, and which have a wildfire consequence of greater than 300 acres in the first eight hours. In sum, SCE will access, inspect and clear (dependent on access and authority) approximately 78,700 distribution poles (separate from and in addition to the 55,100 PRC 4292 [E21] poles). SCE will strive to access, inspect and clear (dependent on access and authority) up to 170,000 distribution poles in HFRA (separate from and in addition to the 55,100 PRC 4292 [E21] poles).

5. Future improvements to initiative:

Data gathered through other initiatives such as the fire science enhancements will allow for a more targeted approach in the scheduling process. SCE is currently evaluating additional risk inputs for pole brushing prioritization. Through 2023, SCE will analyze the effectiveness and operational implementation feasibility of using herbicides to reduce the frequency of visits and maintaining vegetation clearances for longer durations. The use of herbicides has been historically challenging due to environmental compliance, agency permitting, and customer resistance. SCE will also further integrate pole brushing into SCE's Integrated Grid Hardening Strategy as discussed in Section 7.1.2.1.

7.3.5.5.3 Expanded Clearances for Legacy Facilities (VM-3)

SCE creates larger vegetation-free buffers around its Legacy Facilities. Legacy Facilities are generation assets located within HFRA Tier 2 or 3 that have risk of ignition including high voltage facilities such as: powerhouses, switchyards, and substations. Legacy Facilities also include low voltage facilities/assets such as: weather stations, valves, pull boxes or other electrified equipment. SCE has 373 total Legacy Facilities in HFRA.

1. Risk to be mitigated / problem to be addressed:

Many of SCE's Legacy Facilities including powerhouses and switchyards are located in or near heavily forested areas and therefore create a risk for ignition. Analysis of historical events identified increased risk of faults from vegetation contact with electrical facilities and increased risk of fires spreading through vegetation in close proximity to SCE's legacy facilities in the event of any ignition (i.e., even if caused by avian/wildlife contact, CFO, etc.). PRC 4291 [E20] requires a landowner that owns a building in or adjoining a mountainous area, forest-covered lands, shrub covered lands, grass-covered lands, or land covered with flammable material to maintain a defensible space of 100 feet around the building, with more intense fuel reductions within 30 feet around the structure.

[173] This includes 52,600 poles that have been validated to have non-exempt equipment, and 2,500 poles for which validation is pending.

2. Initiative selection:

SCE's analysis determined achieving and maintaining the recommended expanded clearances for legacy facilities, as opposed to routine clearances, was a prudent practice to reduce the risk of vegetation contact with electrical equipment at these facilities, especially given the increased wildfire risks.

The RSE for this initiative is relatively low due to the lack of relevant historical data on ignitions for legacy facilities. However, as mentioned above, this activity is required to comply with PRC 4291;[E20] therefore, SCE will continue to perform this activity.

3. Region prioritization:

SCE prioritizes clearances around Legacy Facilities in HFRA Tiers 2 and 3 over non-HFRA regions. SCE currently uses a risk-informed approach that takes into account the HFRA tier level, voltage levels, and existing vegetation buffer to risk rank the locations. The approach combined desktop review and field visits. Tier 3 locations, facilities with higher voltage levels, and areas with less existing vegetation buffer are considered higher risk.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

In 2020, SCE completed the desktop analysis of all sites to prioritize treatment based on HFRA tier and assessment findings. SCE's analysis determined 156 HFRA Legacy Facilities to be in scope for expanded clearances. In 2020, all 156 sites in scope were assessed and SCE completed treatment of 62 of the highest risk locations, based on HFRA tier and assessment findings. In 2021, SCE completed 62 additional sites. The remaining 32 locations are scheduled for treatment in 2022. The expanded clearances for legacy facilities project will be completed in 2022. This will conclude the expanded clearances project and we will continue to maintain the clearances during regular vegetation maintenance and monitor via the inspections (IN-5) and remediations (SH-11).

5. Future improvements to initiative:

SCE will examine current standards, best practices, vegetation trends from completed inspections (IN-5) and remediations (SH-11) to determine if more vegetation management is needed. New vegetation issues will be identified with the inspections (IN-5) and resolved with the remediations (SH-11).

Once all identified locations have the appropriate expanded clearances (buffer zones) established and post-treatment QC and monitoring have been completed, this program will be complete. The expanded buffer will be maintained moving forward. Through 2023, SCE will evaluate any of the remaining 217 legacy facility sites for expanded clearances, currently being inspected as part of (IN-5) which have not already been treated, to assess for opportunities to further reduce ignition risk probability in HFRA.

7.3.5.6 Improvement of inspections

SCE has implemented plans to improve the quality and consistency of inspections performed around its transmission and distribution systems to help ensure vegetation is maintained in accordance with regulatory requirements and recommendations.

1. Risk to be mitigated / problem to be addressed:

Vegetation may grow faster than anticipated or otherwise make contact with energized conductors and may fall or blow into electrical equipment and conductors and potentially lead to outages or ignitions.

2. Initiative selection:

Pre-inspections (inspections) are performed by SCE's vegetation contractors to verify that clearance requirements are in accordance with regulatory requirements and program standards, and that clearance will be maintained through the annual inspection cycle. In 2018, SCE's Vegetation Management program underwent a comprehensive redesign where it replaced the Vegetation Management Operations Manual with the Transmission Vegetation Management Plan (TVMP) and Distribution Vegetation Management Plan (DVMP) to provide specific guidance to help drive consistency in inspections, in addition to other measures.[174] SCE also added a Hazard Tree program, which is codified in the HTMP.[175] The DVMP and TVMP incorporated the CPUC's GO 95 Appendix E[E19] recommended clearances, while the HTMP was created specifically to address residual risk associated with green trees further away from the conductors that pose a risk of falling or blowing into them. All three documents more clearly identified regulatory and risk drivers for the inspection standards. For example, the TVMP specifically identified the need to address conductor dynamics when determining correct clearance distance.

To ensure the overall quality of the vegetation management program and the effectiveness and performance of SCE's vegetation contract workforce, SCE's QC Program performs inspection sampling and identified conditions are remediated. SCE considered the use of drone technology to perform inspections to determine clearance of the vegetation to conductors. Drones can be used for asset management and inspections to provide useful photographic evidence to help detect asset issues and failure. However, for vegetation management, SCE found that drone technology was limited regarding measurement software needed to determine clearance of vegetation to conductors.

3. Region prioritization:

The TVMP and DVMP apply to SCE's entire service area. QC inspection is performed in HFRA and non-HFRA using sampling methodology. QC in HFRA is based on risk-stratification models (e.g., Technosylva WRRM) to prioritize the highest risk areas for QC inspection.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

As part of SCE's continuous improvement efforts, commencing in 2020 and continuing through 2022 SCE began increasing contractor engagement to help ensure that inspectors are appropriately identifying and prescribing tree maintenance. "Add-on" tree rate training was and will continue to be provided to all

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[174] *See* SCE's response to WSD Data Request 52 (SCE-43895-I-367) filed March 2020 for copies of the DVMP and TVMP.

[175] The Hazard Tree program and HTMP are described in greater detail in Section 7.3.5.16.1.

vegetation management inspection contractors. Additional effortsimplemented to support continuous improvement included holding executive level meetings with contractor management to share results of quality performance, increased training for both internal and external personnel involved with inspections, and requesting contractors to onboard additional contractor QC to provide reasonable assurance contractors are identifying issues before SCE's independent QC identifies them.

5. Future improvements to initiative:

SCE will continue to explore the feasibility of implementing different inspection methodologies, such as the future integration of LiDAR or other remote sensing data beyond where currently implemented. SCE has begun to implement a TRI model which ranks probability of ignition based on species, locations, etc. and Technosylva consequence scores into vegetation management inspections. For example, SCE may identify locations where more frequent inspections are warranted and adjust inspection cycles accordingly. In 2023, SCE plans to update this model with additional inputs, such as remote sensing data, to determine any potential modifications to frequency of vegetation inspections.

7.3.5.7 Remote sensing inspections of vegetation around distribution electric lines and equipment

SCE is analyzing the feasibility of broad implementation of LiDAR on its distribution systems.

1. Risk to be mitigated / problem to be addressed:

Vegetation contact with energized conductors can result in outages or ignitions. While SCE currently conducts inspections using foot patrols, additional or different methods could potentially enhance inspection accuracy. There is an inherent "human factor" involved with foot patrols that leaves the possibility of some inspection inaccuracies. Additionally, it is possible for vegetation to grow faster than expected over the course of a trim cycle and grow within the minimum clearance distance, resulting in vegetation encroachment into or near lines prior to the next scheduled inspection. Also, trimming work can require modification if not performed to sufficiently maintain minimum clearance distances. SCE needs the ability to monitor vegetation and its proximity to the lines to identify necessary vegetation mitigation work.

2. Initiative selection:

The use of remote sensing such as LiDAR to conduct vegetation inspections around distribution electric lines and equipment is currently in early stages, and the current inspection process is performed manually using foot patrols. SCE is currently processing how LiDAR can be optimized to help supplement vegetation inspections of its distribution system.

SCE also considered the use of drone technology to perform inspections to determine the clearance distance between vegetation and conductors. Although drones are used for asset management and inspections and provide useful photographic evidence that helps detect asset issues, drone technology is of more limited use in Vegetation Management because the measurement software available to determine clearance of vegetation to conductors is not sufficiently accurate.

This activity informs other vegetation management activities, such as Section 7.3.5.20, "Vegetation management to achieve clearances around electric lines and equipment."

3. Region prioritization:

In 2021, six distribution circuits (approximately 90 total miles) were chosen to be evaluated for using LiDAR prior to trims for the purposes of work identification and seven distribution circuits (approximately 155 total miles) were chosen to be evaluated for the purposes of using LiDAR for QC. For 2022, SCE is prioritizing the use of LiDAR to inspect Distribution circuits in select AOCs. Current scope for this effort involves 60 circuits with at least 500 miles in HFRAs. These circuits were selected due to their inspection scheduling timelines to ensure vegetation clearances in SCE's AOCs.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

LiDAR data obtained in 2020 was reviewed for validity and usefulness and to determine the future continued use of LiDAR in and around distribution systems. The results reflected that the data did successfully identify encroachment conditions requiring mitigation. In 2021, LiDAR was acquired for six circuits for purposes of pre-inspection work identification, which is when vegetation management identifies and field-plans work that needs to be done. A study was conducted to assess the accuracy of LiDAR versus that of traditional ground inspections. Results were positive with LiDAR being shown to be as accurate, and sometimes more accurate, than ground inspections with regard to identifying clearance between vegetation and conductors. LiDAR can provide the accurate inspection of difficult to access or inaccessible areas (as would be the case in a customer refusal) where inspectors might otherwise have to skip or try to assess from too far away. However, there remain challenges to more broadly implementing LiDAR in vegetation management operations. For example, LiDAR does not provide for the identification of fast-growing species that are often prescribed for trim outside of specific clearance distances, where foot patrols can account for this. Even though a fast-growing tree may not be within proximity to conductors at the time of inspection, the inspector is sometimes able to identify that the tree could grow within proximity before the next inspection and prescribes that tree for trim work. Current requirements still have field inspector validation for customer coordination and environmental review processes. Hyperspectral imaging is available with LiDAR such that species identification is possible and that will be explored in 2022.

In 2022, SCE will work through challenges with how to further expand and deploy LiDAR along its distribution grid-based operation, when LiDAR is typically collected on a circuit-based approach. Additionally, SCE found that LiDAR data collected for the purposes of QC could identify work still on hold due to customer refusals or environmental requirements and erroneously identify those as false clearance violations. SCE will explore the use of tools and/or human resources to analyze and bridge this gap in LiDAR data. In 2022, SCE plans to inspect at least 500 HFRA circuit miles for this continued analysis.

5. Future improvements to initiative:

As results of 2021 LiDAR data acquisition are being finalized, any changes to operations resulting from that review may not be implemented until after 2022 due to ongoing vegetation software development and the establishment of contractual agreements for flights and data processing. A preliminary set of options for LiDAR use has been developed and are being considered for appropriate use cases. Additionally, similar to the 2021 LiDAR pilot, in 2022, SCE plans to conduct a pilot effort to test satellite technology for accuracy of vegetation clearances and tree identification near overhead lines. Lower risk circuits will be selected for this effort and results will be validated against ground inspection data. Satellite technology may be a viable counter solution for evaluating lower risk circuits and would prove less expensive than LiDAR because it would not require helicopters or ground inspectors in the field. The viability of this technology would be a companion to LiDAR in higher risk areas, and also allow SCE to re-allocate resources, such as ground inspectors, to other AOCs.

The future utilization of LiDAR in 2023 is dependent on results of 2022 efforts as well as potential changes to Vegetation Management's operational structure and inspection contracts. In 2023 and beyond, options may include supplementing and potentially replacing ground inspections in their entirety for certain circuits where conditions are favorable to do so. Favorable conditions would involve low to medium risk circuits with less dense vegetation population that, largely by their geographic location or overall length, provide a cost benefit to inspect via remote sensing means as opposed to physical ground inspection. Additionally, changes to the Vegetation Management grid layout to more of a circuit layout and modification of inspection contracts from lump sum to unit price will both make LiDAR more feasible in the distribution space. These changes are conceptual and in their beginning stages at this time but will be continually evaluated and developed over the course of 2022.

7.3.5.8 Remote Sensing inspections of vegetation around transmission electric lines and equipment

SCE utilizes LiDAR technology to inspect select transmission and sub-transmission lines for appropriate clearances between SCE's lines and vegetation.

1. Risk to be mitigated / problem to be addressed:

The primary risk to be mitigated is vegetation contact with energized conductors. Vegetation to conductor clearance for SCE's Bulk Electric Transmission System requires calculation of conductor dynamics (i.e., sag and sway) which can be difficult to accurately perform for pre-inspectors given terrain and access issues.

2. Initiative selection:

Inspections of SCE's Bulk Electric Transmission System are performed by SCE's foot patrols. As LiDAR datais the preferred and most accurate data source, SCE provides it to inspectors on circuits when available to assist them in identifying potential encroachments. SCE utilizes LiDAR technology to inspect select transmission and sub-transmission lines with respect to NERC FAC 003-4, GO 95, Rule 35[E19] and PRC Section 4293[E22], to maintain appropriate clearances between SCE's lines and vegetation. Implementation of LiDAR for Bulk Transmission Lines was a 2019 WMP initiative. After the success of the initiative and effectiveness of using LiDAR for transmission ROW inspections, the use of LiDAR was operationalized in 2020.

Alternatively, SCE considered the use of drone technology to perform inspections to determine clearance of the vegetation to conductors. Drones can be used for asset management and inspections to provide useful photographic evidence to help detect asset issues and failure. However, for vegetation management, SCE found that drone technology was limited regarding measurement software needed to determine clearance of vegetation to conductors.

LiDAR does not have its own RSE because by itself, it does not directly mitigate wildfire or PSPS risk. Rather, it informs the mitigation, Vegetation management to achieve clearances around electric lines and equipment (Section 7.3.5.20), that directly mitigates wildfire vand PSPS risk (as well as outages and reliability concerns).

3. Region prioritization:

LiDAR acquisition on transmission circuits is initially prioritized based on the line voltage, vegetation density, and length of the line in HFRA. Next, inspectors conduct an ad hoc evaluation of the species of trees identified, HFRA classification, accessibility challenges from governing agencies, proximity to structure, overall terrain, and potential for ground inspection inaccuracy. Each Transmission circuit is rated accordingly, and flights are conducted every 1 - 10 years, with the circuits rated higher risk being flown more frequently. While the highest ranked circuits are flown annually, the ratings of the aforementioned circuits sometimes decrease because issues are often remediated within the year. Therefore, at its core, LiDAR is data-collection driven, and each year a holistic overview of circuits is required to reflect which issues may have already been remedied or worsened. Because of flight efficiencies, the data is collected for entire circuits, independent of HFRA status, although the majority of Transmission line miles that are flown frequently fall within HFRA.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

Approximately 1,700 transmission circuit miles were inspected in 2020. Approximately 1,590 transmission circuit miles were inspected in 2021. SCE will continue using LiDAR in 2022 in accordance with SCE's LiDAR inspection plan, and SCE expects at least 1,600 HFRA circuit miles to be inspected in 2022.

5. Future improvements to initiative:

For 2023, SCE will continue to use LiDAR for transmission inspections and will explore if there are additional locations where it makes sense for LiDAR to supplement transmission inspections. A preliminary set of options for LiDAR use has been developed for consideration, up to and including potentially replacing ground inspections in their entirety for certain circuits where conditions are favorable to do so. Favorable conditions would involve low to medium risk circuits with less dense vegetation population that, largely by their geographic location or overall length, provide a cost benefit to inspect via remote sensing means as opposed to physical ground inspection. Additionally, in 2023, SCE will investigate the use of integrating both satellite imagery (discussed in Section 7.3.5.7) and/or hyperspectral imagery to enhance and synergize with the LiDAR data. A hybridization of remote sensing techniques has the potential to improve the accuracy and precision of the vegetation work. This data will assist in enhancing the inputs to SCEs TRI.

7.3.5.9 Other discretionary inspection of vegetation around distribution electric lines and equipment, beyond inspections mandated by rules and regulations

The HTMP deploys inspections to detect fall-in and blow-in risk.

1. Risk to be mitigated / problem to be addressed:

Trees outside of the compliance clearance zone still pose a threat of falling during high wind conditions and striking SCE facilities depending on the condition of the tree and other site-specific factors. Branches or fronds getting dislodged from trees near electrical facilities also have a higher probability of blowing into the lines and equipment and causing faults that can potentially initiate an ignition.

2. Initiative selection:

SCE conducts detailed inspection and evaluation of trees outside of the compliance zone but still within striking distance that pose risks despite trimming and pruning, and appropriate mitigations up to removal of these trees. See Section 7.3.5.16.1 HTMP for more details.

3. Region prioritization:

See Section 7.3.5.16.1 HTMP Program for more details.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

See Section 7.3.5.16.1 HTMP Program for more details.

5. Future improvements to initiative:

See Section 7.3.5.16.1 HTMP Program for more details.

7.3.5.10 Other discretionary inspection of vegetation around transmission electric lines and equipment, beyond inspections mandated by rules and regulations

Discretionary inspections of vegetation management around transmission electric lines and equipment are the same as those performed for around distribution lines and equipment. Please see Section 7.3.5.9 above for additional details.

7.3.5.11 Patrol inspections of vegetation around distribution electric lines and equipment

SCE conducts supplemental patrols to provide assurance that vegetation encroachments do not occur during peak fire season and high wind conditions.

1. Risk to be mitigated / problem to be addressed:

The probability and consequence of vegetation contact with electrical equipment and lines is higher during certain times of the year, such as in summer as the peak fire season starts, and during Santa Ana high wind events in the fall/winter. The risks are also higher in certain locations, such as the canyons, which experience higher winds.

2. Initiative selection:

SCE performs supplemental vegetation inspections to verify certain circuits are free from vegetation encroachments into the minimum vegetation clearance distance. SCE assesses the need for patrols based on various risk factors and analyzes all methods of alternative patrols, selecting the most appropriate patrol based on the need for inspection. Supplemental vegetation inspections provide added assurance that vegetation encroachments will not occur during peak fire season and high wind conditions. These patrols include Canyon Patrols, Summer Readiness Verification Patrols, and Operation Santa Ana.

Canyon Patrols are performed annually and focus on areas where downslope, off-shore winds have greater potential to compromise trees conditioned to growing under *on-shore* winds. These patrols verify that certain circuits located in canyons are free from vegetation encroachments. Summer Readiness Verification Patrols are performed in areas where work may have been delayed or put on hold due to constraints such as agency permitting. Operation Santa Ana is a joint patrol effort with state and local fire authorities to perform patrols of overhead powerlines and poles in the HFRA.

Additionally, inspectors performing work for SCE's ODI program throughout the year also inspect the structure for potential vegetation encroachments. Section 7.3.4.9.1 Distribution High Fire Risk Informed Inspections and Remediations (IN-1.1) provides more details on SCE's risk-informed inspections program. When vegetation encroachments are identified, notifications are created and dispatched to vegetation crews to mitigate.

3. Region prioritization:

These patrols are performed in HFRA and focus on electrical facilities and adherence to PRC Section 4292[E21] and 4293 [E22] vegetation-related requirements. Patrol scope is determined each year based on risk considerations such as HFRA tier, stage in trim maintenance cycle, QC results, and overlap of other supplemental activities.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

In 2020 and 2021, SCE's targets for its Canyon, Summer Readiness, and Operation Santa Ana patrols were completed. In 2020, SCE's supplemental patrols identified approximately 1,500 trees which required mitigation. In 2021, these patrols collectively completed approximately 1,200 trees requiring mitigation. SCE continues to capture costs for supplemental patrols in the total Line Clearing inspection costs. In 2022, SCE expects a slight decrease in scope for these patrols, as scheduling adjustments have been incorporated into routine inspection schedules to reduce the need for supplemental patrols. SCE has made strides to consolidate its supplemental patrol programs to streamline multiple property visits, which would in turn, reduce customer impacts and lessen resource constraints. SCE plans to incorporate the use of the TRI to inform the 2022 supplemental patrol scope of work and will document all completed patrols in 2022.

5. Future improvements to initiative:

SCE will continue to explore the feasibility of implementing different inspection methodologies, such as the future integration of LiDAR or other remote sensing data beyond where currently implemented. SCE has begun to implement a TRI model which prioritizes vegetation management inspections by the probability of ignition based on species, locations, etc. and Technosylva consequence.[176] For example, SCE may identify locations where more, or less, frequent inspections are warranted and adjust inspection cycles accordingly. In 2023, SCE plans to update this model with additional inputs, such as remote sensing data, to determine any potential reduction in supplemental vegetation inspections.

7.3.5.12 Patrol inspections of vegetation around transmission electric lines and equipment

This activity for patrol inspections of vegetation around transmission lines is the same as those performed for vegetation around distribution lines. Please see Section 7.3.5.11 above for additional details.

7.3.5.13 Quality assurance / quality control of vegetation management

SCE deploys certified arborists to perform independent risk-informed QC of its Routine Line Clearing, HTMP, and Dead and Dying Tree Program for the various objectives discussed further below. In addition, Energy Safety provided the following Issues and Remedy requirements, which SCE responds to in this section.

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[176] For a more detailed discussion of the TRI model, please refer to the Vegetation Management section on Quality Control and Assurances.

7.3.5.13.1 Response to SCE Action Statement, 2021 WMP Additional Issue to Address in 2022 WMP:

The following is one of the Additional Issues as provided by OEIS in the Final Action Statement on SCE's 2021 WMP.

> *Issue: In Section 7.3.5.13, SCE's description in reoccurring SCE's 2021 WMP Update header "1) Risk to be mitigated" is narrower in scope as compared to its peer utilities, PG&E and SDG&E. SCE states that quality control and quality assurance audits mitigate risk when "Trimming crews may not prune enough of a tree to maintain the minimum clearance distance;"132 SCE does not include auditing for other standards beyond attaining minimum clearance distance.*
> *Remedy: In its 2022 WMP Update, SCE must broaden its SCE's 2021 WMP Update header "1) Risk to be mitigated" considerations in Section 7.3.5.13 (or similar).*

SCE's response to this Issue/Remedy is described below:

Please see SCE's more comprehensive response to header "1) Risk to be mitigated" below.

7.3.5.13.2 Response to SCE Action Statement, 2021 WMP Additional Issue to Address in 2022 WMP:

The following is one of the Additional Issues as provided by OEIS in the Final Action Statement on SCE's 2021 WMP.

> *Issue: In its 2022 WMP Update, SCE must broaden its SCE's 2021 WMP Update header "1) Risk to be mitigated" considerations in Section 7.3.5.13 (or similar). SCE's 2020 QC audit target was 3,000 circuit miles; SCE exceeded this target, completing over 6,000 circuit miles. However, SCE's 2021 QC target is 5000 circuit miles. It is apparent that SCE has the resources and ability to complete over 6,000 miles of QC audit per year.*
>
> *Remedy: Energy Safety encourages SCE to adjust targets for QC audits based on known, demonstrated capabilities.*

SCE's response to this Issue/Remedy is described below:

Please see SCE's response to Prompt 4: "Progress on initiative (amount spent, regions covered) and plans for next year."

1. Risk to be mitigated / problem to be addressed:

Routine Line Clearing - Arborists certified by the ISA perform QC inspections on a sampling of HFRA circuit miles where trimming was performed by contract tree trimmers to ensure that they achieved the vegetation management standard distances. The risks to be mitigated include: identifying trees which should have a prescription for remediation (trimming or removal) that were not prescribed, confirming prescribed work was performed to achieve the required clearance (e.g., trimming crews may not prune enough of a tree to maintain the minimum clearance distance, thus presenting a risk of vegetation contact with energized conductors), verifying that American National Standards Institute (ANSI) A300 quality pruning standards were achieved, and confirming surrounding areas are free of debris from the work performed.

HTMP - Arborists certified by the ISA perform independent tree risk assessments using SCEs Tree Risk Calculator to verify the HTMP assessors are performing accurate tree assessments. SCE samples at a minimum rate of 99% / 2% confidence level/confidence interval for Subject trees that were assigned a tree risk score of 35-49 (typical). HTMP QC assessors also verify 100% of the prescribed remediation has been performed. The risks to be mitigated include providing reasonable assurance that trees with strike potential have been appropriately identified and mitigated.

Dead and Dying Tree Program – SCE’s Vegetation Management QC inspectors verify that 100% of the completed remediations have been performed. The risks to be mitigated include providing reasonable assurance that trees that have been identified as having strike potential have been appropriately mitigated.

2. Initiative selection:

Given the compliance requirements and the risk of vegetation related faults that can potentially cause ignitions, SCE deemed it important to institute an independent QC initiative in 2019, where arborists certified by the ISA inspect vegetation based on a risk-informed sampling of HFRA circuit miles to verify that the vegetation contractors (pre-inspectors and trimmers) are achieving established internal and regulatory clearance requirements, thereby increasing SCE's assurance that standards are being achieved. After data from the sampled areas are collected, the QC inspections results are analyzed, and SCE provides contractors with feedback for performance improvement. The alternative to this initiative is to rely on existing in-house resources to provide these inspections. Prior to the implementation of independent QC in 2019, oversight of contractor work was performed by in-house certified arborists as part of normal operational practice. SCE determined that having a more robust and structured QC process would allow for a greater number of work points to be evaluated and would provide an unbiased lens on the results. This activity does not directly mitigate wildfire or PSPS risk but it informs the mitigation, Vegetation management to achieve clearances around electric lines andequipment (Section 7.3.5.20), that directly mitigates wildfire and PSPS risk.

3. Region prioritization:

QC is performed using a risk-based approach for sampling. In 2020 and 2021, QC used the Reax risk-stratification model to determine the volume and location where to perform its sample inspections and 100% QC inspection was performed in the highest Reax areas, which represented approximately 94% of the risk-consequence for SCE. In the remaining 6% of Reax risk-consequence areas, QC was performed using judgmental sampling techniques with a Confidence Level/Confidence Interval of 99/1.7% to identify where to inspect.

In Q1 of 2022, QC is transitioning to the TRI model, which is informed by Technosylva WRRM data. For a more detailed description of SCEs TRI, please see Section 4.5. The TRI includes risk areas for both HFRA and non-HFRA. Within the TRI model, there are four risk classes A, B, C and D, with A being the highest. TRI model utilizes a similar methodology to HFRI inspections, which factors in both the probability of a fire starting from an SCE asset, in this case, vegetation contact, and Technosylva consequence values. QC plans to inspect 100% of all Class A HFRA Circuit Miles (unless there are constraints), and a sample population of non-HFRA Class A circuit miles, with an overall Confidence Interval/Confidence Level (CL/CI) of 99/1% for Class A circuit miles, and 99/2% for Class B, C, and D combined. In 2022, QC plans to inspect approximately 8,000 total circuit miles, of which approximately half of the miles will be selected from HFRA. In 2022, OEIS has requested that utilities report the Vegetation Inspections Audited Annually program target in terms of percentage of vegetation inspections audited. The QC plan set forth herein represents approximately 15% of the total tree inventory in SCEs service territory. Please refer to the illustration below on SCEs TRI Risk Classes and circuit miles.

Below, see Figure SCE 7-81 which represents SCE's risk distribution grids (HFRA) by Vegetation Management Grid Class.

Figure SCE 7-81

Distribution Grids (HFRA) by Vegetation Management Grid Class

The upper number represents the count of VM Distribution Grids

The lower is the Quantity of trees VM currently manages within those grids

Probability of Ignition	D	C	B	A
A		1 1799	7 17802	13 37172
B	7 17353	7 20646	9 22736	19 43799
C	23 29170	25 39749	28 38418	34 41815
D	213 154263	143 124661	111 82665	88 76090

Technoslyva Consequence

For HTMP, QC samples at a minimum rate of 99% / 2% CL/CI for Subject trees that were assigned a tree risk score of 35-49 (typical). HTMP QC assessors also verify 100% of the prescribed remediation has been performed. For SCE's HTMP program in 2021, QC performed approximately 13,000 independent risk assessments to verify the quality of the assessments performed. Approximately 12,000 of these assessments were focused on tree risk scores in the range of 35-49 where mitigation is typically not required. Of these 12,000 assessments, QC identified approximately 2,700 cases showing a tree risk score of greater than 50. These cases were re-directed to the HTMP assessors for re-evaluation and potential remediation.

For Dead and Dying Trees, QC verifies that 100% of the completed remediations have been performed. In 2021, QC inspectors verified approximately 2,200 tree remediations. 133 tree remediations did not pass QC inspection, most of which were due to lack of site debris clean up. These 133 tree remediations were reassigned to vegetation management contractors for re-work.

For both HTMP and Dead and Dying Tree Program, QC inspectors also look for and document any trees with strike potential that were missed, any new introduced hazards as a result of the mitigations performed, and whether site conditions were left satisfactory.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

In 2020 and 2021, SCE had a goal to perform 3,000 risk-based HFRA circuit mile vegetation management QC inspections (per VM-5 in SCE's 2020 WMP) annually. In both years, SCE exceeded its goal by achieving over 6,000 HFRA circuit mile inspections (approximately 46% of HFRA total circuit miles), based on better-than-expected production rates and the ability to onboard qualified resources to perform the QC work. SCE's 2021 vegetation management QC results showed a conformance rate of 99.2%. Since vegetation management QC commenced in 2019, the conformance rate steadily increased each year with a conformance rate trend of 97.9% for 2019, 98.6% for 2020, and 99.2% for 2021. In 2022, SCE is using the TRI to inform the QC inspection scope, which instead of focusing exclusively on HFRA, ranks risk across the service territory, as described above. SCE plans to perform over 8,000 circuit mile inspections throughout its service territory (approximately 15% of SCEs tree inventory), more than half of which will be in HFRA. The circuit mileage targets pertain to QC inspections of line clearing activities.

5. Future improvements to initiative:

SCE is continuing to explore the feasibility of utilizing QC on more vegetation management programs, such as pole brushing and non-routine work[177] in 2023 and beyond. SCE expects to make a determination about the feasibility of expanding the QC program in Q1 2023.

7.3.5.14 Recruiting and training of vegetation management personnel

SCE recruits and trains qualified personnel, including ISA-certified arborists, to perform quality and timely vegetation management work.

1. Risk to be mitigated / problem to be addressed:

A shortage of vegetation management personnel, including internal and external ISA Certified Arborists, can put SCE's ability to perform high quality and timely vegetation management at risk.

[177] Non-routine work includes supplemental patrols, ad-hoc notifications for remediations, etc.

2. Initiative selection:

SCE employs or contracts with ISA-certified arborists or persons close to certification when it is necessary to do so. For example, SCE requires that its vegetation QC inspectors are ISA-certified arborists. SCE also employs a number of ISA-certified arborists for internal positions to provide guidance to contractors for SCE's vegetation management activities.

For line clearing work, SCE requires any person supervising or advising pre-inspection activities in the field to be ISA-certified. For workers performing pre-inspections without supervision responsibilities, SCE requires a two-year degree or four years' worth of field experience in arboriculture or related field.

Pre-inspections require a worker to accurately determine distances between vegetation and SCE's facilities as well as estimating annual growth rates of different types of trees. Currently, SCE does not believe this work requires an ISA-certified arborist at the time of hire to perform. Further, SCE strongly recommends that each pre-inspector who is eligible to become a Certified Arborist does so within twelve months of becoming eligible.

SCE provides annual training to all vegetation management employees and vegetation contractor lead personnel, called "Utility Vegetation Management (UVM) Core Plans Training." This training is intended to provide program knowledge to SCE's certified arborists and others to enhance understanding of the specific requirements of SCE's vegetation management program. Vegetation management has a training and qualification advisor to organize its training programs. Vegetation management contractors are responsible for training their own crews on vegetation management work to meet SCE's standards specified in the contract scope of work and SCE's applicable program manuals.

3. Region prioritization:

Recruiting and training vegetation personnel is an ongoing activity and not subject to region or other prioritization efforts. Staffing levels are continuously evaluated and adjusted based on identified needs and implementation of future programs.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

Based on the currently defined program needs and skills, SCE in 2021 had a sufficient amount of ISA-certified assessors to effectively manage its applicable programs, as described below:

<u>HTMP</u> – In 2020, SCE performed approximately 100,000 HTMP assessments with an average of 18 assessors. In 2021, SCE performed approximately 130,000 HTMP assessments with an average of 30 ISA certified assessors. The number of assessors needed is a function of the planned assessments to be performed as ISA-certified arborists are needed to help identify defects in HTMP. Throughput varies, and SCE has observed that 20-30 assessments can be performed by an individual assessor each day, depending

on terrain and density of vegetation. In 2022, SCE plans to update the way it reports out on HTMP goal progress, to reflect its goal using circuits inspected as the metric rather than completed tree assessments. See Section 7.3.5.16.1. SCE plans to perform inspections on approximately 330 circuits in 2022, which will require a year-end total of approximately 30 ISA Certified assessors to achieve this goal.

Quality Control – SCE's QC inspections are performed by an independent contractor which uses ISA Certified Arborists to perform the inspections. SCE's contractor has 25 inspectors. In 2020, SCE's contractor performed 3,000 risk-based HFRA circuit mile inspections. In 2021, SCE performed over 6,000 risk-based HFRA circuit mile vegetation management QC inspections. In 2022, using its TRI model to identify and prioritize risk, SCE plans to inspect 8,000 circuit miles across the service territory, more than half of which will be in HFRA.

Contractor Guidance Activities – SCE uses internal Senior Specialists (SSPs), who are ISA-certified arborists, to provide oversight and general guidance to contractors for SCE's compliance activities. SSPs are responsible for coaching and performing work verification on a sample of completed vegetation work performed in their respective work districts to verify contractors are meeting SCE's performance expectations. SCE currently has approximately 40 SSPs across its service area. To address future needs and potential industry-wide shortages of ISA-certified arborists, SCE created a pipeline for future grooming of ISA-certified arborists with sufficient skills, knowledge and experience needed to support all SCE vegetation management activities. SCE started hiring experienced, but non-certified personnel as Specialists (SPs), with the intent that SPs will be mentored by SSPs in arboriculture and SCE program standards. After acquiring sufficient experience, the SPs will be prepared to take the required examinations to become ISA-certified.

SCE continues to evaluate the effectiveness of the vegetation management organization and adjust as needed. SCE sees advantages to increasing the skillset of its large contract workforce developing more ISA-certified arborists, while being mindful that the rapid expansion of vegetation management work, in California and across the country, can constrain resource availability.

The goal for 2022 is to maintain the current staffing levels of certified arborists performing work within SCEs service territory (90-100 ISA certified arborists) across the various vegetation programs, unless work demands significantly change due to new regulatory requirements, or unforeseen labor constraints exist.

5. Future improvements to initiative:

SCE will continue to evaluate resource requirements necessary to effectively perform work across its vegetation management programs and will continue to address those needs through a combination of internal and external staffing solutions. In 2023, SCE will continue to develop internal ISA certified arborists for SSP roles by mentoring SPs to become SSPs/ISA Certified Arborists. Longer term, SCE will also explore the benefit of ISA certification for line clearing inspectors and potential incentives for contractor companies and their individual employees for obtaining ISA certification.

Additionally, from 2022-2024, SCE partnered with Cal Poly-SLO to create a Vegetation Management Workforce Development Program to train current and future workforce in ways to increase the pace and scale of vegetation management and fuels treatment across California. By 2025, SCE also intends to contribute to the design and implementation of a professional training series to improve Cal Poly's college curricula related to vegetation management.

7.3.5.15 Identification and remediation of "at-risk species"

SCE takes steps to mitigate the risk of at-risk species coming into contact with energized conductors.

1. Risk to be mitigated / problem to be addressed:

Certain tree species, due to their characteristics, have the potential to cause "grow-in", "blow-in", or "fall-in" incidents that could lead to an outage or an ignition.

2. Initiative selection:

SCE manages at-risk species and implements clearances to reduce the probability of vegetation contacting electric facilities. One objective of this initiative is to avoid "grow-ins" into the area directly beneath the line by allowing a greater buffer for individual tree growth rates that may be faster than typical or anticipated. Another objective is to reduce "blow-ins," by reducing opportunity for nearby trees to shed limbs or branches that can blow into conductors, especially during heavy winds.

SCE considers other factors, but primarily focuses on tree growth rates, to identify at-risk tree species. SCE has categorized tree inventory species within three growth rate selections (fast, medium, slow). In addition, SCE has documented the list of species contained in SCE's service area that have historically caused problems such as TCCIs. Some of the risk attributes associated with these species include, but are not limited to, being prone to trunk failure, branch failure, limb sway during windy conditions, frond drop, root failure, and tree flammability. SCE's vegetation crews are knowledgeable about both tree growth rates and tree risk attributes. Crews are instructed to factor risk attributes into the decision-making process when determining the right tree prescriptions, to ensure compliance clearances are maintained, or when determining if a tree removal is warranted. Additionally, all fast-growing species in grow-in zones are targeted for removal, if possible, when the species has the capacity to encroach into the clearance distance at the time of tree maturity. When practical, SCE removes immature vegetation in the drop-in zone (e.g., overhangs) within HFRA and removes or makes safe palms that have the potential to dislodge fronds. This is not currently an activity separate from Vegetation management to achieve clearances around electric lines and equipment (Section 7.3.5.20).

In June 2019, SCE began performing line clearances across its transmission and distribution facilities in HFRA that are aligned with the guidance in Commission Decision D.17-12-024[E25] and in conformance to the recommended clearances in GO 95 Rule 35, Appendix E[E19]. While SCE has implemented these practices, SCE continues to work and to apply recommended clearances to the individual trees and property where the owner had refused to grant SCE authority to make the recommended clearances.

SCE's HTMP has a separate set of criteria for mitigating palm trees that have the potential to strike SCE's facilities. For a detailed discussion of HTMP, please refer to Section 7.3.5.16.1. below.

3. Region prioritization:

Remediation of at-risk species is implemented throughout SCE's service area, in HFRA and non-HFRA.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

In August 2020, SCE completed its first cycle of enhanced clearances for all distribution lines in its HFRA. Subsequently, in 2021, SCE completed it second cycle of enhanced clearances. Through 2022, SCE will continue to strive for the implementation of enhanced clearances. Managing at-risk species based on individual tree risk factors and growth rates is partof SCE's normal vegetation management practices and will continue to be implemented and refined as new information is gathered.

In 2021, SCE updated its palm tree removal program to help mitigate the risk of vegetation-related ignitions and faults caused directly by palms. Trimming a palm poses worker safety risks. Approximately 40% of palm inventory requires climbing the tree to trim it. To further remediate public and worker safety risks associated with trimming palm trees, palms near lines should eventually be removed. SCE currently has an inventory of approximately 95,000 palms that may pose significant operational challenges, which include: (1) the palm is a major driver of emergent work and outages (e.g., palm fronds drop onto primary wire); (2) the palm represents a wildfire threat, as dead palm fronds are highly flammable and are easily blown long distances by winds; and (3) the palm is fast-growing (upwards) and may require multiple trims per year to maintain compliance. SCE removed 10,000 palm trees posing potential blow-in or grow-in hazards.

SCE's historical approach to palm removals is more conservative than some peer utilities. Customers have proven to be very resistant to removals. In 2021, SCE developed an integrated approach across stakeholder groups to address palm challenges. For example, SCE published and sent out targeted mailers, launched a social media campaign, informative emails, and continued Voice of the Customer surveys. Longer-term, SCE will adjust its overall strategy with stakeholders to ensure SCE has support and the required resources to address palm inventory. SCE's updated Palm Removal strategies will remain an integrated part of day-to-day processes through 2022.

5. Future improvements to initiative:

SCE will continue to look for additional measures to mitigate risks associated with at-risk tree species and refine its methodology for the identification of at-risk species and subsequent remediation. For example, based on the data collected from SCE's analysis of its expanded clearances, SCE may be able to identify tree species that continue to cause TCCIs even with greater clearance distance and then target them for special remediation measures. In 2023 and future years, SCE expects to gain intelligence from the risk modeling associated with the TRI. While it is challenging to anticipate what level of granularity will be available in future years, SCE anticipates the data will help inform operational decisions on appropriate mitigations. In addition, SCE will consider the benefits of the palm removal program and determine whether more removals or expanded clearance are effective.

7.3.5.16 Removal and remediation of trees with strike potential to electric lines and equipment

7.3.5.16.1 Hazard Tree Mitigation Program (HTMP) (VM-1)

SCE takes steps to remove live trees that represent a significant fall-in or blow-in risk.

1. Risk to be mitigated / problem to be addressed:

Analysis of TCCI data revealed that a significant number of faults were caused by green trees “falling in” or branches / fronds from green trees “blowing in” to SCE lines and equipment. These trees were typically outside of the compliance clearance zone. Some visually healthy trees that were far enough from SCE lines and equipment to meet clearance requirements still pose a fall-in risk, depending on condition of the tree and other site-specific factors. Branches or fronds getting dislodged from trees near electrical facilities also have a higher probability of blowing into the lines and equipment and causing faults that can potentially initiate an ignition.

2. Initiative selection:

SCE’s annual line clearing and dead and dying tree removal activities are insufficient to adequately address the risk described above. Regarding the removal and remediation of trees with strike potential to electric lines and equipment, SCE considered the alternative to HTMP of only performing Dead and Dying Tree Removal in accordance with SED Resolution ESRB-4. However, the risk of living trees with strike potential would not have been addressed. Therefore, SCE initiated the HTMP which entails detailed inspection and evaluation of trees that pose risks despite trimming and pruning, and appropriate mitigations, up to removal of these trees.

Detailed inspections for HTMP involve a two-level assessment process. A Level 1 limited visual assessment is performed to determine if the tree is within the USZ and has the capability to strike SCE facilities if it fails. If a tree meets these criteria, a Level 2 assessment of the tree is conducted using SCE’s Tree Risk Calculator. The Tree Risk Calculator is unique to hazard tree assessment and considers factors specific to the tree at issue and its probability of failure[178]. The assessment results yield a risk score between 1 and 100, with risk scores above 50 typically requiring remediation. SCE deems this a valuable initiative, given that this activity implements permanent solutions for contact from high-risk trees. SCE calculated an RSE for HTMP, and its score is relatively high.

[178] The Tree Risk Calculator assesses individual trees and is different from the TRI, which is a risk model used for prioritizing vegetation management inspections.

In the third quarter of 2020 an independent study was performed by engineering consultants to evaluate the effectiveness of SCE's "Tree Risk Calculator" for hazard tree identification and mitigation. The report concluded SCE's program is an effective and needed measure in reducing risks from hazard trees.

Region prioritization:

HTMP is focused in HFRA. SCE prioritizes locations within HFRA based on HFRA tier and density of vegetation surrounding SCE's facilities.

SCE plans to transition the basis of circuit prioritization from Reax consequence scores to the TRI in 2022, which is informed by inputs from the WRRM.

3. Progress on initiative (amount spent, regions covered) and plans for next year:

SCE performs all inspections in accordance with HTMP program requirements, and in 2021, SCE removed approximately 80% of active inventory[179] within six months of identification. This was below the target of 90% and was due to multiple contractor stand downs to help ensure safe work practices were in place. SCE plans to continue HTMP program efforts in 2022 and plans to continue targeting 90% active inventory removal within six months of identification, subject to having access and authority, for HTMP program efforts.

The number of assessments that can be completed is dependent on a variety of factors, such as the number of available qualified personnel, tree density/productivity per circuit, and number of subject trees per circuit (sufficiently tall that have strike potential).

In 2020, SCE performed 100,000 assessments, far exceeding its target of 75,000 assessments. In 2021, SCE had the initial goal of conducting between 150,000 to 200,000 individual HTMP tree assessments, which was later reduced via the Change Orders Report to 120,000 to 130,000 HTMP tree assessments. In 2021, SCE completed approximately 131,000 individual HTMP tree assessments. SCE determined that it had significantly over-estimated the number of trees with strike potential that were likely to be found during HTMP inspections. Given that the number of trees with strike potential is difficult to estimate with accuracy, in 2022 SCE is shifting its program targets to be based on circuits, not trees. For 2022, SCE's target will be to inspect 330 circuits and assess any trees with strike potential along those circuits. SCE plans to continue HTMP in 2023 and anticipates completion of tree assessments along all circuits in HFRA by December 2024.

[179] Active inventory reflects trees for which SCE has both access and authorization to perform the removal.

However, since the amount of time it takes to inspect a circuit varies greatly based on terrain and number of trees that need to be assessed, SCE may be able to complete its first pass of assessments across all of SCE's HFRA in 2023.

4. Future improvements to initiative:

SCE plans to continue QC inspections for HTMP in 2022 to verify the quality of assessments and remediations. In 2023, SCE plans to further evaluate risk mitigation strategies/methods to implement any potential quality enhancements. Additionally, SCE will further integrate this activity into SCE's Integrated Grid Hardening Strategy as discussed in Section 7.1.2.1, to continue to evaluate the benefits of SCE's HTMP in areas where other grid hardening and risk mitigation strategies such as covered conductor are being implemented.

7.3.5.16.2 Dead and Dying Tree Removal (VM-4)

SCE takes steps to remove trees that are dead, dying, or diseased and represent a significant fall-in or blow-in risk.

1. Risk to be mitigated / problem to be addressed:

Dead, dying and diseased trees have higher a probability of failing, and if within striking distance of SCE lines and equipment, can cause fault conditions, sparks, and ignition. SCE removes trees that have a high probability of failing due to drought or other conditions such as insect infestations.

2. Initiative selection:

The Dead & Dying Tree Removal program (formerly called the Drought Relief Initiative) was established as a result of the epidemic of dead and dying trees brought on by climate change and years of drought. Moreover, Resolution ESRB-4, GO 95[E19] and PRC 4923[E22] require that SCE mitigate the hazards posed by dead trees or those that are identified as significantly compromised. Under this program, SCE conducts patrols in HFRA to identify and remove dead, dying, or diseased trees affected by drought conditions and/or insect infestation. All trees that are identified within strike distance of SCE overhead facilities that are dead or expected to die within a year are prescribed for removal. SCE performs inspections in accordance with program requirements. One alternative to the Dead and Dying Tree Program is to remediate dead, rotten, and diseased trees during the routine line clearing when identified by inspection personnel. However, due to the risks associated with the drought epidemic, SCE believed it was prudent to have a dedicated and comprehensive program to mitigate the risks of dead, rotten, and diseased trees.

SCE deems this a valuable initiative, given that this activity implements permanent solutions for contact from dead, dying and diseased trees, and its RSE is high.

3. Region prioritization:

SCE patrols HFRAs several times a year as conditions warrant to identify and remove compromised trees. For example, insect infestation can move quickly, and trees within strike distance of SCE overhead facilities that are dead or expected to die within a year are removed. SCE selects the scope of work for the Dead and Dying Tree Program to focus on areas historically impacted by bark beetle infestations and drought.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

In 2021, SCE performed Dead and Dying Tree annual inspections and prescribed mitigations in accordance with program guidelines and schedules. SCE plans to continue Dead & Dying Tree Removal program efforts in 2022 and plans to inspect 900 unique circuits and prescribe mitigation for dead and dying trees with strike potential along those circuits.

5. Future improvements to initiative:

As needed through 2023, SCE may expand the program's scope of work to include new invasive insect species, such as the invasive shot hole borer, which was recently identified in SCE's southern service area, and the golden spotted oak borer. If expanded, SCE will provide training on insect species identification and mortality indicators such as canopy dieback and bark spotting. SCE would also respond with incremental patrols and partnering with contract resources on approved mitigation methodologies and fuel management (e.g., proper disposal of infested debris).

7.3.5.17 Substation inspections
SCE inspects vegetation around its substations for potential mitigation.

7.3.5.17.1 **Response to SCE Action Statement, 2021 WMP Additional Issue to Address in 2022 WMP**:

The following is one of the Additional Issues as provided by OEIS in the Final Action Statement on SCE's 2021 WMP.

> *Issue: SCE inspects and manages the vegetation at substations "outside the fence line for potential encroachment" in its HFRA. However, it is unclear what standards or guidelines it adheres to ensure consistent VM at all HFRA substations.*
> *Remedy: SCE must describe the standards and/or guidelines SCE uses to manage vegetation around substations (e.g., radial zones).*

SCE's response to this Issue/Remedy is described below in the Initiative Selection Prompt below.

1. Risk to be mitigated / problem to be addressed:

The primary risk to be mitigated is vegetation contact with energized conductors and equipment, as well as preventing fire damage to substations.

2. Initiative selection:

SCE Substation Operators perform substation inspections in accordance with CPUC GO 174[E23] requirements and SCE's Substation Operations and Maintenance Policy and Procedures (SOM). Although vegetation is not specifically referenced in GO 174[E23], persons performing substation inspections do inspect for potential vegetation encroachments on substation equipment, in accordance with the SOM. Specifically, persons entering a substation to do an inspection are to observe and report the following conditions: trees and other vegetation that are not in compliance with SCE's Electrical Design Standards Layout 06-90-01 (which defines requirements for substation perimeter landscaping to promote reliability when landscaping is required); trees that could fall into the energized equipment; trees that could blow into or have foliage that could blow into the energized equipment; dried vegetation that poses a fire risk; vegetation that encroaches into the clear zone around the perimeter of the sub; vegetation growing inside the substation that could encroach on the Minimum Approach Distance; and vegetation growing outside the substation that could encroach on the Minimum Approach Distance. Persons entering a substation to perform an inspection also follow SCE's weed maintenance protocols in the SOM, which include observing and reporting the following conditions: weeds that could grow into the energized switchrack, weeds that could blow into or foliage that could blow into the energized switchrack; and dried vegetation that poses a fire risk. If any of those conditions are observed, the person identifying them creates a notification (or coordinates with the Facility Maintenance Supervisor to create a notification) and notifies the local switching center, which then contacts the Facility Maintenance Supervisor. The Facility Maintenance Supervisor determines a strategy for mitigation, coordinating with vegetation management, utility workers, and/or SCE's corporate real estate department's approved vendor(s), as appropriate. This activity by itself does not directly mitigate wildfire or PSPS risk but rather, informs the mitigation, Substation vegetation management (Section 7.3.5.18).

3. Region prioritization:

All SCE substations in HFRA areas are inspected in accordance with standards established to meet the requirements of CPUC GO 174[E23], the CAISO or NERC reliability standards, and the SOM, as applicable.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

SCE has 169 total substations in HFRA. Of these, substation inspections for the 146 substations reportable under CPUC GO 174 [E23] are performed a minimum of five times per year and will continue in 2022 and beyond. Substation inspections of the 23 substations subject to the CAISO-control and/or NERC reliability standards are also performed five times per year and will continue in 2022 and beyond.

5. Future improvements to initiative:

Substation inspections will continue to meet the requirements of CPUC GO 174.[E23]

7.3.5.18 Substation vegetation management

SCE manages vegetation-caused risks around its substations.

1. Risk to be mitigated / problem to be addressed:

SCE manages vegetation around its substations. The risks to be mitigated are vegetation contact with energized conductors and equipment, as well as preventing fire damage to substations.

2. Initiative selection:

SCE manages vegetation in proximity to substation equipment and outside the fence line for potential encroachment or fall in risk by performing pruning, removal, and weed abatement. Due to the lack of historical data on vegetation-caused ignitions involving substation facilities, SCE did not develop an RSE for this activity. However, SCE determined that it was prudent to manage the vegetation around its substations and will continue to do so for the foreseeable future.

3. Region prioritization:

Any necessary vegetation management for substations are performed annually in HFRA Tier 2 and Tier 3.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

In 2021 SCE completed all vegetation management for substations as planned. Based on the demonstrated success of SCE's substation perimeter clearing during the 2020 Creek fire, SCE will continue performing vegetation management for substations in 2022 and SCE plans to perform vegetation management substation inspections in the course of regular line clearing activities in Tier 2 & Tier 3 totaling approximately 169 substations. SCE will also focus on obtaining human resource and scheduling efficiencies by integrating substation inspections with routine inspections.

5. Future improvements to initiative:

In 2023, SCE may expect to see a significant reduction in vegetation work identified at substation locations, due to work performed in previous years in HFRA. SCE may commence including inspections in non-HFRA pending sufficient resources.

7.3.5.19 Vegetation management system (VM Work Management Tool – Arbora – VM-6)

SCE is in the process of consolidating its vegetation programs into a single digital tool to streamline its view and management of vegetation risks.

7.3.5.19.1 Response to SCE Action Statement SCE-21-08, 2021 WMP Key Areas For Improvement

The following is one of the Key Areas for Improvement as provided by OEIS in the Final Action Statement on SCE's 2021 WMP - SCE-21-08 Incomplete identification of vegetation species and record keeping

Issue: SCE needs to ensure proper identification of trees to the species level. In response to RCP Action-SCE-20, SCE submitted "Action SCE-20 SRVP.xlsx": a list of all remediations required from the 2020 Canyon Patrols and Summer Readiness inspections. Under the column labeled "tree_species," values include oak, pine, maple, etc. However, these are not tree species, but tree genera.

Remedy: SCE must:

1. Use scientific names in its reporting (as opposed to common names). This change will be reflected in the upcoming updates to the WSD GIS Reporting Standard by Energy Safety.

2. Add genus and species designation input capabilities into its systems which track vegetation (e.g., vegetation inventory system and vegetation-caused outage reports).

3. Identify the genus and species of a tree that has caused an outage or ignition in the Quarterly Data Reports (QDRs) (in these cases, an unknown "sp." designation is not acceptable).

4. If the tree's species designation is unknown (i.e., if the inspector knows the tree as "Quercus" but is unsure whether the tree is, for example, Quercus kelloggii, Quercus lobata, or Quercus agrifolia), it must be recorded as such. Instead of simply "Quercus," use "Quercus sp." If referencing multiple species within a genus use "spp." (e.g., Quercus spp.).129 5. Teach tree species identification skills in its VM personnel training programs, both in initial and continuing education.

5. Encourage all VM personnel identify trees to species in all VM activities and reporting, where possible.

SCE's response to this Issue/Remedy is described below in prompt two on Initiative Selection.

1. Risk to be mitigated / problem to be addressed:

Vegetation management is a very important component of SCE's WMP and includes several separate high-volume activities, mostly managed using contract resources. It is challenging to assign work, monitor progress, and manage performance and quality without adequate tools to monitor and analyze work management data. SCE maintains multiple digital tools for Vegetation Management, including Collector/Survey 123 for line clearing inspections and FULCRUM for HTMP, Dead & Dying Tree Removal and Pole Brushing. Housing data from different vegetation management programs on different platforms, as well as the limited nature of the data analytics options on those platforms, constrains advances in efficiency and risk-optimization.

2. Initiative selection:

SCE is working to consolidate these various digital tools into an IVM platform, Arbora, in order to enhance efficiency, risk modeling, communication, reporting, planning, and scheduling.The platform's underlying, cloud-based software will include process orchestration, automation, mobile tools, and an integrated repository across all programs to support collaboration with customers, arborists, environmental regulators, and utility regulators.

SCE considered numerous digital platforms as alternatives, but ultimately selected Salesforce to develop the IVM platform that would later become Arbora. Given the criticality and scope of vegetation management programs, SCE aims to have more quantitative tools to analyze work allocation, scheduling, and execution bottlenecks so that it can focus on the right issues at the right time to get work completed more efficiently. This platform will provide this functionality; not only within individual workstreams but also across simultaneous support of both desktop/back-office and field tools. This was the deciding factor that resulted in Salesforce's selection, as alternatives did not have capabilities to combine all work programs (i.e. HTMP, routine line clearing, non-routine, etc.) into one work management tool with equal ease. SCE wanted an integrated platform to also facilitate alignment with electrical infrastructure mapping and findings from other types of inspections, such as aerial inspections. Finally, the platform can be used to leverage AI, remote sensing tools, and predictive modeling data to drive vegetation management decision-making based on various risk characteristics. For example, SCE is currently piloting the use of LiDAR to scope work.

Arbora enables SCE to better execute other wildfire mitigation activities, and the RSE calculations for those activities in the future will reflect this benefit. For example, SCE has considered the costs of Arbora and has allocated its costs to those related activities, thereby affecting their respective RSEs. Thus, while Arbora does not have a standalone RSE, its impact is considered broadly in all activities it enables, namely HTMP, Dead and Dying, and Expanded Line Clearing.

In response to Key Areas for Improvement SCE-21-08, SCE worked in conjunction with the other California IOUs to develop a tree species list and has enhanced its current field tools to better capture Genus and species scientific names. Arbora will continue to support recent enhancements to allow SCE to analyze and report on tree data at the species level.

3. Region prioritization:

Implementation risk associated with documenting and completing the prescribed work is the major driver for the location and program prioritization. A phased approach provides opportunities to adjust and advance the platform in accordance with user feedback, which provided added assurance of success when rolled out to broader audiences and/or larger programs.

SCE is taking a phased approach by program, not regionally, to the platform's implementation to include more locations and vegetation management programs. If all goes as planned in the phased rollout, SCE expects to have the new platform deployed for the entire vegetation management portfolio.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

In 2020, SCE selected Salesforce and began planning the development of what would become Arbora. In 2021, SCE launched its Dead & Dying Tree Removal pilot, which demonstrated early success in scheduling functionality and reducing cycle time for inspections and remediations in the field. Through this pilot, SCE received user feedback, which contributed to tool enhancement and utilization of dynamic forms (via Youreka). For 2022, SCE will implement the following programs within the VM Work Management Tool, Arbora: the Hazardous Tree Program (HTP) (including: Dead & Dying Tree Removal and Hazard Tree Mitigation) and Routine Line Clearing.

5. Future improvements to initiative:

The platform uses an agile approach to development which integrates continuous improvement through frequent product updates based on prioritized or changing business needs. Future improvements are anticipated to include the integration of the TRI to drive specific mitigations. The ultimate goal is for Arbora to provide a holistic view of SCE's work by grid, circuit, and span across the service territory. This would increase efficiency and improve customer impact. For 2023, SCE will continue enhancing and developing on-going releases of its work management systems.

7.3.5.20 Vegetation management to achieve clearances around electric lines and equipment

SCE performs enhanced line clearances to mitigate the risk of vegetation contact with energized conductors. As discussed in Sections 7.3.5.2 and 7.3.5.3, the majority of SCE's routine line clearing is completed pursuant to compliance regulations. In addition to this work, SCE goes beyond compliance regulations and completes expanded line clearing to further target wildfire mitigation.

1. Risk to be mitigated / problem to be addressed:

SCE performs line clearances to mitigate the risk of vegetation contact with energized conductors. The primary risk to be mitigated is vegetation contact with energized conductors. For distribution line voltages between 2.4 kV to 69 kV, vegetation can create a risk to SCE facilities when the vegetation is located in grow-in zones (i.e., beneath or adjacent to the conductors), blow-in zones (i.e., within general blow-in proximity to conductors), and fall-in zones (i.e., outside of grow-in but within striking distance of conductors). For transmission line voltages greater than 115 kV, SCE has a "wire-zone" which is defined as the area directly beneath the conductors and includes the distance of the conductors at maximum sway condition (line dynamics). Vegetation within this zone has the potential to grow-in and fall-in which creates risk to SCE equipment and facilities.

2. Initiative selection:

To mitigate the risk of wildfire and reduce the probability and consequence of potential ignitions, vegetation management activities to maintain clearance distances from transmission and distribution lines and equipment are conducted in HFRA and non-HFRA. In HFRA, SCE seeks to achieve enhanced line clearances beyond regulatory requirements. This work includes two distinct activities: (1) expanding clearances, where achievable, to GO 95 Rule 35[E19] Appendix E recommendations; (2) maintaining expanded clearances from SCE's lines for trees that have previously been trimmed.

Although risk analysis guides some line clearance activities, as described in the Sections 7.3.5.2 and 7.3.5.11 above on inspections and patrols, the line clearance scope in HFRA is driven by the CPUC requirement and GO 95 Rule 35 Appendix E [E19] recommendations to mitigate wildfire risks. Even though the RSE for this activity is relatively low, SCE's has deemed it prudent to perform this work in order to adhere to State and CPUC recommendations[180].

Energy Safety issued a deficiency (SCE-12) in SCE's 2020 WMP because it found that SCE had not adequately discussed nor provided evidence of the effectiveness of increased vegetation clearances on decreasing utility near misses (i.e., outages) and ignitions. In response to SCE-12, SCE is performing a trend analysis on the reduction in TCCI and ignition events over time and plans to perform an analysis correlating TCCI and vegetation-caused ignition events to trees in the vicinity of these incident locations that are with and outside enhanced post-trim clearances.

3. Region prioritization:

Vegetation management activities to maintain enhanced clearance distances from transmission and distribution lines and equipment are conducted throughout SCE's entire service area on an annual basis.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

SCE performed planned 2021 inspections for all Transmission circuits and Distribution grids. SCE is continuously striving to expand areas within its HFRA where enhanced clearances can be achieved and is currently observing approximately 60% achievement based on the sampling results from its QC inspections within the service area.[181] Some reasons for not achieving enhanced clearances may include: customer refusal, environmental restrictions, or permitting requirements.

Initial evaluations from deficiency (SCE-12) in SCE's 2020 WMP using TCCI data from December 2019 through year-end 2021 showed 33 TCCIs in its HFRA, compared to 118, 144 and 90 TCCIs for the same periods in 2018 through 2020 respectively. The TCCI volume in 2021 has trended lower than the prior years with an overall reduction of approximately 63% in HFRA. Initial indications show a positive correlation that enhanced clearances contribute to a reduction of outage/risk events. SCE expects it will take approximately two to three years of further data analysis to determine the effectiveness of enhanced clearances on reducing vegetation-caused outages and ignition events. The results and methodology used in the initial analysis will be used to refine SCE's approach as appropriate.[182]

5. Future improvements to initiative:

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[180] See CPUC's GO 95 Rule 35, Appendix E[E19] and PRC 4293.[E22] Inspections are performed annually, region prioritization is only performed to help ensure inspections and required trimming can be performed in light of certain access conditions (e.g., snow).

[181] See SCE's response to Action SCE-17 for further explanation of these targets.

[182] Additional detail on the plan to analyze the data collected is provided in SCE's response to Action Statement SCE-16 (addressed in this WMP filing) and the methodology for the effectiveness analysis is provided in SCE's response to Action Statement SCE-18 (to be submitted on February 26, 2021).

In 2023, SCE will continue to contribute to the joint IOU efforts to analyze the effectiveness of enhanced clearances, results of the analysis are expected in 2024-2025. Additionally, SCE will implement methods to increase efficiency in its work, by evaluating how work is scheduled to maximize use of available crews by reducing revisits to sites. Similar to the development of the Palm Program efforts, SCE is exploring expanding clearance efforts into additional high-risk species (e.g., Eucalyptus).

7.3.5.21 Vegetation management activities post-fire

SCE manages post-fire efforts to address trees that have become hazards due to fire damage and resulting debris.

1. Risk to be mitigated / problem to be addressed:

Trees can become hazards as a result of recent fire damage and be at risk of falling into SCE facilities and infrastructure.

2. Initiative selection:

In 2021, SCE began developing internal standard practices for post-fire remediation work. This involved integrating SCE's vegetation management documentation processes with those of SCE's IMT related to restoration work. This allows for an integrated approach to post-fire vegetation management work as part of SCE's overall restoration efforts.

Because this vegetation management work is critical to helping ensure the safety and reliability of the electric system, our workers, and our customers, and because it is often necessary to clear vegetation from roads, ROWs, properties, etc., prior to other restoration work beginning, SCE does not see a viable alternative to the safe and expeditious remediation of identified vegetation management issues post-fire. Delaying restoration efforts until routine work is scheduled is not practical and could result in too high a risk for tree failure.

3. Region prioritization:

Post-fire restoration work is completed in response to fires that occur anywhere within SCE's service area.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

In response to 2020's Creek Fire events, SCE's Vegetation Management team, in tandem with SCE's IMT, identified trees that had become hazards and conducted requisite removals. In 2021, SCE also responded to the French fire, and performed mitigation work to identify hazard trees and remove them. In 2021, SCE issued an RFP seeking resources specifically to assist with debris management and restoration. Debris management includes cleaning up fallen debris near right-of ways and structures. In 2022, SCE plans to execute work pursuant to the RFP. In 2022, Vegetation Management will implement standard operating procedures for addressing post-fire work in a timely and more efficient manner. SCE will also evaluate how to standardize its process of documenting data collection related to post-fire work among existing programs, leading to more efficient use of resources and more complete data records.

5. Future improvements to initiative:

SCE plans to integrate its work management tools into a single platform. SCE will also refine its contracts to secure more resources to respond to fire events. Lastly, SCE is developing general debris management strategies, partially informed by a Fuel Study expected for completion at the end of Q1 of 2022, to identify the appropriate methodologies to address dealing with fuel loads for 2023 and beyond.

7.3.6 Grid Operations and Protocols

7.3.6.1 Automatic recloser operations

SCE includes its operational protocols for making reclosers non-automatic and implementing FC settings for designated overhead transmission, sub-transmission and distribution circuits or circuit sections that traverse SCE's HFRA during a RFW declared by the NWS, and/or a Fire Weather Threat (FWT)[183], Fire Climate Zone (FCZ)[184], Thunderstorm Threat (TT)[185] or PSPS Proximity Threat[186] in its SOB 322.[187] Stakeholders are trained using SOB 322, which is monitored for areas of improvement and updated as necessary to further automate/restrict reclosers.

1. Risk to be mitigated / problem to be addressed:

RFWs, FWTs, FCZs, TTs, or PSPS Proximity Threats may signify an elevated risk of fire ignitions from SCE's electrical system which may necessitate the initiation of PSPS events. SCE's operating restrictions provides requirements to avoid potential ignitions upon re-energization.

2. Initiative selection:

SOB 322 helps to ensure consistency in execution of PSPS and other HFRA protocols by having them all documented in one bulletin, on which key stakeholders are trained. Updated operational protocols and standards for safe operations for HFRA circuits in the SOB 322 guide SCE's response during wildfire events and PSPS operations which help mitigate and reduce wildfire ignitions. The application of FC settings for the distribution system during a RFW, FCZ, FWT, TT helps to ensure that any relay operation during a time of high wildfire risk release as little electrical energy as possible. Transmission and sub-transmission systems have high-speed tripping relays, so FC settings are not needed on these systems. A PSPS Proximity Threat puts operating and reclosing restrictions on transmission and sub-transmission lines within one

[183] Declaration made by SCE Weather Services based on an assessment provided by SCE's Meteorology Group of possible fire threat triggering SCE to initiate Recloser Restrictions, Enable FCSs, and apply Operating Restrictions based on PSPS Watch List.

[184] Declaration made by SCE Weather Services based on an assessment provided by SCE's Fire Science Group of possible fire threat triggering SCE to initiate Recloser Restrictions, Enable FCSs, and apply Operating Restrictions based on PSPS Watch List.

[185] Declaration made by SCE Weather Services based on an assessment provided by SCE's Meteorology Group of possible thunderstorms producing dry lighting and strong downburst winds during periods of increased fire threat.

[186] Declaration made by GCC Liaison during PSPS activation and throughout a POC. This threat is declared for the Switching Center and counties affected by the circuits listed on the POC Circuit List. Transmission and sub-transmission circuits in proximity to the distribution circuits listed on the POC circuit List will have Operating Restrictions applied.

[187] See Section 7.3.6.1.1

mile of a distribution line that is on the period of concern (POC).[188] Additionally, blocking reclosers means that no attempted re-energization can take place automatically, possibly preventing a second relay operation which further reduces ignition risks. Lastly, the implementation of operating restrictions provides testing and patrolling requirements for circuits and circuit sections that traverse HFRA following a relay operation, which helps to ensure qualified personnel identify and mitigate any conditions that could potentially lead to a wildfire ignition upon re-energization. SCE's present remote control capabilities allow it to block reclosing relays for CBs and RARs with group commands of hundreds of devices at once – thus, there is minimal incremental cost to execute the commands, as this effort is part of a larger initiative.

SCE's risk analysis and RSE score for RARs Settings (SH-5) are discussed in Section 7.3.3.9.

3. Region prioritization:

The protocols are in place throughout SCE's HFRA and can be applied to a single circuit, or all circuits within a particular switching center jurisdiction, county or fire climate zone.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

In 2021, SCE completed a review and performed an update to SOB 322 to reflect lessons learned from past elevated fire weather threats/PSPS events and integrated new and improved situational awareness data, improved threat indicators, and applicable regulatory requirements in an effort to reduce wildfire risk and the impact of outages on customers.[189] Principal among these changes was allowing a longer timeframe for workers to switch between fieldwork and updating the standards to reflect new work restriction operations around fuel threats by FCZ.

5. Future improvements to initiative:

SCE plans to implement a new Hazard Event Restriction and Management Emergency System to automate operating restrictions on the distribution system, which would remove human error, reduce the time needed to implement changing business requirements, and enable forthcoming advanced applications to adhere to SCE's operating restrictions in 2024.

SCE will continue to monitor SOB 322[190] for areas of improvement. Additionally, FC and RAR setting changes may impact protocols. SCE will update SOB 322 as necessary, as well as continue to build in flexibility to further automate/restrict reclosers when hazardous conditions are identified. This work and

[188] POC refers to the timeframe in which conditions on circuits meet or exceed elevated wind and FPI thresholds. For more information on POC, please see Chapter 8.

[189] See Section 7.3.6.1.1.

[190] The Annual SOB 322 review initiative was discussed as WMP activity OP-1 in SCE's 2020 WMP. As this ongoing annual review is formalized and operationalized, it will be discussed in this section and remain a part of SCE's WMP but will not have program targets specifically tracked by SCE to monitor wildfire mitigation implementation.

potential changes thereto will also be considered alongside SCE's Integrated Grid Hardening Strategy as discussed in Section 7.1.2.1.

7.3.6.1.1 Response to SCE Action Statement, 2021 WMP Additional Issue to Address in 2022

The following is one of the Additional Issues as provided by OEIS in the Final Action Statement on SCE's 2021 WMP related to SOB 322.

> *"Issue: SCE failed to provide all supporting documents referenced within its WMP, and while SOB 322 was discussed in Section 7.3.6.1, SCE did not provide the actual procedures.*
> *Remedy: Include attachments on SCE's WMP website for all documents and procedures referenced within SCE's WMP, including (but not limited to) SOB 322."*

SCE's response to this Issue/Remedy is described below:

SCE's SOB 322 is confidential as it contains SCE's internal process and procedures directly relating to critical energy infrastructure information. As such, SCE did not include it as an attachment to its WMP but instead is providing it to Energy Safety confidentially contemporaneously with the 2022 WMP Update under separate cover.

7.3.6.2 Protective equipment and device settings

FCs are implemented in microprocessor relays at both the substation CBs and Automatic Reclosers on circuits which traverse high fire areas. See Section 7.3.3.2 for a description of CB hardware for FC.

1. Risk to be mitigated / problem to be addressed:

Fault energy can pose an ignition risk. As such, to reduce the total amount of fault energy, FC settings are installed in microprocessor relays to provide faster interrupting times during an electric fault on the circuit.

2. Initiative selection:

This initiative is designed to select those older electromechanical protective relays that are not capable of having FC set within the device and replace them with modern microprocessor protective relays capable of being set with the FC settings. The selection is focused on HFRA circuits with existing electromechanical relays.

SCE's risk analysis and RSE score for CB Relay Hardware for FC (SH-6) are discussed in Section 7.3.3.2.

3. Region prioritization:

The FC setting is applied uniformly throughout SCE's HFRA and is applied to both microprocessor protective relays on both substation CBs and Automatic Reclosers.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

In 2021, SCE exceeded achieved its WMP goal (see description of SH-6 in Section 7.3.3.2) of upgrading 60 relays through the HFRA region by upgrading 95 relays. For 2022, SCE has set a goal of upgrading 104 relays, and will strive to upgrade up to 122 relays.

5. Future improvements to initiative:

SCE is evaluating the effectiveness of the existing FC setting practice to determine if refining the settings will be able to increase sensitivity and provide increased circuit coverage while not compromising reliability. The revised FC setting practice is planned to be used for new installations and on existing FC circuits when setting changes are required due to circuit upgrades or changes. The development of the revised FC setting practice will be completed by the end of Q2 2022.

7.3.6.3 Crew-accompanying ignition prevention and suppression resources and services

When SCE crews are performing construction and maintenance work in the field, especially if it is considered "hot work," there is a small chance of generating sparks, arcs or incandescent particles while this work is being performed. "Hot work" is defined as activities that are capable of initiating a fire or generating potential ignition sources. SCE and contract crews performing this work are equipped with basic fire mitigation and suppression tools.

1. Risk to be mitigated / problem to be addressed:

The risk to be mitigated is the potential of an ignition when crews perform hot work in the field because sparks, arcs and incandescent particles can occur as a result of this work.

2. Initiative selection:

SCE's HFRA Hot Work Restriction and Mitigation Measures program contains provisions to mitigate crew-caused ignitions and are in effect whenever performing hot work activities in SCE's HFRAs, with limited exceptions (See Section 7.3.6.4 for more information). The program requires SCE and contract crews performing hot work activities to be equipped with basic fire mitigation and suppression tools with the goal of preventing ignitions and rapidly responding to incipient stage ignitions should one occur during the normal course of their work in the field.

SCE performed benchmarking studies regarding dedicated fire suppression resources and services with other utility companies and determined that the number and size of ignitions first encountered by field crews did not support pursuing professional, private firefighting resources at this time. SCE will continue using its existing HFRA Hot Work Restriction and Mitigation program and related protocols that are in place to help prevent crew or equipment caused ignitions, and in the event of an ignition, the crews will use their equipment, such as fire extinguishers, shovels, and rakes, to put out incipient stage fires that could occur during the course of their activities in the field. SCE will also continue to monitor the risks posed by ignitions first encountered by its field crews and consider professional firefighting crews as an option in future iterations of its WMP.

3. Region prioritization:

SCE equips all its field crews with fire prevention and suppression tools across its entire service territory, regardless of region.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

All of SCE's field crews have been, and will continue to be, equipped with the required prevention and suppression tools.

5. Future improvements to initiative:

SCE plans to explore options that would enable field construction and maintenance crews to transport larger volumes of water into the field and onto jobsites where more hot work activities may be prevalent and/or where the jobsite is remote and access to water is limited.

7.3.6.3.1 Response to SCE Action Statement, WMP Additional Issues to Address in 2022

The following is one of the Additional Issues as provided by OEIS in the Final Action Statement on SCE's 2021 WMP related to Work Restrictions During Elevated Fire Conditions Program.

"Issue: SCE failed to provide details on its Work Restrictions During Elevated Fire Conditions Program.
Remedy: Include a) all procedures affected as a result of the Program, b) a description of how such procedures are affected, c) the threshold(s) used to determine elevated fire conditions, and d) define and provide the criteria for a "PSPS Proximity Threat."

SCE's responses to the remedies identified in the Action Statement are described below:

a) The HFRA Hot Work Restriction and Mitigation Program was formerly known as the Work Restrictions During Elevated Fire Conditions Program. Hot work activities affected by this program are defined as any construction or maintenance activity that can initiate a fire or generate potential ignition sources. These activities generally include the following: metal cutting and grinding, welding, burning, oxygen and arc cutting, open flame soldering, brazing, pipe thawing, torch applied roofing, and thermal spraying.

b) Certain mitigations must be in place when conducting hot work activities throughout the year in HFRA (with limited exceptions), and field work that involves these activities shall be cancelled when working on circuits under consideration for or de-energized due to an active PSPS event. Additionally, the program requires certain mitigations when performing primary and secondary line work and switching throughout the year in HFRA, which include the following: manual operation of energized electrical devices for the purpose of reconfiguring circuitry, manually energizing or de-energizing lines or equipment, opening or closing taps on energized electrical equipment, opening or closing fuses on an energized line, clearing foreign objects/vegetation in contact with energized lines, installing or removing protective covers on energized lines or equipment, and working on energized secondaries or services.

c) Mitigations are required throughout the year when performing hot work activities in HFRA, with some limited exceptions. Field work that involves hot work activities are cancelled when working on circuits that are on the period of concern (PSPS-monitored) and the de-energized list. Additionally, district management and field workers are empowered to cancel or delay routine construction, maintenance and inspection work if local fire weather conditions warrant based on their knowledge of the job, work processes, and conditions, and other factors beyond fire weather like egress, accessibility, other safety factors that could increase ignition risk or stifle response/suppression.

d) A PSPS Proximity Threat Declaration is made by Grid Control Center (GCC) Liaison whenever there is a PSPS activation and throughout a POC. A PSPS Proximity Threat puts operating and reclosing restrictions on transmission and sub-transmission lines within one mile of a distribution line that is on the period of concern.[191] This threat is declared for the Switching Center and counties affected by the circuits listed on the POC Circuit List. Transmission and sub-transmission circuits in proximity to the distribution circuits listed on the POC Circuit List will have Operating Restrictions applied. The PSPS Proximity Threat does not relate to HFRA Hot Work Restrictions Mitigation Program but is another means of initiating operating restrictions in SOB 322.

7.3.6.4 Personnel work procedures and training in conditions of elevated fire risk

SCE crews are responsible for de-energizing and re-energizing power lines during PSPS events based on decisions made by the IMT. SCE has implemented procedures that the crews follow during de-energizing and re-energizing power lines. The crews are trained in these procedures, so they are better prepared to perform their duties during conditions of elevated fire risk. Additionally, as described in Section 7.3.6.3, SCE's HFRA Hot Work Restriction and Mitigation Measures program outlines basic protocols which should be followed whenever conducting hot work activities in HFRA.

SCE appreciates the importance of employee and public safety and does not take lightly the risks associated with wildfires and its impact upon SCE customers and communities. SCE promotes year-round awareness and updates wildfire related training material annually and is continuously working to improve its training outreach. Currently, SCE is refining its field employee engagement strategy to improve the training program and wildfire safety related communications with the frontline workforce.

1. Risk to be mitigated / problem to be addressed:

[191] POC refers to the timeframe in which conditions on circuits meet or exceed elevated wind and FPI thresholds. For more information on POC, please see Chapter 8.

Training personnel performing high risk grid operating procedures in elevated fire conditions is necessary to promote sound decision-making and to reduce the chance of utility-associated ignitions.

2. Initiative selection:

SCE has implemented work procedures that outline the necessary steps to mitigate ignitions associated with crews and equipment in HFRA and empower qualified employees to request temporary de-energization of a line or line segment. These procedures also contain provisions which restrict or delay field work when conditions call for such action. Non-emergency/routine work involving hot work activities shall be cancelled when working on or near circuits under consideration for or de-energized due to a PSPS event. SCE also provides these employees the training necessary to safely perform these activities. The HFRA Hot Work Restriction and Mitigation Measures program applies to both SCE employees and contractors and is intended to reduce their risk of causing an ignition during the normal course of work in HRFA whenthe weather and fuel conditions are more susceptible to fire ignitions.

SCE routinely conducts reviews of its protocols and work procedures related to its activities in areas of elevated fire risk. These are protocols and procedures followed by SCE as a prudent utility operator and thus, SCE did not calculate an RSE for this activity.

3. Region prioritization:

The training activities are delivered across all HFRA within SCE's service area and are not region specific. SCE delivers training to all employees engaged in wildfire mitigation activities and promotes year-round awareness of the company's HFRA operating protocols, i.e., Hot Work Restrictions and Mitigation Measures. HFRA training is not region specific, as it is consistent across all HFRA within SCE's service area. When operating restrictions are declared (discussed more above in Section 7.3.6.1) or circuits under consideration for or de-energized due to a PSPS event, the protocols then become region or circuit-specific.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

SCE provides annual training to all field personnel (both employees and contractors) performing wildfire mitigation activities, patrols, and live field observations which includes all updates to SOBs, which encompass operating protocols, remedial actions, communication and notification protocols, ratings and limits of lines and equipment, and system protection schemes. In addition, the training included PSPS Operating Protocols, PSPS Decision-Making Tool Enhancements, Patrolling and Live Field Observation for field operations, and Field Operations Tool Training. This training will be refreshed for all field personnel performing the same types of patrols in 2022, which includes both experienced and new resources.

5. Future improvements to initiative:

SCE will continue to provide training to field personnel prior to every wildfire season, as additional resources are onboarded every year that will need to be trained. The annual training will include updates to all SOBs and any updates in work restriction procedures. SCE continues to refine its training program based on feedback from field employees and its QC program.

7.3.6.5 Protocols for PSPS re-energization

SCE has established protocols to patrol its lines after a PSPS de-energization to enable the swift and safe restoration of power.

1. Risk to be mitigated / problem to be addressed:

Restoring power after a PSPS de-energization may lead to an ignition if lines are not properly inspected. Restoring power quickly and safely presents challenges because when a circuit is de-energized, SCE does not have the same indicators of potential hazards that it might normally have. For example, if a foreign object were to come in contact with a line while energized, the circuit protection system and alarming system would alert SCE that there is a fault on the system, but this alert is not available when a circuit is de-energized. Therefore, prior to re-energizing a line, SCE must patrol the line to ensure it is free from CFO, damaged equipment, and other conditions that could create ignition hazards when the line is re-energized.

2. Initiative selection:

When SCE de-energizes circuits during PSPS events, all de-energized circuits are required to be patrolled prior to re-energization to confirm there is no damage to equipment or unsafe conditions on the lines that could lead to possible ignitions. For larger-scale PSPS events, SCE also activates an Electric Services Incident Management Team (ES IMT) to assist with restoration planning and strategy. The ES IMT focuses on circuits that are safe to begin restoration while the PSPS IMT continues to monitor circuits of concern. Once field resources confirm that it is safe to re-energize the circuit(s), power is restored, and Public Safety Partners[192] and customers are notified of the re-energization. The order in which circuits are re-energized depends on many factors including, but not limited to, customer safety and wellbeing, consideration of impacted essential services, damage to electrical and other infrastructure, and circuit design/topology. SCE strives toto restore power as soon as safely possible within 24 hours of the subsidence of dangerous weather conditions.[193]

SCE's risk analysis and RSE score for adequate and trained workforce for service restoration (SCE Emergency Response Training) (DEP-2) are discussed in Section 7.3.8.1.

3. Region prioritization:

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[192] The term "public safety partners" refers to first/emergency responders at the local, state and federal level, water, wastewater and communication service providers, affected community choice aggregators and publicly-owned utilities/electrical cooperatives, the Commission, the California Governor's Office of Emergency Services (Cal OES) and the California Department of Forestry and Fire Protection. Public safety partners will receive priority notification of a de-energization event, as discussed in subsequent sections.

[193] This is consistent with D.20-05-051,[E28] which requires each electric investor-owned utility to ensure that electric service to impacted service points is restored as soon as possible and within 24 hours from the termination of the de-energization event, unless it is unsafe to do so.

This initiative covers all circuits in HFRA that are in scope for any given PSPS event.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

In 2021 PSPS season, SCE initiated 9 PSPS events. Through the course of these events, SCE continued to revise its processes and protocols to incorporate lessons learned during the de-energization and re-energization activities. For example, SCE refined its re-energization procedures for inspecting its facilities and determining when it is safe to restore power to circuits based on prevailing conditions, and how to minimize undue delays (e.g., restoration plan developed beforehand, restoration patrols completed, etc.). SCE also conducted several table-top simulation exercises, and incorporatedlearnings from these activities into PSPS processes.

In the 2021 fire season, SCE performed 124 restoration patrols on circuits that were de-energized. Out of 124 de-energized circuit events, SCE was able to restore electric service to 117 circuits within 24 hours of threatening fire weather conditions abating. Of the seven not re-energized within 24 hours, the majority of customers were re-energized prior to 24 hours with just a portion remaining de-energized beyond 24 hours, due to site specific situations such as requiring air patrol, facilitating repairs, etc.

In 2021, SCE staffed its PSPS IMT from a large pool of company-wide resources, to manage and coordinate potential responses. IMTs were placed on rotations, and on-call teams were required to activate virtually within two hours, with limited exceptions. These teams werespecifically structured to have multiple backups available, so that response and recovery efforts could beconducted 24 hours-a-day for several days or even weeks.

Beginning in 2021, SCE implemented a fully dedicated PSPS IMT, trained in PSPS event management following Incident Command System (ICS) standards and procedures in order to improve its PSPS readiness capabilities, reduce employee fatigue, and help improve coordination, consistency and execution of PSPS events. SCE's Wildfire Infrastructure Protection Team includes 18 additional full-time employees. Based on lessons SCE learned in 2019 and early 2020,having variable resources from PSPS event to event created inefficiencies in operations and decision making. Additionally, a dedicated full-time PSPS IMT reduces stress on company-wide employees being "activated" for PSPS events and allows employees to focus on their regular roles, including manyemployees who are working on other wildfire mitigation efforts, uninterrupted by "activations."

5. Future improvements to initiative:

SCE will be further piloting the use of UAS and remote sensing capabilities to assist with PSPS patrols and data gathering for situational awareness during any events that may be necessary in 2022. Although SCE is in the early phases of the pilot, UAS are proving to be valuable to supplement in-person patrols, allowing qualified personnel to more quickly assess circuit conditions on conductor segments that traverse rugged and heavily vegetated terrain and would otherwise require a lengthy hike or helicopter patrols. If the UAS pilot continues to be successful, SCE plans to update its protocols to increase use of UAS, where appropriate.

SCE's use of UAS is described in more detail in Section 7.3.8.1 of this WMP. In addition, SCE intends to explore the potential for installing remote sensors on SCE equipment to help assess a circuit's readiness to return to service.

7.3.6.6 PSPS events and mitigation of PSPS impacts

SCE recognizes the impact that PSPS de-energizations have on its customers. As discussed in Section 7.3.9, SCE conducts extensive community outreach to educate its customers on SCE's use of PSPS and ways to improve customer resiliency. Also as described in Section 7.3.10, SCE uses the Emergency Outage Notification System (EONS) to send targeted notifications to customers in areas potentially subject to PSPS. For residents who are not SCE customers (e.g., residents who live in master-metered buildings), SCE uses a variety of targeted communication channels such as Nextdoor and Address Level alerts. Address Level Alerts launched on October 25, 2021. These notifications are meant for non-account holders, and are helpful for master-meter residential tenants, small business tenants, landlords, caregivers and relatives, in-person service providers and frequent travelers. As discussed further below, SCE employs a number of initiatives to help mitigate the impacts of PSPS to our customers, ranging from employing a dedicated IMT, providing incentives for installing backup generation, and activating CRCs for customers to receive services and information during PSPS events.

7.3.6.6.1 PSPS Incident Management Team

Execution of the PSPS protocol is overseen by a specialized task force in the ICS overseen by the PSPS IMT. The PSPS IMT is responsible for monitoring and considering conditions and relevant information before recommending the de-energization or re-energization of any SCE circuit(s). SCE's PSPS IMT includes a dedicated Customer Care Team that is activated during PSPS events with primary responsibility of mitigating customer impact of a de-energization during a PSPS event.

1. Risk to be mitigated / problem to be addressed:

PSPS events may have significant impacts on our customers. Specially trained staff and specific protocols are necessary to limit the scope and duration of PSPS de-energizations and mitigate the impacts of any de-energizations that are necessary for public safety. A well-trained team also provides better coordination and interactions with other emergency management entities, such as local police, fire and emergency service departments, that may serve to limit negative impacts to customers during events.

2. Initiative selection:

SCE has established and trained a dedicated PSPS IMT team staffed solely for the purpose of responding to PSPS events and advancing operational protocols and enhancements during normal daily operations. A dedicated team creates greater consistency across PSPS activations when communicating with customers and public safety partners. Additionally, this specialized team is able to more quickly adapt and make changes from one event to another. The ICS is typically utilized by private and public organizations across the country as a best practice for emergency response, regardless of incident size or type. As the ICS has been successfully utilized within SCE for several years, it allows for all IMT members to respond in a cohesive manner during IMT activations, including those related to wildfires and PSPS events. To improve IMT in the future, SCE plans to integrate the Standardized Emergency Management System (SEMS) training and the Access Functional Needs training.

The IMT oversees and executes PSPS protocols, which detail how PSPS activation, notification, de-energization and service restoration processes work (e.g., roles and responsibilities, decision-making processes, and execution). As described in Section 8.2, when SCE forecasts that windspeeds will breach circuit-specific thresholds for activation and monitoring for potential PSPS, SCE activates its PSPS IMT and begins preparations for the upcoming event (notifications, pre-patrols, etc.). The IMT will use a variety of factors to guide its decision on whether or not de-energization or each circuit or circuit segment is necessary, including FPI and real-time data from weather stations and field observers (if available). When fire risk conditions subside to safe levels and safe conditions are validated by field resources, SCE will begin patrolling impacted circuits to check for any condition that could potentially present a public safety hazard when re-energizing circuits. Once field resources confirm that it is safe to re-energize the circuit(s), power will be restored, and local government and customers will be notified of re-energization. The order in which circuits are re-energized will depend on many factors including, but not limited to, consideration of affected essential services, damage to electrical and other infrastructure, and circuit design/topology. SCE has established processes and procedures that outline how to handle critical business decisions during a Public Safety Emergency.

3. Region prioritization:

Protocols for initiating PSPS events cover all circuits in HFRA that are in scope for any given PSPS event. At a circuit level, SCE uses PSPS as a last resort based on de-energization wind speed triggers that are unique to each circuit and are dynamic based on evolving environmental and circuit-specific characteristics. Please see Section 8.1 for more details.

IMT resources are trained to handle major incidents, such as wildfires, PSPS events and earthquakes, that arise across SCE's service area. As such, IMT resources are not region specific, and regions are not prioritized differently.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

SCE determined that, as discussed previously, in 2021, SCE implemented a fully dedicated PSPS IMT, composed of 18 additional full-time employees. The PSPS IMT was activated nine times in the 2021 fire season to prepare for and monitor PSPS conditions, perform customer notifications, ensure resource coordination and implementation of compliancerequirements. When the decision is made to activate the PSPS IMT, the team begins executing the PSPS protocol and mitigations including deploying CCVs and/or CRCs, deploying mobile generation to essential customers for life safety emergencies (where appropriate) and initiating pre-patrol activities to assess safety hazards on impacted circuits. These PSPS activities are critical for minimizing impacts and public safety risks to customers and communities before and during a PSPS event.

5. Future improvements to initiative:

SCE continuously refines its ICS and PSPS protocols as real-world incidents occur in order to ensure best practices are captured and trainings are as up to date as possible. As such, SCE will update its processes and protocols in 2022 and beyond to incorporate any best practices identified.

SCE has contracted with a third-party technology company, Palantir, to help automate SCE's PSPS forecasting and event management tools and processes. Please see Section 8.2.2 for additional details.

7.3.6.6.2 Customer Care Programs (PSPS-2)

SCE routinely assesses the needs of our customers and may introduce new solutions as needed for Customer Care programs. For 2022, SCE offers customer care programs to help mitigate the impacts of PSPS to our customers including CRCs, Community Resiliency Programs, and Customer Resiliency Equipment. These programs are described further below in Figure SCE 7-82.

Figure SCE 7-82

SCE Customer Care Programs

SCE CUSTOMER CARE

Programs to help customers mitigate the impacts and consequences of PSPS and other emergencies

CUSTOMER RESOURCE CENTERS

Community Resource Centers (CRC) and Community Crew Vehicles (CCV) are temporary public gathering places that help mitigate the impacts of a PSPS event on customers. Services offered at the CRCs and CCVs include information, charging of mobile and portable medical devices, updating of contact information and enrollment in outage alerts, as well as access to bottled water and light snacks, ice and ice vouchers, and restrooms. SCE also provides small, insulated bags to keep small medication cold and translation service for over 120 languages including American Sign Language.

CUSTOMER RESILIENCY PROGRAMS

SCE provides year-round care coordination in partnership with 211. Care coordination helps customers with Access and Functional Needs (AFN) develop a resiliency plan and enroll in eligible assistance programs. 211 also provides specialized referrals to resources for customers with AFN experiencing PSPS. 211 services include connecting customers to shelf-stable food, hot meal delivery, transportation, and/or temporary shelter. SCE will improve communications methods including creating videos utilizing American Sign Language for marketing and PSPS notifications.

CUSTOMER RESILIENCY EQUIPMENT

Programs such as the Critical Care Backup Battery program and the In-Event Battery Loan Pilot provide eligible customers with a portable backup battery to power a medical device or assistive technology during a PSPS event. SCE also offers rebates to assist customers residing in high fire risk areas with the purchase of a portable battery or generator through the Portable Power Station Rebate and Portable Generator Rebate programs on SCE's Marketplace website.

7.3.6.6.2.1 Community Resource Centers

SCE representatives provide information and services to customers at CRCs and CCVs to reduce the impact of PSPS de-energization events.

1. *Risk to be mitigated / problem to be addressed:*

During PSPS de-energization events, customers often need access to services such as power sources for the charging of devices and medical equipment and information on the event such as the event duration.

2. Initiative selection:

CRCs provide services such as access to device charging, restrooms, water, snacks, and resiliency kits (which contains a tote bag, LED lightbulb or flashlight, pre-charged phone battery, ice voucher, personal protective equipment (e.g., masks, hand sanitizers, etc.)). Contents of the resiliency kits provided to customers may be adjusted as needed. CRCs also provide an opportunity for customers to sign up for PSPS alerts, update their SCE contact information, and receive answers to PSPS, SCE program or customer account questions.

SCE also uses mobile CCVs as needed to reach affected communities that do not have a CRC location in their community or as a supplement to CRCs. SCE has designed and outfitted these vehicles with the required equipment and technology to enable SCE staff to transport and distribute water, snacks, and resiliency kits to communities potentially impacted by a PSPS event. CCVs can be quickly activated to serve customers and can be set up in open areas without a standing facility and/or in remote areas. CCVs may be especially useful in limiting indoor interactions during the COVID-19 pandemic.

To continue to serve customers during the COVID-19 pandemic, SCE will continue the modifications it made in 2020 and 2021 to the operation of CRCs and CCVs to enforce social distancing. For example, instead of allowing customers to help themselves to snacks, fact sheets, and other amenities, SCE has pre-packaged these items into a resiliency kit, as described above. SCE is also prepared to set up alternatives to indoor CRCs such as drive-through or outside walk-up CRCs as space and conditions permit to further enforce physical distancing mandates, as necessary.

CRCs and CCVs can reduce the impacts associated with PSPS risk. SCE performed an RSE calculation on this initiative, which resulted in a relatively low RSE score. However, RSEs were not used to directly inform the implementation of this activity, as SCE deems this activity to be critical in supporting our customers who are impacted by PSPS events.

3. Region prioritization:

CRCs are activated and CCVs are dispatched to communities that are impacted by a PSPS event. When contracting with sites to host CRCs, SCE targets communities using the following factors: (1) analysis of circuit locations impacted during prior wildfire seasons, (2) analysis of circuits likely to be impacted by PSPS events in the coming year (this analysis considers AFN and other essential customers groups), (3) population density, and (4) special needs within the community. If a CRC cannot be located in an identified community, SCE searched for locations in neighboring communities within a reasonable distance from a HFRA circuit where customers could go to during a PSPS event. Additionally, SCE identified rural locations that might have a need for CRCs with resiliency in the form of a transfer switch that can connect to a temporary mobile backup generator provided by SCE. Nine CRCs in these remote communities are equipped with resiliency, two of which are SCE-installed transfer switches. Looking forward into the next 2-4 years, SCE will adjust CRC needs and locations based on grid hardening efforts and the frequency and duration of PSPS events.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

As of December 31, 2021, SCE has 64 contracted CRCs (62 of which are indoor), 52 of which can operate from 8am-10pm (CPUC mandated hours for non-governmental facilities). In 2021, SCE activated CRCs on 22 occasions for a total of 50 days and deployed CCVs on 31 occasions for a total of 66 days in multiple counties (Mono, Inyo, Kern, Ventura, San Bernardino, Orange, Los Angeles, Santa Barbara and Riverside) to support community members during PSPS events. Approximately 6,500 customers visited the CRCs and CCVs during PSPS events in 2021. SCE provides its CRC and CCV activation and availability information on its website.

For 2022, SCE is evaluating circuits that will likely be impacted by PSPS events in order to determine how many CRCs and CCVs will be needed to support its customers in these areas during PSPS events.

5. Future improvements to initiative:

SCE continues to seek feedback from community stakeholders on the siting, services, and experiences at the CRCs to adapt to new emerging needs. For example, in 2021, SCE launched a language translation service at the CRC that supports over 120 languages including American Sign Language. This service will allow customers whose primary language is not spoken English to receive information they need to manage the PSPS event. SCE also has made available medical thermal bags for customers who need to keep medication cold. SCE also recently made the CRC/CCV survey available via a Quick Response (QR) code display at the CRC or CCV site to enable visitors to provide onsite feedback regarding their experience. This supplements the email surveys that SCE has provided since 2020 to customers who were willing to provide email addresses. SCE hopes that by giving customers a direct and accessible channel to provide feedback, SCE will receive more information to better serve customers at CRCs. SCE continues to evaluate alternatives and refinements to its customer support approach and will include changes in approach, scope or cost in a Change Order Report, as applicable.

7.3.6.6.2.2 Customer Resiliency Programs

SCE has also created customer programs to assist with building resiliency and reduce the impact of PSPS events. SCE continues to communicate with our customers the importance of building resiliency to prepare for PSPS events. As part of this effort, SCE provides additional programs to assist customers and communities with resiliency solutions. SCE offers resiliency programs listed below:

(a) Meter Mounted Adapter Pilot: Limited pilot to field test the installation, maintenance and customer satisfaction of meter mounted adapters to support customer resiliency;
(b) AFN Enhancements: Enhance PSPS mitigation efforts for the AFN community with improved communication and services;
(c) 2-1-1 Pilot: Two-year pilot to expand 2-1-1 service to include PSPS information and services;
(d) Resiliency Zones: Provides in-front-of-the-meter and behind-the-meter temporary generation during PSPS events; and,

(e) Customer Resiliency Equipment Incentive (CREI): Provides a financial incentive towards the installation cost of a microgrid control system at customer sites to provide support during PSPS events.

1. Risk to be mitigated / problem to be addressed:

SCE is pursuing multiple customer resiliency programs that will help mitigate the impacts of PSPS on our customers and communities. The Meter Mounted Adapter pilot will test meter mounted technologies in support of customer resiliency. The AFN Enhancements program expands on current AFN communication and program service offerings. 2-1-1 Pilot expands on the 2-1-1 service to include PSPS information and services for individuals with AFN. The Resiliency Zones program allows customers to have temporary generation during PSPS events. The CREI program constructs a microgrid control system site to support PSPS events as a CRC.

2. Initiative selection:

The Meter Mounted Adapter pilot will allow SCE to determine if such meter mounted technologies supporting customer resiliency, aside from what the market currently provides, align with SCE future program development to reduce the impacts of PSPS events. The Meter Mounted Adapter is a cost-effective plug and play transfer switch that allows residential customers to seamlessly connect a portable backup generator directly into their home's electric panel. This technology would allow customers to connect vital medical power equipment, refrigerators, fans, or other similar appliances without running hazardous extension cords throughout their residence or leaving their doors or windows open to accommodate an extension cord connected to an outdoor portable generator. Other IOUs are currently using meter mounted technologies to support customer resiliency. SCE did not develop an RSE for this activity as it is a pilot and SCE will monitor the activity closely to determine if it should be expanded in the future.

AFN Enhancements will improve PSPS mitigation efforts for individuals with AFN through tailored customer outreach, education, assistance programs and services in alignment with the 2022 AFN PSPS Plan[194]. Communication enhancements include creating videos utilizing American Sign Language for marketing and notifications, accessible program enrollment tutorials for MBL, and outreach to better identify individuals with AFN. Service and program offerings include the expansion of resourced CBOs for community engagement, meal / food augmentation beyond that provided in partnership with 2-1-1 (e.g., Meals on wheels, food banks, etc.) to be on par with SDG&E and PG&E for consistent statewide service, and augmenting resources at CRCs/CCVs (e.g., AFN-related resiliency items, privacy screens, providing a safety/preparedness checklist that is accessible to customers with AFN, etc.). These AFN enhancements can reduce the impact of PSPS events; as such, SCE performed an RSE calculation on this initiative, which resulted in a relatively low RSE score. However, RSEs were not used to directly inform the

[194] SCE 2022 AFN PSPS Plan can be found in the following link: https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M449/K511/449511922.PDF

implementation of this activity, as SCE deems this activity to be critical in supporting our customers who are impacted by PSPS events.

2-1-1 provides 24 x 7 live support during PSPS events, providing information and referrals to resources. SCE entered into a contract with 2-1-1 to support customers with AFN during PSPS events. 2-1-1 connects customers with AFN who are experiencing a PSPS event to direct services such as shelf-stable food, hot meal delivery, transportation, and/or temporary shelter. When not providing assistance during PSPS, 2-1-1 focuses on outreach to at-risk customers, focusing on those living in SCE's HFRAs who are eligible for income-qualified assistance programs and rely on life-sustaining medical equipment. The focus during these periods is to evaluate these customers' resiliency plans, connect them with existing programs that can help them prepare for outages and assist them in completing applications for these programs.

- SCE's partnership with 2-1-1 connects customers with approximately 10,000 CBOs across its service area.[195]
- These CBOs may offer services to the community that may mitigate the impact of PSPS. For example, an organization that could lend a battery to power accessible technology or a food pantry to replace spoiled food.

2-1-1 can reduce the impact of PSPS events, thus SCE performed an RSE calculation on this initiative, which resulted in a relatively low RSE score. However, RSEs were not used to directly inform the implementation of this activity, as SCE deems this activity to be critical in supporting our customers who are impacted by PSPS events.

As part of the Resiliency Zones Pilot program, SCE explored the creation of resiliency zones, which would use in-front-of-the-meter and behind-the-meter backup generation to provide power to essential services in remote communities impacted by PSPS events to allow these communities to have access to basic essential services such as food, fuel, medicine, and other public safety services. SCE identified seven remote communities impacted by multiple PSPS events in 2019 for participation in the Pilot. 2020 PSPS event data supported the selection of the seven remote communities. The goal of the pilot was to provide communities access to basic essential services by offering the providers of these services resiliency through backup generation. SCE worked with community and county leaders to identify customers offering essential services and offered the Pilot to these customers. Eight customers elected to participate in the pilot. SCE will not pursue new sites in 2022 due to lack of customer participation but will maintain customer agreements carrying into 2022 and will provide the eight Resiliency Zone sites with backup generation for the duration of the executed contract term if the sites are de-energized during PSPS events.

The design of the CREI Program was to be based on the findings of two microgrid control system pilot projects SCE funded. SCE will not be moving forward with the CREI Program because the CPUC did not approve funding in the 2021 GRC Decision given the potential duplication with the existing Self-Generation Incentive Program.[196] The first pilot project was completed in 2020 adding a microgrid control system to San Jacinto High School's existing resiliency system to provide temporary shelter to surrounding

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[195] 2-1-1 provided the volume of CBOs across SCE's service areas.
[196] Decision on Test Year 2021 GRC for SCE, p. 241.

communities. The second pilot project was started in 2021 and will be completed in 2022 implementing a microgrid control system for a school in the Rialto Unified School District that will support PSPS events as a CRC. SCE will complete the Rialto school site as part of a PSPS Corrective Action Plan commitment.[197]

3. Region prioritization:

The Meter Mounted Adapter pilot will prioritize and target homeowners in HFRA that experience PSPS events. AFN Enhancements and 2-1-1 activities target individuals with AFN that experience PSPS events. For the Resiliency Zones program, priority is given to customers in remote locations impacted by multiple PSPS events and sites are selected in collaboration Community Leaders within the participating communities.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

For the Meter Mounted Adapter pilot, SCE is currently targeting 100 homeowners in HFRA that experience PSPS events to test the safe use of meter mounted technology, and to capture and share demonstration lessons learned. During 2021, participant locations did not experience de-energizations, therefore, data could not be gathered to determine if these adapters are capable of supporting the pilot offering.

For the AFN Enhancement program, SCE will work on closing gaps in current AFN communication and program service offerings as identified through the development of the 2022 AFN Plan.

For the 2-1-1 pilot, the service provides communities access to accurate and up-to-date information about resources during PSPS events. This free, confidential service is available to communities 24 hours a day and 7 days a week in multiple languages via call, web, and text. The 2-1-1 Pilot was implemented in August 2021 and has provided active PSPS response to customers with AFN. SCE will continue this service in 2022.

For the Resiliency Zones program, in 2021, SCE continued to target the seven remote communities identified in 2019.[198] In 2021, SCE executed four Resiliency Zone agreements for sites located in Bridgeport, Lee Vining, Mammoth Lakes and Stallion Springs. The customer at the site in Stallion Springs has already installed the infrastructure for a generator, and SCE will fund all deployment costs for a backup generator to this Resiliency Zone site if the site is de-energized during a PSPS event. Construction at the sites in Lee Vining and Mammoth Lakes is complete and construction has started at the Bridgeport location.

The work on Resiliency Zone sites in 2021 increased the total number of sites to eight:

- Three in Agua Dulce (contracted in 2020)
- One in Cabazon (contracted in 2020)
- Two in Bridgeport/Lee Vining (contracted in 2021)

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[197] SCE PSPS Corrective Action Plan 2-12-21, p. 33.

[198] Acton and Augua Dulce (Los Angeles County); Tehachapi (Kern County); Mammoth and Bridgeport/Lee Vining (Mono County); Cabazon and Idyllwild (Riverside County).

- One in Mammoth (contracted in 2021)
- One in Tehachapi (contracted in 2021)

For the microgrid control system pilot, global supply chain issues delayed the delivery of the materials (energy storage components, Automatic Transfer switch, etc.) required to complete the Rialto school site started in 2021. The project will be completed in 2022.

5. Future improvements to initiative:

For the Meter Mounted Adapter pilot, SCE will assess customer participation, the installations, maintenance, and customer experience to determine if the field tests warrant expansion to a full program.

For the AFN Enhancement program, SCE will improve the customer experience for those individuals with AFN through tailored customer outreach, education, assistance programs and services in alignment with the 2022 AFN Plan. Some enhancement examples include providing PSPS Alerts and educational materials in American Sign Language, improving accessibility in CRCs/CCVs such as providing translation services in CRCs, providing insulated bags for customers who need to keep medication such as insulin cool, and providing meal replacements through enhanced partnerships with CBOs (e.g., Meals on Wheels, Food Pantries, etc.)

SCE recognizes that there are still many individuals with AFN who have yet to be identified. SCE will expand its current strategies to identify customers and promote programs and services through various methods and will begin to employ new efforts in 2022. SCE is exploring leveraging existing opportunities to identify customers and households with AFN through market research, appending additional questions pertaining to AFN characteristics to post-event and in-language surveys, SCE's live agent call center where agents can ask customers about their unique needs during a PSPS, and on SCE.com when customers turn on their service, enroll in an online program, or through a pop-up window for the customer's most up-to-date information. SCE is also examining piloting a self-identification survey in a HFRA through direct mail.

For the Resiliency Zones program, SCE will maintain the eight customer agreements carrying into 2022 but will not be pursing new sites due to lack of customer participation.

For the CREI program, SCE will not be offering the incentive program based on the 2021 GRC Decision given the potential duplication with the existing Self-Generation Incentive Program. SCE will complete installation of the Rialto microgrid control system school site that begun in 2021.

7.3.6.6.2.3 Customer Resiliency Equipment

SCE has developed various programs to provide customers with financial assistance in developing their resiliency to prepare for de-energizations from PSPS and other emergencies. These programs provided by SCE include the CCBB program, an in-event battery loan Pilot, Portable Power Station Rebate program, and the Portable Generator Rebate program.

1. Risk to be mitigated / problem to be addressed:

PSPS events can impact our customers, including those relying on critical life-sustaining medical devices, those dependent on well water pumping, as well as household appliances. This initiative does not reduce the probability nor consequence of ignitions, but rather reduces the consequence of PSPS events to customers.

2. Initiative selection:

The CCBB program supports income-qualified customers residing in HFRA and enrolled in the MBL Allowance program by providing a free portable backup battery to eligible customers to operate medical equipment during a PSPS activation. This program does not reduce wildfire risk but does reduce the consequence of PSPS and an RSE has been calculated based on this benefit. Despite the relatively low RSE for the CCBB program, the decision to undertake this initiative was driven by the needs of SCE's income-qualified MBL customers residing in HFRA to receive a fully funded battery-powered portable backup solution to operate medical equipment during PSPS activations. In addition, SB 167[E26] authorized electrical corporations to deploy backup electrical resources or provide financial assistance for backup electrical resources to those customers identified as MBL and who meet specified requirements.

As required in the PSPS OIR Phase 3 Decision,[199] to further assist customers with AFN that utilize a medical device or assistive technology for independence, health, or safety, in 2022, SCE will supplement the CCBB offering with a pilot to provide in-event support to customers that escalate a need for SCE to accommodate the provision of temporary power for a medical device or assistive technology during a PSPS activation. Customers who participate in the pilot are those who would not otherwise be eligible to receive a free portable backup battery through the CCBB program. Through SCE's in-event battery-loan pilot, the pilot will loan on a temporary basis, a portable backup battery to customers that reside in SCE's HFRA. The customers must provide proof of a medical device or assistive technology that supports independence, health, or safety, and are notified of the potential for de-energization as part of a PSPS activation. Dedicated battery deployment contractors will deploy a portable back up battery to qualifying customers prior to a PSPS de-energization, will provide the customer with an overview of the safe operation of the portable backup battery, and will arrange to retrieve the battery from the customer once the PSPS activation concludes.

To accommodate customer escalations, SCE will collaborate with community- and faith-based organizations (CBOs and FBOs) that serve people with AFN in HFRAs. SCE will educate CBOs and FBOs about in-event support and co-develop the process to intake and triage customer escalations. These organizations will be provided with contact information for battery deployment contractors that are geographically located throughout SCE's service area. Upon receiving a customer escalation, community- and faith-based organizations will have the ability to contact a battery deployment contractor directly to

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[199] Decision (D.)21-06-034 Adopting Phase 3 Revised and Additional Guidelines and Rules For Public Safety Power Shutoff (Proactive De-energizations) of Electric Facilities To Mitigate Wildfire Risk Caused By Utility Infrastructure, Appendix 9.8.1 Page A-10.

arrange for qualifying customers to receive a portable backup battery on loan prior to a PSPS-de-energization.

To operationalize the in-event battery loan pilot, SCE will procure 50 portable backup batteries that will be utilized during PSPS activations that may occur in 2022. To help ensure the process of escalation, triage, and deployment is expeditious, the pilot will utilize the largest size portable backup battery available.[200] SCE will utilize the pilot to determine if providing in-event support should be expanded beyond 50 portable backup batteries in 2023. In 2022, SCE will track portable battery-related escalations during each PSPS activation to determine what the demand for in-event support might be and will utilize the data to establish a baseline to inform scalability in future years; SCE will work with community- and faith-based organizations to gather feedback about the escalation process and make modifications to improve the process as needed; will survey customers that participate in the pilot to determine how satisfied they are with in-event support and will use survey data to modify and improve the pilot; and will track battery deployment contractors to measure how many times portable backup batteries were deployed/not deployed prior to de-energization. SCE will monitor the pilot closely to determine if it should be expanded in the future. If the pilot is successful and SCE decides to expand it, SCE will calculate an RSE based on the reduction of PSPS consequence.

The Portable Power Station Rebate Program promotes resiliency by providing a $75 rebate to customers for purchasing a portable backup battery for their general home resiliency use. This program was initiated when SCE identified the need for battery backup to power small appliances including lighting, TVs, routers and modems, as well as the ability to charge devices such as cellphones, laptops and tablets, in the event of an extended outage such as a PSPS event. This program does not reduce wildfire risk but does reduce the consequence of PSPS and an RSE has been calculated based on this benefit. Despite the relatively low RSE for the Residential Rebate Battery program, the decision to undertake this initiative was driven by the need to support customers by developing their resiliency.

The Portable Generator Rebate program was developed to assist customers residing in HFRAs and impacted by a PSPS event by offsetting the cost of purchasing a portable backup generator. During community meetings facilitated by SCE in 2019 and 2020, specifically in areas dependent on electricity to pump water, SCE learned that some customers may not be able to access water during PSPS de-energizations. SCE launched this program initially in June 2020 by offering a $300 rebate on the purchase of a qualified backup generator, and further enhanced the rebate amount to $500 for income-qualified customers (e.g., those enrolled in CARE or FERA). In July 2021, SCE revised the program eligibility requirements and rebate amounts, based on customer survey feedback. The water pumping dependency eligibility requirement was removed and enrollment in the MBL program was added to increase accessibility. The rebate was reduced from $300 to $200 to support an increase in wider customer participation, due to the removal of the water pumping dependency customers. MBL customers were added to the eligibility of the $500 rebate to expand accessibility. This program does not reduce wildfire risk but does reduce the consequence of PSPS and an RSE has been calculated based on this benefit.

[200] https://www.goalzero.com/shop/portable-power/goal-zero-yeti-6000x-portable-power-station/

Despite the relatively low RSE for the Portable Generator Rebate program, the decision to undertake this initiative was driven by the need to support customers by developing their resiliency.

In addition, SCE also has an ongoing Self-Generation Incentive Program (SGIP), which is a Statewide program that provides financial incentives for the installation of new qualifying technologies that are installed to meet all or a portion of the electric energy needs of a facility. To help address the need for resiliency and better prepare our customers for outages and PSPS events, SGIP offers incentives for the installation of self-generating energy storage systems designed to offset the customer's energy use and work as backup power when an outage or a PSPS occurs. The SGIP handbook outlines in detail the eligibility requirements for the Equity Resiliency budget for both residential and non-residential customers. SGIP is a state-mandated program that SCE is required to implement and is not driven bya risk analysis; therefore, SCE did not develop an RSE for SGIP.

3. Region prioritization:

The CCBB Program is available to customers who reside in HFRAs, are enrolled in the MBL program, and are enrolled in either the CARE or FERA programs. The in-event battery loan Pilot will be available to customers that reside in a HFRA and demonstrate the need for backup power for a medical device or assistive technology for independence, health, or safety. The Portable Power Station Rebate Program is available to all SCE customers residing in a HFRA or served by circuits passing through HFRA that may benefit from having a battery backup for their home resiliency and electric device charging needs. For the Portable Generator Rebate program, SCE targeted customers living in HFRA communities or surrounding communities that receive their power from a circuit fed from a HFRA circuit, whose electrical needs may extend beyond the limited power supply offered by a portable power station.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

In 2021, SCE expanded the CCBB program to include customers enrolled MBL (not just Critical Care), enrolled in either the CARE or FERA program, and that reside in a HFRA. Additionally, SCE increased program awareness through marketing and outreach by utilizing direct mail, outbound phone calls, door knocking, and through increased engagement with CBOs to help inform and educate their community members. SCE has made significant progress in the CCBB program in 2021. Between January 2021 and December 2021, SCE deployed 6,021 free portable backup batteries to eligible customers. Since launching the CCBB program in July 2020, SCE has enrolled nearly 7,000 customers in the program, and has deployed over 6,740 free portable back-up batteries to eligible customers.[201] SCE will continue to offer the CCBB program to newly identified eligible customers, will deploy backup batteries to all eligible customers who choose to participate in the program, and will adjust the program outreach and strategy as needed to serve all eligible customers. In addition, SCE will launch the in-event battery loan Pilot to serve additional customers not eligible for the CCBB program by providing a portable backup battery, on loan, prior to a PSPS de-energization.

[201] Timing differences may cause discrepancies between the enrollment and battery deployment numbers.

As of July 1, 2021, the Portable Power Station rebate and Portable Generator rebate programs were updated to help ensure that those funds were directed to customers residing in HFRA. Those enhancements to the program also included increasing the Portable Power Station value of the rebate to $75 while the $300 Portable Generator rebate program dropped the well water dependency requirement, limited only to residential customers residing in HFRA, and reducing the rebate value to $200 to accommodate more participating customers. All CARE- and FERA-enrolled customers residing in HFRA continued to be eligible for the $500 rebate, and MBL-enrolled customers were added to the eligibility to expand access. As of December 31, 2021, SCE issued 1,761 Portable Power Station rebates and 666 Portable Generator rebates.

5. Future improvements to initiative:

For the CCBB program, with the success and growth of portable battery deployment programs across the state, PG&E, SCE, and SDG&E have engaged a non-biased third party to conduct a research study of portable battery technologies and their use with medical equipment. The IOUs anticipate the study will inform future portable battery program direction by providing guidance regarding which type of portable battery is best paired with certain medical devices. The IOUs also look to utilize the results of the study to help drive the development of safety standards for portable batteries utilized by the programs.

SCE will continue to assess the effectiveness of the portable battery and portable generator rebate programs to identify opportunities to enhance the offerings as appropriate. Consideration will be given to adjustments to the rebate amount, eligibility criteria, and the list of eligible products. SCE conducted customer research in March of 2021 to obtain feedback about this program's market audience and adjusted eligibility criteria to reflect the feedback received. Based on that feedback, SCE is evaluating additional future program enhancements.

In addition, SCE is continuing to evaluate alternatives and refinements to its customer resiliency equipment programs and may include changes in approach, scope or cost in Change Order Reports to this WMP, as applicable.

PSPS-related website enhancements

Providing information to customers before, during, and after PSPS events is critical to reduce impacts to customers. SCE typically administers surveys after each PSPS event to understand customer concerns. Based on the feedback collected in 2020, SCE has found that customers have difficulty navigating its website, SCE.com, for information about the outages. To address this concern, in 2021, SCE deployed a consolidated outage map on SCE.com, to make it easier for customers to access information. The consolidated outage map provides the current outages, upcoming, and scheduled outages, including PSPS outages. SCE also found that customers may also be unaware of how to access information from SCE's weather stations and HD camera feeds on the website. To help customers better understand the weather and fire conditions in their area, SCE also deployed the seven-day PSPS Weather Awareness map. To help customers plan for a potential PSPS event, this map displays how counties in our service area could be in-scope/affected by dangerous weather conditions up to seven days in advance.

1. Risk to be mitigated / problem to be addressed:

PSPS events may have significant impact on customers. It is important for customers to have access to current information about outages, weather, and fire conditions, on an easy-to-navigate webpage. These website enhancements are intended to address customer feedback around the usability of SCE's PSPS-related website.

2. Initiative selection:

Improving the PSPS webpages and user experience on SCE.com do not reduce the POIs or PSPS, but rather will help overcome challenges with navigation and ensure customers can find information on the website easily. SCE is also working to provide customers with better access to its situational awareness tools. As such, risk models were not used to select the scope of work or target deployment, and SCE did not calculate an RSE for these activities.

3. Region prioritization:

The SCE.com website and associated improvements are public and made available to everyone, including SCE's customers.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

As discussed above, in 2021, SCE deployed a consolidated outage map, as well as a seven-day PSPS Weather Awareness map. SCE also enhanced the consolidate outage map, by providing the ability to look up information for CRCs, location of electric vehicle (EV) charging stations, and improving site navigation. Customers can also sign-up for PSPS notifications on SCE.com. In the future, SCE is seeking to continue adding additional information on sce.com by adding additional layers of pertinent information, such as windspeed data from SCE weather stations. SCE is currently conducting a user experience research study to understand customers' reactions to SCE.com and collect information on what customers are looking for in a website.

5. Future improvements to initiative:

SCE will continue to make website improvements, based on feedback from customer surveys, customer research, and site diagnostics. SCE will continue to enhance SCE.com with additional situational awareness features that will provide additional information, including but not limited to consolidated wind speed/weather station data, ALERT Wildfire HD cameras location and feeds, and potential satellite-based fire detections across the SCE service area.

7.3.6.7 Stationed and on-call ignition prevention and suppression resources and services

SCE does not utilize stationed and on-call ground-based ignition prevention and suppression resources and services. As discussed in Section 7.3.8.3, SCE does provide funding for aerial suppression resources in its service area to meet fire suppression needs (DEP-5). As stated previously, SCE provides workers with fire suppression equipment and training to extinguish incipient-stage ignitions. SCE also restricts work during elevated fire weather conditions and relies on the expertise of its fire agency partners to support fire suppression activities throughout its service area. In addition, SCE's HD cameras can resolve gaps in SCE's spatial data and provide improved fire detection capabilities (SA-10). Please see Section 7.3.2.2.2.

1. Risk to be mitigated / problem to be addressed:

Not applicable

2. Initiative selection:

Not applicable

3. Region prioritization:

Not applicable

4. Progress on initiative (amount spent, regions covered) and plans for next year:

Not applicable

5. Future improvements to initiative:

SCE continues to evaluate various wildfire mitigation options, including the use of stationed and on-call ground-based ignition prevention and suppression resources and services.

7.3.6.7.1 Response to SCE Action Statement, 2021 WMP Other Issue to Address in 2022

The following is one of the Additional Issues as provided by OEIS in the Final Action Statement on SCE's 2021 WMP.

> *"Issue: SCE does not have on-call ignition prevention and suppression resources, instead relying on fire agency partners for fire suppression activities.*
> *Remedy: In 2020, a lesson learned was that more collaboration is needed with fire agencies to enhance fire suppression efforts for protecting electrical infrastructure during fires for service reliability and resilience, and SCE partnered with Orange County Fire Authority several times (see also Section 5.10). SCE must describe how it plans to continue or expand on its program of partnering with fire agencies."*

SCE's responses to the remedies identified in the Action Statement are described below:

SCE increased its aerial suppression support in partnership with OCFA and to support coverage for Orange, Ventura and LA Counties. Lessons learned from the Thomas and Woolsey Fires have driven fundamental changes in the way fire agencies in Southern California operate, specifically how resources are ordered and deployed during fires.

Ventura, Los Angeles, and Orange county fire agencies are leading an initiative which has changed how resources are ordered and deployed. SCE partnered with these counties to create a QRF of aerial firefighting resources that are capable of fighting fires during the day and at night. These resources were capable of being deployed by these agencies virtually anywhere in SCE's service territory, individually or all together. The QRF consisted of two CH47 helitankers (capable of dropping 3,000 gallons of water each), one S-61 helitanker (capable of dropping 1,000 gallons) and an S-76 coordination helicopter which is capable of directing operations of the other three helicopters.

Southern California is unique in that five of the six counties CAL FIRE contracts with to provide firefighting in SRAs are within southern California (Santa Barbara, Ventura, Kern, Los Angeles, Orange). The fact that these are "contract counties" means they have the authority to act independently, or in this case as a collective, to make changes in processes such as ordering and deploying resources. The collaboration between SCE and these agencies resulted in faster deployment of assets. For example, ordering and allocation of QRF assets relied on an agency to agency verbal request versus having to go through the normal resource ordering process, which can be complex.

These aircraft are considered "county assets" and are not included in the Southern Operations resource pool. As such, they cannot be ordered out of SCE's service territory. Notwithstanding this, the QRF did deploy twice in 2021 to Northern California in support of firefighting operations.

SCE established Memoranda of Understanding with each fire agency where SCE would fund the cost of "stand-by time" for the helicopters and each fire agency would pay for flight time when the helicopters were used to fight fires. Operational decisions regarding where and when the assets would be used is at the discretion of the individual fire agencies. SCE's Fire Scientist and Fire Management will provide input into the decision-making process for staging locations

The QRF was used multiple times in 2021 and SCE and the fire agencies intend to continue this partnership in 2022. From June through December 2021, the helitankers saw 433 hours of flight time, making 1,836 drops for a total of 2.6 million gallons of water and 123,455 gallons of retardant, helping significantly reduce the consequences of wildfires in California).

7.3.7 Data Governance

SCE's Information Technology (IT) Portfolio is comprised of several technology initiatives as part of SCE's wildfire mitigation strategy. In 2020, discovery workshops were conducted to gather information on wildfire mitigation needs, tools, and technology that are used to manage and report out on data related to assets and wildfire mitigation initiatives. Information gathered from the workshops was used in the development of a technology roadmap and identification of required projects to realize the vision to more fully mature SCE's data governance capabilities.

While individual projects provide discrete value, the harmonization of these initiatives enables the greatest value realization. Key foundational projects, such as those in the area of data governance are required to provide enabling capabilities to a variety of other efforts and consumers, such as the vegetation and inspection programs. These projects are described below in more detail.

7.3.7.1 Centralized repository for data (Wildfire Safety Data Mart and Data Management) (DG-1)

SCE has undertaken the following activities to progress our wildfire mitigation capability maturity with centralization of wildfire-relevant data, the development of more rigorous data governance processes, and integrated, real-time data access:

1) Implementation of an integrated Wildfire Safety Data Mart and Portal (WiSDM) will enable a centralized repository of wildfire datasets to support comprehensive analysis, data utilization across wildfire programs, and wildfire data portal for reporting and secure data sharing.

2) Implementation of a Cloud Big Data and Artificial Intelligence platform (Ezy Data): will enable SCE to (a) effectively ingest, organize, store, analyze, and visualize remote sensing Big Data collected for wildfire mitigation initiatives and (b) enable SCE's data scientists to develop, train, test, and deploy ML models within business processes.

1. Risk to be mitigated / problem to be addressed:

The data and information associated with SCE's wildfire risk mitigation initiatives such as asset inspections, system hardening, vegetation management, situational awareness and PSPS, and risk events – are currently contained in distributed and disconnected IT systems and databases, that are not currently integrated. With the volume and complexity of wildfire mitigation activities and decision making, more efficient access to consistent data about assets, asset conditions, and work performed on assets is needed for risk analysis, program execution and reporting.

SCE's wildfire mitigation initiatives generate very large volumes of remote sensing data, such as images, videos, and LiDAR data, to help identify and remediate asset conditions and hazards that are potential ignition risks. For example, in 2021 alone, our aerial inspections activities generated approximately seven million images. The scale of this data collection makes it too large and/or complex to be stored, managed, and analyzed using traditional data-processing solutions.

Key areas for ongoing improvements:

- Increase data availability and utilization across a wider array of business processes.
- Reduce resourcing requirements and increase efficiency of desktop inspections.
- Improve efficiency in wildfire data reporting and comprehensive analysis across wildfire datasets.
- Support customizable timely data sharing with internal and external stakeholders, including support of spatial GIS and non-spatial data delivery for SCE's Quarterly Data Reports to Energy Safety.
- Operationalize AI and ML analytics for improved and faster decision making.

2. Initiative selection:

Wildfire Safety Data Mart and Portal (WiSDM)

To address these risks, SCE is implementing a scalable, cloud-based, and geospatially-enabled centralized wildfire data repository or data mart, aligning with the Wildfire Mitigation Capability Maturity Model for Data Governance. This data mart will consolidate datasets from federated data sources[202] to enable the following benefits:

- Strengthen SCE's ability to perform detailed analysis based on asset, situational, operational, and risk data, leading to more rapid risk-informed decisions to mitigate ignition risks and minimize the use of PSPS.
- Provide a single source for wildfire data analytics and reporting, improving data consistency and quality.
- Reduce manual efforts required to consolidate and aggregate data, leading to improved data accuracy, improved work efficiency and response times, and more effective use of data to inform wildfire mitigation strategies.
- Increase data traceability and auditability.

[202] Consolidation and normalization of all the data from different sources to a common platform.

- Improve data availability, with near real-time/event driven integration for various datasets

- Sharing of data in real-time with internal and external stakeholders using APIs (Application Programming Interface) and a secure wildfire data portal.

- Improve the process, efficiency, and data quality in complying with the GIS data reporting standards established by Energy Safety.

Cloud Big Data and Artificial Intelligence Platform (Ezy Data). Ezy Data allows SCE to:

- Effectively ingest, store, organize and analyze massive volumes of remote sensing data. For example, SCE's wildfire mitigation initiatives have resulted in the collection of photographs, videos, and LiDAR data using drones and helicopters, that has exceeded well over a petabyte of data, with this volume consistently growing. Ezy Data enables a cost-effective, scalable, and robust technology solution to manage this data.

- Easily share and visualize and utilize remote sensing data across a wide array of initiatives and business processes such as inspections, remediations, work planning, and asset data management. For example, imagery collected for desktop Aerial Inspections is now shared across and utilized for many business processes within Asset Master Data, Engineering, Joint Pole, QC / Inspection, and Telecom. This data was previously limited in usage to Aerial Inspections only.

- Automate data analysis functions, such as detection of equipment failure or structural issuesfrom photographs. For example, AI/ML models have been deployed to automatically detect asset defects visible in photographs collected using drones and helicopters. This increases the accuracy and integrity of the desktop inspection process which otherwise fully relies on (manual) visual detection of asset failures from photographs by a QEW.

- Improve the quality of its asset data. Data quality issues are hampering the advancement of SCE's goals by having to make assumptions instead of relying on actual data. For example, the Asset Master Data group uses high quality asset photographs as a source to validate and correct asset data representations in the work management system, fixed asset inventory, and GIS.

Enabling an enterprise AI Platform allows SCE's data scientists to develop, manage, and deploy AI/ML models within business workflows to aid in decision-making. Enablement of AI/ML-assisted business processes have enhanced SCE's ability to mitigate wildfire risk as outlined in Section 7.3.4.3 Improvement of Inspections.

SCE evaluated several alternative options. SCE evaluated implementing on-premise solutions. This was deemed impractical due to the technical challenges of duplicating the cloud-based data infrastructure services (e.g., Microsoft, Google, Amazon clouds) in SCEs Data Centers to support advanced analytics of unstructured data. SCE has been collecting data volumes that are in the 100s of GB/year, which has well exceeded the existing capacity of our data centers. Building out SCE's infrastructure to handle projected data volumes, which potentially would require the construction of additional data centers, makes it a cost ineffective option. SCE also evaluated an alternative where no information technology investment was made – effectively the status quo – where SCE would hire significant additional resources to continue performing manually-intensive processes. This was not selected due to the many challenges described earlier, and the lack of progress that would create in maturing SCE's data-driven decision making and our ability to use data to advance wildfire risk analytics, mitigation deployment strategies, and effectively comply with reporting requirements.

As both WiSDM and Ezy are enabling activities that support multiple activities within system hardening, asset management & inspection, situational awareness, and vegetation management categories, SCE has included the costs of these efforts in the various RSE calculations they support. This is further detailed in Table SCE 4-11.

3. Region prioritization:

SCE's centralized data repository and data governance solutions are planned to be implemented for the management of wildfire data across distribution, transmission, generation, substation, and customer service throughout SCEs service area.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

SCE is implementing its data management strategy in a phased approach, focusing on building minimum viable products to rapidly increase near-term capabilities while also developing foundational capabilities that will drive long-term benefits to our WMP and wildfire operations.

Completed in 2021

- Initiated in 2020 and completed in 2021, discovery workshops to gather information on as-is processes and tools that are used to manage and report out on the following wildfire datasets: assets, wildfire mitigation initiatives (vegetation management inspections, vegetation management projects, asset inspections, and grid hardening), PSPS events, and risk events (e.g., wire-down events, ignitions, and unplanned outages).

- Meeting the 2021 WMP data governance program target set for the Wildfire Data Mart and Data Management (WiSDM/Ezy). SCE has completed the WiSDM solution analysis and design for centralized data repository and initiated staggered consolidation of datasets from SCE Enterprise systems. Initiated in 2020 and completed in 2021, SCE has implemented the cloud platform infrastructure for Ezy Data to build a solution for data consumption, storage, and visualization of inspection data (LiDAR, HD videos, HD photographs) and enable an environment for AI assisted analytics.

- Completed the detailed design, build, and test of Google Cloud platform infrastructure for SCE to manage remote sensing Big Data.
- Designed, built, and deployed a scalable solution for ingestion, storage, analysis, and visualization of imagery for Aerial Inspections.
- Completed the design of AI platform for data analytics which will enable development, training and deployment of image quality models and defect identification models as part of the aerial inspection workflow.
- Deployed initial set of AI/ML models for asset defect detection in support of desktop inspections.

Work In-progress and plans for 2022

- WiSDM:
  - Complete wildfire data repository design
  - Consolidate wildfire data storage onto wildfire data repository platform
- Ezy Data:
  - Expand cloud AI platform
  - Enable LiDAR data storage capability

5. Future improvements to initiative:

7.3.7.1.1 Response to SCE Action Statement, 2021 WMP Additional Issue to Address in 2022 WMP

The following is one of the Additional Issues as provided by OEIS in the Final Action Statement on SCE's 2021 WMP.

Issue: In section 7.3.7.1 SCE describes several products or platforms which are in development to further its goal of having centralized data repositories. No specific dates are proposed for

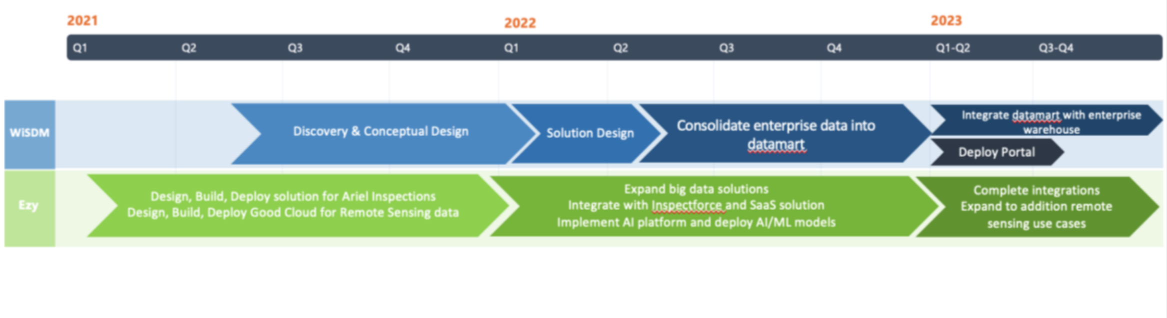
implementation of any of these products/platforms. Furthermore, SCE reported considerably lower Data Governance spend compared to PG&E and SDG&E (Figure 5.7.b). The WSD suggest that SCE could do more to prioritize its centralized data capabilities.
Remedy: Provide a timeline for implementation of centralized data repositories.

SCE's response to this Issue/Remedy is described below:

SCE will build upon efforts completed in 2021 and planned for 2022 for its data management strategy in 2023 and future years to realize the full benefits. This will principally involve the continued development of WiSDM and Ezy Data. See Figure SCE 7-83 below for a timeline for the implementation of its data management strategy from 2021 through 2023.

Figure SCE 7-83

WisDM/Ezy-Data Project Timeline



Plans for 2023

- WiSDM
  - Integrate the centralized wildfire data repository with the enterprise data warehouse.

  - Deploy the wildfire data portal with multi-level access for broad-based sharing and utilization of SCE's wildfire datasets both within and outside the company. In the current environment, there are significant limitations in the ability to access wildfire datasets from outside of the systems/processes managing the wildfire mitigation activity.

  - Enable automation in wildfire data reporting with simplified generation of GIS and non-GIS quarterly data reports. Generation of reports is currently a manually intensive, multi-week process that relies on a dedicated reporting team to extract, transform, combine, and QC data for submission on a quarterly basis.

- Ezy Data

  - Complete the integration of Ezy Data with the inspection application for imagery data.

- Complete data integration in support of LiDAR data analytics and visualization solution deployment.

- Expand to further optimize asset management & inspections, vegetation management & inspections and situational awareness programs data capabilities by building additional remote sensing use cases.

Plans for 2024-2025

- WiSDM
  - Perform a feasibility study to further enhance the data repository and expand the data capability maturity

- Ezy Data
  - Expand further data capability maturity
  - Increased application of advanced analytics for short and long-term decisions.
  - Transition to operations for long-term solution sustainability

7.3.7.2 Collaborative research on utility ignition and/or wildfire

SCE collaborates with academic institutions and research groups on co-sponsored research projects, as well as provides input in the form of data or technical expertise in studies around the country. Please referto Section 4.4 for more information on SCE's approach to collaborative research.

1. Risk to be mitigated / problem to be addressed:

Collaboration with non-utility partners such as academic institutions, government agencies, and private industry can help to enhance utility perspectives and reduce the risk of duplicative research efforts related to various wildfire topics. Addressing the continued wildfire threats in California will require new and innovative ideas that could be generated through cross-industry research partnerships.

2. Initiative selection:

Please refer to Section 4.4 for more information on SCE's approach to collaborative research. SCE did not develop an RSE for this activity because it does not directly mitigate the risk of wildfire or PSPS but rather supports and enables the future improvement of wildfire mitigation.

3. Region prioritization:

Please refer to Section 4.4 for more information on SCE's approach to collaborative research.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

Please refer to Section 4.4 for more information on SCE's approach to collaborative research.

5. Future improvements to initiative:

Please refer to Section 4.4 for more information on SCE's approach to collaborative research.

7.3.7.3 Documentation and disclosure of wildfire-related data and algorithms

SCE documents and updates its probability of failure and fire spread algorithms pursuant to its model creation, test and validation processes. And as described in Section 7.3.7.1, SCE is in the process of implementing a centralized repository of wildfire datasets to support detailed analysis, data utilization across wildfire programs, and wildfire data portal for reporting and secure data sharing.

1. Risk to be mitigated / problem to be addressed:

Important data such as SCE's ML algorithms or wildfire risk mitigation initiatives information should be stored in a manner that makes them readily accessible for utilization and updates.

2. Initiative selection:

SCE's ML algorithms to assess an asset's probability of failure are stored and utilized on SCE's secure SharePoint Sites and GitHub platforms; the probability of failure data is securely stored on SCE's SAS databases. SCE's fire spread algorithms and input data are stored and utilized on Technosylva's cloud platforms. For more information on SCE's centralized database for its wildfire mitigation information, please see Section 7.3.7.1.

As this is an enabling activity, SCE did not develop an RSE as they do not directly reduce the risk of wildfire or PSPS but rather support and enable SCE's risk modeling and implementation of its wildfire mitigations.

3. Region prioritization:

SCE's algorithms are used to inform and prioritize many of SCE's wildfire mitigation activities such as grid hardening, vegetation management, and wildfire inspections across HFRA. For its wildfire-related data, please see Section 7.3.7.1.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

In 2020, SCE created predictive models for its transmission and sub-transmission systems and updated its existing models for the distribution asset risk models and its process for updating and documenting them. In 2021, SCE updated its existing models with the latest available data.

SCE's wildfire risk models include EFF models which cover different asset types, and CFO models which address drivers caused by foreign objects.

SCE's EFF Models include the following:

- Overhead Conductor Model
- Capacitor Bank Model
- Switch Model
- Transformer Model
- Transmission/Sub-transmission Model

SCE's CFO Models address the following drivers:

- Vehicle hit pole
- Balloon contact
- Vegetation contact
- Other contact
- Unknown contact

Completed in 2020:

- Risk models are calculated using ignition prediction models and REAX consequence values
- Technosylva calculated consequence value (using 41 worst weather scenarios) are incorporated in the risk model
- New predictive models are created and incorporated into the risk modeling for Transmission and Sub-transmission

Completed in 2021:

- Refreshed existing predictive models
- Technosylva consequence values were updated to include 444 worst weather days as well as improved vegetation maps

Planned for 2022:

- Model data refresh with updated weather and asset data
- Technosylva consequence values update with updated vegetation maps

Develop additional predictive models such as secondary models to support more granular risk modeling

5. Future improvements to initiative:

SCE continues to update its existing models by using the latest and best suitable data science algorithms with the latest available data. Also, SCE will continue to expand its risk modeling capabilities by identifying new features contributing to ignition events discovered through engineering root cause analysis, field observations, and subject matter expertise.

7.3.7.3.1 Response to SCE Action Statement, 2021 WMP Additional Issue to Address in 2022 WMP

The following is one of the Additional Issues as provided by OEIS in the Final Action Statement on SCE's 2021 WMP.

> *Issue: In section 7.3.7.3 SCE states that it "created predictive models for its transmission and sub transmission systems and updated its existing models for the distribution asset risk models." It is not clear what is being modeled.*
> *Remedy: Provide information on what is being modeled, specific to the asset type if necessary.*

SCE's response to this Issue/Remedy is described below:

Please refer to the prompt 4 on Progress on Initiative in the section above for currently used models for wildfire risk mitigation, and relevant asset types for the risk models.

7.3.7.4 Tracking and analysis of risk event & near miss data

In April 2019, SCE launched the Fire Incident Preliminary Analysis (FIPA) process to perform more in-depth investigations into all ignitions that occur in connection with SCE facilities. The FIPA process has been continuously improving throughout 2020 and 2021 to enhance efficiency of the investigation process related to ignitions and other data pertaining to near-miss events, such as wire downs and underground equipment failures.

1. Risk to be mitigated / problem to be addressed:

SCE documents and analyzes risk event data to gain insights and gather lessons learned to help mitigate risks by reducing or preventing risk events from occurring. Previously, data collection on fault and failure events were captured on multiple forms that did not collect data in a standardized electronic format, resulting in inconsistent data capture and the need for linguistical analysis to capture trend data from free text responses. To address this problem, SCE has begun to roll out an electronic form called that Material Performance Failure Report (MPFR) that allows for capturing more specific data from equipment failures on the electric grid. The MPFR addresses two previous issues, the first being providing a centralized location allowing incoming data to be more efficiently captured, and the second being improvements to the robustness of data and in-depth (root cause) analysis.

2. Initiative selection:

SCE currently accounts for risk events in several databases:

- Wire Down Database – Monitors wire-downs based on wire-down calls and repair orders across the entire SCE service area.
- ODRM – Monitors distribution, substation, and transmission unplanned outages that affect a single line transformer or more on SCE's grid.

- FIPA Database – Collects and annually reports certain information that would be useful in identifying operational and/or environmental trends relevant to fire-related events.

The FIPA process was established to gain insights and learn lessons to help further SCE wildfire mitigation efforts. The FIPA process has three levels of investigation, depending on the complexity of the ignitions. The investigation approach is determined by engineering judgement based on a variety of factors, such as the potential severity of the situation, the extent of condition, and what is already known of the event. A brief description of the actions taken for each level are listed below:

- Level 1 - May include a review of pictures, telephone interviews, and Repair Orders.
- Level 2 - In addition to Level 1, may include site visits and fault analysis.
- Level 3 - In addition to Level 2, may include evaluating the equipment/material by a root cause engineer.

During the FIPA process, the assigned staff enter the data in a database. The FIPA process has continued through 2021 and provides additional data through more in-depth investigations into ignition events, which have helped SCE's mitigation strategies. Furthermore, SCE is conducting pilots to expand investigation methods and failure types. SCE did not develop an RSE for this activity as it does not directly reduce wildfire or PSPS risk. Rather, it supports and potentially improves SCE’s wildfire mitigations and risk modeling. The RSEs of these activities reflect the benefits of having adequate monitoring analysis of near miss data.

3. Region prioritization:

SCE monitors this information for its entire service area. Although SCE prioritizes incidents that occur in HFRA, SCE also collects information in non-HFRA because there may be common failure modes that occur throughout the service area. SCE can then use this information to target risk mitigations where needed.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

SCE has expanded its FIPA team and refined the tools and processes used. In 2021, the FIPA team analyzed over 1,000 events.[203] SCE has expanded the presentation of its faults and wire-down causes to add categories not listed in the OEIS list. This will allow greater visibility to causes that were previously listed as ‘Other.’ SCE has further refined the way it finds ignition and near miss data using a software tool that searches the free form text in repair orders to find key words that indicate potential ignition or near misses. In 2021, SCE has begun to roll out an electronic form called the Material Performance Failure Report (MPFR) that allows for dynamic data collection. The MPFR addresses two previous issues with

[203] This number includes: 1) CPUC reportable and non CPUC Reportable events; 2) ignition and events where there was the potential for an ignition, but no ignition occurred; and 3) events where it was subsequently determined that SCE equipment was not involved.

respect ignition data collection and storage, the first being providing a centralized location allowing incoming ignition data to be more efficiently captured, and improvements to the robustness of the ignition data for more in-depth (root cause) analysis and trending.

5. Future improvements to initiative:

Through 2023 & 2024, SCE will enhance its post failure data collection processes to make data collection more consistent, relevant, and efficient. SCE will also update its database for storing this information and its processes for root cause analysis. SCE is updating the failure event database to include wire-down, underground equipment failures and ignitions to assist in identifying related failures in a single database. For example, an underground equipment failure may cause an ignition that burns a pole that in turn may then result in a wire-down. Currently, these are recorded as three separate events. Under the new structure, all three events will be related and analyzed as a single incident. SCE is incorporating additional transmission outage data as an improvement to its outage reporting.[204] SCE is also working towards aligning pre-failure inspection data with post-failure data which would give a holistic view of overall asset health.

[204] Historical reporting has been revised to reflect the additional Transmission outage data.

7.3.8 Resource Allocation Methodology

7.3.8.1 Allocation methodology development and application

SCE uses risk analysis along with other operational considerations to prioritize deployment of human and financial resources.

1. Risk to be mitigated / problem to be addressed:

Labor and financial resources are limited. In addition, hiring, onboarding, training, deploying, and managing resources requires oversight and coordination. Given the volume of work to meet compliance requirements and address customer safety and reliability risks, including wildfire risk mitigation, SCE must prioritize its available resources to complete the required work, and in some cases retain support from external resources

2. Initiative selection:

SCE uses risk analysis to determine the key drivers of ignition risk, develop mitigation options, and evaluate these options using risk and other analysis to select preferred mitigation options and the scope of work necessary. Once an activity is selected, SCE uses granular risk analysis to prioritize deployment. For example, SCE used its enterprise-level wildfire risk bowtie to determine distribution overhead conductors to be a driver of ignitions associated with electrical infrastructure. Alternatives such as reconductoring with bare wire, undergrounding and covered conductor installation were considered and evaluated. Covered conductor installation had the highest RSE, reduced more risk than bare conductors, was less expensive than undergrounding, and is quicker to deploy compared to undergrounding. Therefore, we decided to allocate resources to the broad deployment of the WCCP to quickly reduce ignition risk in SCE's HFRA, while performing more targeted deployments of undergrounding. SCE's WRRM (described in detail in Chapter 4) is used to prioritize circuit segments by risk scores along with other considerations, such as bundling work geographically for crew efficiency.

An RSE was not calculated for this activity as it needs to be undertaken irrespective of RSE score; it is impractical to estimate risk reduction from risk reduction modeling. Further, this activity helps inform how other risk mitigation activities are selected and deployed. The RSEs of these other activities reflect the benefits of having an adequate allocation methodology.

Once activities are selected for deployment, SCE utilizes Organizational Change Management (OCM) to effectively manage the impact of business and process transformation. OCM focuses on managing the impacts of change related to building and enhancing business processes, systems, tools, job roles, policies and procedures, and other areas that may have a corresponding impact to employees. OCM resources support and facilitate internal and external awareness and education via comprehensive communication, training, and risk mitigation activities. Through effective OCM, we decrease opportunities for resistance and increase our chance to realize value through faster adoption, ultimate utilization, and greater level of proficiency. This work supports the implementation of the wildfire mitigation initiatives represented throughout Section 7.3.3, from grid hardening to vegetation management to workforce development and training to other enabling activities. SCE also selectively retains consulting resources to support wildfire mitigation plan development and internal processes pertaining to its execution.

Separately, SCE utilizes third parties to perform contractor safety oversight for contractors who perform electrical, vegetation management, and other wildfire mitigation work for SCE. These third parties help oversee adherence to contractor standards, contractor onboarding, field oversight, performance management, and incident management. SCE's third-party safety oversight contract for work within HFRA is driven to eliminate serious injuries and fatalities.

3. Region prioritization:

Region prioritization for this activity is not applicable as it applies to all of SCE's HFRA.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

The work completed to advance SCE's risk modeling capability is discussed in detail in Chapter 4. SCE augmented the analysis to provide more granular RSE results. For the 2022 WMP update, SCE used the WRRM to calculate RSEs at either the segment level or structure/pole/tower level, depending on the mitigation. These results can be aggregated to any level of granularity – circuit, region, HFRA tier, etc. Over the course of 2021, the analysis was augmented to more clearly provide RSE results that illustrate how RSE varies across the system, (e.g., as deployment proceed down the risk buy-down curve).

For 2022, SCE plans to further enhance its wildfire risk modeling by updating its existing models with the latest available input data, and by creating new models to cover more asset types that have not been previously modeled. In addition, SCE plans to improve the methodology by which mitigation effectiveness values are quantified for existing and new wildfire mitigation programs, which will allow for enhanced, data-driven determinations of the magnitude and effectiveness of the risk reduction that our wildfire mitigation programs can deliver.

In 2021, SCE performed OCM work for a variety of wildfire mitigation activities. This work entailed performing business readiness activities, developing training strategies, developing structured communication strategies and materials, and supporting implementation for these activities. These activities supported the planning, development, and/or implementation of various PSPS activities, data governance platforms such as WiSDM and Ezy Data, various inspection tools such as Arbora, InspectForce Aerial and InspectForce Transmission, and the redesign of SCE's inspection portfolio.

In 2022, SCE will continue to implement OCM for a number of wildfire mitigation activities and enabling programs. This includes OCM support for our data governance platforms, digital deployment tools for our inspection and maintenance activities,[205] and various new and ongoing activities associated with PSPS.[206]

3rd Party Contractor oversight is focused on identifying and supporting the management of conditions and behaviors that can lead or contribute to serious injuries and fatalities. SMEs conduct field safety observations on contractor vegetation management and electrical line construction activities. Throughout 2021, 3rd party observers conducted over 6,000 documented observations and identified over 700 opportunities for improvement which included undesired performance in jobsite planning, vehicles

[205] For example, InspectApp, InspectCam, InspectForce Aerial, InspectForce Transmission, and Arbora.

[206] For example, OCM engagement activities for PSPS will likely include support for PSPS/Safety Culture Assessment Frontline Workers Engagement, Weather Services, Customer Services, SCE.com, Post Event Reporting, Survey 123 Repair & Photos Support / QC, etc.

and equipment, electrical contact, fall from heights, Personal Protective Equipment, suspended loads, and chain-saw use. 3rd Party Contractor oversight is currently active in 2022 and SCE is continuing to evaluate the program.

5. Future improvements to initiative:

SCE expects to augment its RSE framework to allow comparative analysis of multiple mitigations at a granular level. Currently, while RSE results are available with high locational granularity (i.e., structure, pole, tower, or segment level), the framework is not ready to directly compare/optimize any set of mitigations at that specific location. In 2022, SCE will continue to augment the WRRM model to allow for further comparisons of multiple mitigations that may substitute each other or complement each other. SCE is beginning to consider this level of analytics in the development of its Integrated Grid Hardening Strategy as discussed in Section 7.1.2.1.

SCE provides more details about its WRRM and how it is advancing its ability to make data-driven, risk-informed decisions for prioritizing wildfire mitigation activities in Chapter 4. Further discussion on mitigation strategies and comparative analyses that are informed by these granular risk analyses is provided in Section 7.1.

Beyond 2022, SCE anticipates the level of OCM required will be adjusted commensurate with the maturation of our wildfire mitigation portfolio and number and complexity of large scale and cross-functional initiatives that will be required to execute our wildfire mitigation plan.

7.3.8.2 Risk reduction scenario development and analysis

Please see detailed descriptions of models and risk analyses approaches used along with work completed and future improvements in Chapter 4 and Section 7.3.7.3 above. This activity does not directly reduce wildfire or PSPS risk but can inform which activities to perform and prioritize. This also does not have any incremental costs. The RSEs of the activities that use the analysis reflect the impact of this activity.

7.3.8.3 Risk spend efficiency analysis – not to include PSPS

Please see detailed descriptions of models and risk analyses approaches used along with work completed and future improvements in Chapter 4 and Section 7.3.7.3 above. This activity does not directly reduce wildfire or PSPS risk but can inform which activities to perform and prioritize. This also does not have any incremental costs. The RSEs of the activities that use the analysis reflect the impact of this activity.

7.3.9 Emergency Planning and Preparedness

SCE maintains a workforce trained to respond to various emergencies and disasters. This includes communicating and supporting customers, protocols for re-energizing service, and other related activities before, during, and after emergencies.

7.3.9.1 Adequate and trained workforce for service restoration (SCE Emergency Response Training (DEP-2)

SCE maintains a robust and highly skilled field workforce (both employees and contractors) to provide effective emergency response and restore service during and after a major event. SCE also uses contract resources that can assist with restoration after a major event. In addition, SCE's existing mutual assistance agreements with other utilities can be activated in situations where the required response exceeds the capacity of SCE's crews and emergency contracting capabilities.

SCE develops technical training programs that prepare employees to perform their jobs safely, comply with regulatory requirements and laws, maintain system reliability, and leverage new technology. For example, SCE maintains a program to train personnel in the use of UAS for overhead inspections, system troubleshooting, and PSPS circuit patrols. To help ensure that its employees and contractors are adequately trained for service restoration, SCE conducts specific training on an annual basis for field workers responsible for restoration of power after emergencies. SCE also provides specialized training on an annual basis for IMT members, who oversee and execute de-energization and restoration protocols.

1. *Risk to be mitigated / problem to be addressed:*

Training personnel is necessary to promote sound decision-making and reduce the chance of ignitions or restoration delays that would impact communities, customers and/or property. Training also promotes consistent messaging and operational alignment across all departments involved in an event.

2. *Initiative selection:*

SCE conducts a robust, ongoing training program for IMT, Incident Support Team (IST), and other critical personnel to prepare for and respond to all types of hazards in the service area. IMT and IST personnel receive ICS training consistent with Federal Emergency Management Agency (FEMA) trainings, as well as trainings that incorporate Standardized Emergency Management System (SEMS) protocols, processes, and guidelines. SCE ensures that IMT and IST personnel trainings are reflective of SEMS, National Incident Management System (NIMS), and ICS – the same foundational programs which Cal OES and our Operational Area partners utilize in their emergency response structures. In addition to standard ICS trainings, IMT and IST personnel also receive training specific to their response roles (position-specific training) and, for certain personnel, additional hazard-specific training. SCE has trained over 600 employees throughout the entire company as qualified IMT or IST members.

ICS training helps to ensure SCE personnel tasked with incident response and support understand the national and state frameworks and standards for emergency response and recovery. Position-specific trainings cover specific roles and responsibilities, how a position supports SCE coordination and restoration, and specific requirements or tasks the position is responsible for. Hazard-specific trainings, particularly PSPS trainings, cover specific protocols, issues, or actions associated with hazards SCE may need to mitigate or respond to. This type of training was selected to help ensure that personnel tasked with coordinating restoration are well versed in company processes and procedures, and that the many different parts of the company that work together to restore power following a major incident are working within the same framework and structures.

SCE also trains all PSPS field personnel and briefs its contractors on requirements and potential impacts related to PSPS protocols. Training is provided based on proactive operational changes or identified risks. SCE performed the following activities related to PSPS training in 2021:

- Provided employees with tools, plans, guidelines, and strategies to efficiently apply our PSPSprotocols during de-energization and re-energization scenarios.

- Conducted virtual training sessions and job shadowing weeks to months in advance of the “fire season,” in addition to “just in time” training.

- Obtained trainee feedback on lessons learned from PSPS event debriefings and trainings and implemented corrective action to improve the PSPS program. Examples of potential changes based on lessons learned may include revising circuit switching playbooks to minimize customer outages, improving internal communication protocols, and other improvements.

This type of training was selected based on identified risks and field personnel expertise. The purpose is to improve the consistency, efficiency and reliability of the de-energization and re-energization process. SCE has a continued focus on limiting the number of customers impacted by PSPS and improving restoration efforts.

To facilitate service restorations, SCE also trains employees to operate UAS. Unmanned aircraft operation requires a Small UAS Pilot certificate issued by the FAA. Company personnel entering SCE’s UAS Program are provided training required to attain FAA certification and are then further trained in actual UAS flight operation and specific techniques such as flight in the electric power system environment. This training promotes safe, compliant, and efficient use of UAS as a force multiplier and significantly enhances the efficiency with which an operator can detect degraded circuit components, which often are only visible from a top-down perspective. SCE’s training approach is unique in the industry and promotes operational risk mitigation and the safety of the public. After a de-energization event, circuits must be patrolled to identify any potential hazards before restoration of power. SCE partnered with the FAA to conduct mock PSPS drills (power remained on) using BVLOS UAS profiles under Special Government Interest (SGI) waivers, to determine feasibility of the approach and measure efficiency. During these remarkably successful demonstrations, SCE ushered BVLOS UAS operation into the tool kit for California utilities. These operations demonstrated that UAS on a BVLOS waiver potentially reduces the duration of the

‘Return to Service’ phase of a PSPS outage by as much as 50 percent relative to traditional vehicle-driven circuit patrols on rights-of-way. UAS also reduces pole climbs for troublemen responding to circuit outages in order to locate issues and restore service that would previously require several pole-climbs to locate faults. The UAS also introduces IR imaging to the troubleshooting toolkit which enhances the ability to rapidly identify issues that may otherwise be invisible to the human eye.

In this WMP Update, SCE calculated RSEs for two distinct sub-activities associated with maintaining an adequate and trained workforce for service restoration: (1) UAS activities; and, (2) IMT / Field Training activities. The RSE for UAS was ranked medium, largely for its ability to reduce the time associated with restoring service and limiting reliability impacts. Because UAS represents a substantial opportunity to reduce the time to restore service to customers following events, SCE deems it a prudent investment to continue into 2022, particularly as we learn more about the technology and how we can further incorporate its capabilities into our operations. The RSE for IMT / Field Training activities was relatively low. In this case, the RSE score for this activity was not a primary driver for its selection. It is critical for the safety and well-being of our workforce and our customers to have an adequate and trained workforce capable of safely and efficiently restoring power after an event. SCE will continue to evaluate ways in which SCE can enhance the performance and capabilities of its workforce as it relates to these activities and incorporate any findings into future plans and RSE calculations.

3. *Region prioritization:*

IMT and IST members are trained to coordinate response, restoration, and recovery across any part of the SCE service area. UAS trainees are also not restricted to a specific region of SCE’s service area. PSPS teams receive additional training on working in HFRAs within SCE’s service area; they are not region specific within that classification. Response and restoration protocols, as well as PSPS protocols, remain consistent throughout SCE’s HFRA. The PSPS restoration training protocols are applied across SCE’s HFRA.

4. *Progress on initiative (amount spent, regions covered) and plans for next year:*

SCE has provided incident response and restoration training to employees and briefings to contractors prior to the 2021 wildfire season. These trainings included procedures for conducting service restorations in response to emergencies, with specific additional trainings for personnel tasked to support PSPS de-energizations and restoration. SCE will continue to provide training to employees and briefings to contractors prior to its wildfire seasons, and as SCE onboards new qualified personnel on an ongoing basis.

In 2021, SCE continued to evaluate areas where additional personnel were needed and held SCE IMT member training on emergency response and management protocols to develop additional SCE employees as qualified IMT members. This training consists of an ICS training program based on guidelines provided by FEMA and that follows the NIMS and SEMS models. This training is required for employees that serve in the IMT. SCE has trained over 600 employees as qualified IMT members. SCE conducted seven end-to-end PSPS de-energization exercises to prepare for the 2021 wildfire season in an all-remote environment. These de-energization exercises encompassed a complete PSPS activation scenario, simulating the situation five days prior to a potential de-energization.

SCE's Aircraft Operations manages the UAS program and has developed a UAS training regimen that is considered among the top UAS training programs in the United States today. SCE is leading the national utility space with 53 internal UAS operators currently on the roster. 58 employees attained their FAA UAS certificates in 2021. Many of these employees are currently operating and the remainder (approximately 25) are expected to complete flight training and technical qualification in Q1 2022. An additional 19 employees also completed the initial training to attain a UAS certificate in December 2021. SCE currently manages a UAS fleet of over 100 aircraft to support our qualified operators and anticipates growing this fleet commensurate with the growth of technically qualified operators. In addition, SCE is continuously exploring new developments in this area to provide the cadre of UAS operators with the equipment best suited for the demands of utility UAS operation.

In 2022, SCE is aiming to have all PSPS IMT and Task Force members fully trained and qualified or requalified by mid-year (July 1, 2022) and to continue the de-energization exercises to provide realistic training for IMT members. All other IMT and IST members assigned to other teams will go through requalification training and exercises on an ongoing basis, with the goal of having all personnel requalified by December 31, 2022. After FAA certification is obtained, SCE's Air Operations will conduct Basic and Advanced flight training in a wires-environment with issuance of a SCE UAS to the Operator. After completion of SCE's training program, each operator (if they meet the criteria) will become advanced and technically qualified to utilize a UAS in the field. In 2022, SCE plans to technically qualify 50 UAS operators. COVID-19 continues to be a challenge and may limit the number of UAS operators that can be trained in 2022 due to social distancing measures.

5. Future improvements to initiative:

The annual training will be updated with current service restoration procedures and based on feedback from its employees. SCE continuously reviews and refines its trainings as real-world incidents occur to capture best practices. SCE will update its IMT trainings in 2022 and beyond to incorporate any best practices identified.

UAS work methods are continuously updated and improved as the pool of UAS operators progressively gain greater experience and additional skillsets. SCE also expects to incorporate the BVLOS SGI Waiver strategy for our internal operators, as opposed to solely relying on contracted services. SCE anticipates moving into BVLOS operations as a more common work method with a full waiver in the near future. This will lead to greater efficiency in grid maintenance and wildfire mitigation efforts.

7.3.9.2 Community outreach, public awareness, and communications efforts[207]

SCE uses a variety of methods to increase public awareness of emergency planning and preparedness information; distribute and translate communications; and measure those efforts.

1. Risk to be mitigated / problem to be addressed:

Emergencies can affect the electricity supply and public safety related to the provision of electricity; thus it is vital that SCE's customers are able to receive timely, intelligible, and actionable communications from SCE.

2. Initiative selection:

SCE engages in a suite of outreach activities, including community meetings (DEP-1.2), marketing campaigns (DEP-1.3) and customer research and education (DEP-4), as described further in Section

7.3.10.1. SCE has also increased the number of prevalent languages pursuant to Ordering Paragraph 3 of D.20-03-004[E30] in its service area when conducting community outreach to increase public awareness of emergency planning and preparedness as discussed in Section 8.4. SCE also conducts the In-Language Wildfire Mitigation Communications Effectiveness Pre/Post Surveys, to measure the communications and outreach effectiveness prior to and coincident with the wildfire seasons by prevalent language, as discussed in Sections 7.3.10.1.4 and 8.4.

These activities are not intended to directly reduce the probability or consequence of ignitions or de-energizations, but rather support the essential task of SCE's response to emergencies, and therefore risk models were not used to select the scope of work or target deployment, and SCE did not calculate an RSE for these activities.

3. Region prioritization:

See Section 7.3.10.1..

4. Progress on initiative (amount spent, regions covered) and plans for next year:

See Section 7.3.10.1.

5. Future improvements to initiative:

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[207] A statewide information campaign was described in this section in the 2020 WMP (IOU Customer Engagement (DEP-3). That activity was suspended in 2020, as indicated in SCE's Off Ramp Report submitted June 1, 2020, as SCE determined local campaigns were more effective to increase customer awareness of wildfire mitigation efforts.

See Section 7.3.10.1.

7.3.9.3 Customer support in emergencies

In the event of a major emergency, SCE has a dedicated customer support team to help impacted customers by providing information on available resources during emergencies. All customer inquiries about major emergencies, such as wildfire, are prioritized. SCE's efforts to reach, engage and support AFN communities, including by developing partnerships with CBOs and providing for AFN needs at CRCs, can be found in the AFN Plan Quarterly Update reports and the AFN Plan filed on January 31, 2022.[208]

1. Risk to be mitigated / problem to be addressed:

During emergencies customers may face hardships; SCE has programs available to customers that may help them through emergencies. SCE continues to improve communications to promote awareness and provide access to information and resources needed to mitigate the safety and economic risks customers may face.

2. Initiative selection:

Phone support is available in English, Spanish, Chinese, Korean, Vietnamese and Cambodian. SCE's customer service representatives also use a translations service vendor that supports more than 150 languages for customer inbound inquires. Information about SCE's customer support resources for customers impacted by any natural disaster is available on our dedicated webpage for disaster support at sce.com/disastersupport and emergency preparedness information is available at sce.com/beprepared. Customers can also advise SCE that they have been impacted by a natural disaster by submitting an online form at sce.com/assistance-center and can also use the same form to notify SCE of their intent to rebuild their Net Energy Metering system. SCE also shares timely updates on PSPS events and customer resources leveraging multiple communications channels such as outbound messaging, social media and NextDoor.

To mitigate customer risks that could arise during and after an emergency,[209] SCE utilizes the following practices and/or enacts customer protections in line with Commission directives, as appropriate:

1. Access to outage reporting and emergency communications

   SCE uses best practices to provide customers with the most up-to-date information regarding outages and emergency communications, and to provide resources for reporting outages.

2. Support for income-qualified customers

[208] *See* SCE's Access and Functional Needs Plan for Public Safety Power Shutoff Support for 2022 Pursuant to Commission Decision in Phase Two and Phase Three of R.18-12-005 filed on January 31, 2022, available at https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M449/K511/449511922.PDF.

[209] As declared by the Governor of California.

Flagging California Alternate Rate for Energy/Family Electric Rate Assistance customer accounts to automatically prevent annual verifications and high usage verifications.

3. Billing adjustments

   Affected customers will not receive estimated bills, and daily minimum charges are halted/adjusted.

4. Extended payment plans

   Providing affected customers with extended payment plans as needed.

5. Suspension of disconnection and nonpayment fees

   Affected customers are not sent for disconnection due to non-payment, and assessment of non-payment fees are eliminated.

6. Repair processing and timing

   Provide access to local planning resources to assist with expediting SCE support for rebuilding and providing up to date information about restoration timing both through the customer contact center and the web for affected customers.

7. Access to utility representatives

   Typically, SCE directs staff and resources to county and local government assistance centers during disasters and other events to provide in-person support to assist with information and consumer protections; however, due to the COVID-19 pandemic, SCE has not been providing in-person support to these centers. SCE has been utilizing its virtual resource center (sce.com/disastersupport) and makes information on SCE's disaster support programs, such as flyers, available to local assistance centers. Once it is safe to do so and in alignment with SCE's COVID-19 protocols, SCE will continue its practice of providing in-person staff to county and local government assistance centers during disasters and other events.

   During PSPS events, and in alignment with SCE's COVID-19 protocols, SCE staff are deployed to CRCs and CCVs to support customers.

These activities are not intended to directly reduce the probability or consequences of wildfire and de-energization, but rather support customer needs during an emergency, and therefore risk models were not used to select the scope of work or target deployment, and SCE did not calculate an RSE for these activities.

3. Region prioritization:

Customer support resources for emergencies are provided for all regions in SCE's service area.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

In alignment with an Administrative Law Judge (ALJ) ruling made in August 2020,[210] SCE's website, which contains three wildfire pages and four PSPS pages, now provides readily available information in prevalent languages in addition to English. SCE implemented these changes in November 2020 and continues to evaluate whether additional languages should be added to its website. Additional details on these languages are discussed in Section 8.4.2.

Nextdoor is also used as a channel to reach populations who may not have access to other channels or forms of communications. SCE made 174 PSPS posts with 361,180 impressions to Nextdoor in 2021. In 2022 SCE will continue to enhance its Nextdoor communications strategy to further refine our targeting capabilities and ensure PSPS notifications are delivered directly to the impacted customers aligning with the segmentation of circuits impacted.

Throughout the year on social media, we communicate our wildfire mitigation work, including PSPS preparedness tips and resources, alert signups and information about community meetings, resource centers and outreach vehicles. During a PSPS/wildfire incident, we communicate information about CCVs and Resource Centers, including information about how PSPS events are called and preparedness information.

In addition, social media is also leveraged to communicate our branded storytelling website Energized and SCE.com about topics related to PSPS, wildfire mitigation and emergency preparedness. Some ads are targeted territory-wide, while others focus on HFRAs or other niche targeting (i.e. MBL or other vulnerable groups). In 2021, social media targeted ads generated more than 126 million impressions across Facebook, Instagram and Twitter. In 2022, SCE will continue to leverage social media to amplify PSPS resources and preparedness information to customers in HFRAs.

5. Future improvements to initiative:

SCE's long-term strategy focuses on continual improvement in areas that aim to increase customers' awareness before, during and following emergencies. SCE will work to improve customers' knowledge of the program offerings available and ensure customers receive critical notifications when emergencies arise. SCE will also emphasize reaching customers throughout its service area, including people present in the area that may not be SCE customers (e.g., visitors), and will continue its campaigns to residents that are not direct SCE-metered customers (e.g., residents at locations with master-metered customers) to reach as many residents affected by PSPS as possible. These notifications include instructions on how to sign up for alerts and notifications and provides a link to SCE's website where more information is available on PSPS activities and consumer protections. These are in addition to the PSPS event notifications described in Section 8.2.4.

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[210] *See* August 21, 2020 Administrative Law Judge's Ruling Regarding Compliance Filings Submitted In Response to Decision 20-03-004[E29] (R.18-10-007) Related to In-Language Outreach Before, During And After a Wildfire And Surveys Of Effectiveness of Outreach, OP 1, p. 6.

7.3.9.4 Disaster and emergency preparedness plan

SCE addresses response planning through an all-hazards approach, which focuses on capabilities that are critical to address a full spectrum of disruptive events, including natural and/or human-caused emergencies. SCE maintains an All Hazard Emergency Operations Plan (AHP) that incorporates disaster and emergency preparedness, emergency incident response, and recovery activities that facilitate restoration and continuity of critical operations. It outlines the roles and responsibilities for the company leadership and incident response personnel across the enterprise for response operations during any type of event. In 2021, SCE's AHP received a comprehensive update that included additional elements recently required by D.21-05-019.[E30]

1. Risk to be mitigated / problem to be addressed:

Comprehensive plans are needed to identify hazards and memorialize the protocols necessary to address the hazards and coordinate with internal and external stakeholders for rapid restoration of electrical service following a disaster or emergency.

2. Initiative selection:

The AHP articulates the operations and policies that guide how the company prepares for, responds to and recovers from, emergency electrical incidents using the utility-specific Incident Command Structure. It is designed to facilitate safe and efficient restoration of outages caused by outside forces, through the development of accurate situational awareness and the sharing of critical information during an incident. The AHP outlines the communications strategy and notification procedures that SCE utilizes to communicate with its customers, the public, appropriate government agencies, essential service providers, critical care customers, and other important stakeholders in the restoration process. It also outlines how SCE will collaborate with the communities it serves in preparing for and responding to emergency events, which may include activities such as pre-positioning of field resources or equipment in advance of forecasted weather events.

SCE's AHP outlines preparedness, response, and recovery activities that are consistent across all hazard types. As part of the comprehensive update, SCE is reviewing all existing hazard-specific response plans to extract information that applies across all incidents, and as a result, the previous version of the Wildfire Response Plan has been transformed into the PSPS Protocol, and as SCE continues refinement into 2022, SCE will evaluate the need to develop a separate Wildfire Response Plan as an appendix.

In addition to the AHP, SCE maintains additional preparedness and response plans and guidelines including IMT/Incident Support Team Guidelines, Earthquake Plan, Cybersecurity Plan, Electric Emergency Action Plan, Storm Plan, and several other plans, protocols, and procedures to support incident response. While the AHP will be used regardless of the type of incident, any number of or combinations of these plans and procedures may be used to inform response and coordination.

These activities are not intended to directly reduce the probability or consequence of ignitions or de-energizations, but rather support the essential task of SCE's response to emergencies, and therefore risk models were not used to select the scope of work or target deployment, and SCE did not calculate an RSE for this activity.

3. Region prioritization:

No region prioritization has been used for this initiative as these plans apply to SCE's entire service area.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

The Storm Plan was updated in 2021 on schedule, and it will be updated by July 1, 2022 to reflect any lessons learned or changes decided upon in 2021. The AHP received a comprehensive update in 2021 and will be filed with the Commission in April 2022.

5. Future improvements to initiative:

Components of SCE's disaster and emergency plans are regularly quality checked to promote improvement. For example, each real-world event and simulation exercise is required to have an After Action/Corrective Action plan for issues identified over the course of the incident. SCE incorporates all lessons learned into existing plans and protocols through regular updates to disaster and emergency plans. SCE maintains an annual plan maintenance schedule and a training/exercise calendar to facilitate syncing plan updates with lessons learned from existing trainings and exercises. SCE's long-term disaster and emergency plans will continue to be regularly updated to incorporate updated or additional regulations and identified corrective actions and maturity models.

SCE also actively engages key stakeholders in conjunction with maintaining its disaster and emergency preparedness plans. As previously described in Section 7.3.6.5, in the event of a PSPS activation, SCE coordinates with local emergency management agencies and employs a variety of targeted communicationchannels to provide timely notifications. SCE also describes engagement with public safety partners, including fire and law enforcement agencies, to collaborate on mitigation strategies and event protocols, as well as outreach efforts to water agencies, telecommunications companies, and healthcare providers to educate them on PSPS protocols and potential impacts.

7.3.9.5 Preparedness and planning for service restoration

Depending on the type of service restoration, SCE utilizes the PSPS protocol, AHP, and other plans described in Section 7.3.9.4, to determine the protocols for conducting inspections and remediations prior to re-energizing lines. SCE utilizes the training described in Section 7.3.9.1 to execute those protocols. [211]

1. Risk to be mitigated / problem to be addressed:

[211] In addition to these protocols, SCE also adheres to the notification requirements in D.21-10-020[E31] (R.20-09-001), which adopted new post-disaster community engagement and reporting requirements for IOUs and facilities-based telecommunication service providers.

Service outages caused by emergencies and PSPS events may negatively affect customers. Comprehensive plans and well-trained personnel promote safe and timely service restoration in support of affected customers and communities.

2. Initiative selection:

SCE provides its employees with the tools, plans, guidelines, and strategies to promote safe and timely re-energization. SCE increases resiliency by training employees to handle PSPS events. SCE utilizes plans, trainings, and exercises as described in Sections 7.3.9.1 and 7.3.9.4 to plan and prepare for all types of hazards that may impact service delivery. SCE reviews and updates plans, and conducts trainings for personnel, on an ongoing basis.[212]

As previously discussed in Section 7.3.9.1, each year SCE requires all personnel assigned to a non-PSPS IMT to receive initial or refresher training in all-hazards response operations. During this training, personnel receive instruction regarding incident response operations and plans, or updates to plans or protocols that had taken place since their last training session. This provides all personnel an opportunity to learn about and/or review and discuss best practices and lessons learned/observed during training sessions, exercises, and real-world activations. These training sessions are followed by drills or exercises to ensure the training information is retained and can be successfully demonstrated. Once both requirements are fulfilled, the personnel are considered to be qualified, or requalified for their specific position. It should be noted that the Business Resiliency team is responsible for training personnel on response plans and response operations, while more technical training specific to service restoration is provided by the personnel's home organization.

Additional protocols are followed for restoring power following PSPS events. Prior to and during a PSPS event, the IMT briefs local field personnel on circuits that have a potential of being de-energized for PSPS. Existing repair notifications are given to the local field personnel ahead of the activation to help remediate issues on those circuits before the wind event begins. If a circuit is nearing the de-energization criteria, SCE reviews circuit-specific switching plans to assess how the de-energizations can be the least impactful to the customers, while isolating the area of concern. These switching plans are also used when the circuits are being re-energized. Once circuits have de-escalated from PSPS criteria, the circuits are prioritized by the restoration teams to be patrolled and re-energized in a strategic fashion. Restoration teams have the expertise to assess whether additional resources are needed to reenergize a circuit faster, especially in the hard-to-reach circuits, by proactively requesting air operations to aid in the patrolling of de-energized lines. As the lines are being patrolled and monitored for re-energization, SCE maintains clear communications with all the affected departments. Consistent with the Commission's direction in D.20-05-051[213], SCE endeavors to restore power as soon as possible and within 24 hours from the cessation of

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[212] SCE trains its employees in emergency response so that they will be prepared in advance of any emergency, which by their nature often strike without warning. Although wildfires and PSPS events have a "season" during which it is more likely they will occur, climate change is now causing a year-round wildfire season. In addition, other types of emergencies, such as earthquakes, may strike at any time of year.

[213] See May 28, 2020 Decision 20-05-051[E28] (R.18-12-005) Decision Adopting Phase 2 Updated and Additional Guidelines for De-Energization of Electric Facilities to Mitigate Wildfire Risk.

extreme weather, when safe to do so. SCE also reports to the Commission any instances where it was unable to meet the 24-hour timeframe. SCE also informs customers, to the extent possible, that it will re-energize a circuit within one hour of knowing it will do so.

Protocols for safe restoration of power is an essential part of our business and thus not informed by an RSE. The training allows SCE personnel to support vital activities (e.g., service restoration after an emergency) and/or specific wildfire mitigation initiatives (i.e., PSPS). The impacts of this activity are therefore included in the RSE calculations of the individual activities it supports.

3. Region prioritization:

No region prioritization has been used for this initiative as these plans and protocols apply to SCE's entire service area.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

Training sessions, including both initial trainings for new personnel and requalification trainings for existing personnel, were successfully conducted and completed for required personnel in 2021 as described in greater detail in Section 7.3.9.1. In 2022, SCE will continue to conduct a review of company preparedness and revise or update plans and trainings. All IMT and IST personnel will go through requalification trainings by December 31, 2022.

5. Future improvements to initiative:

Each year, training sessions are re-evaluated and actionable feedback from trainings, exercises, and real-world events are incorporated into the following years' training to ensure the information is as current and accurate as possible. SCE is currently evaluating and enhancing these training sessions. This information is expected to be incorporated into training sessions held throughout 2022. Additionally, plans, processes, and procedures are evaluated on an ongoing basis and updated to incorporate best practices and lessons learned from exercises and real-world incidents. In 2022, SCE will continue to review and revise existing guidance materials.

For PSPS specifically, in 2021 SCE implemented numerous improvements to its PSPS related protocols, including de-energization and re-energization operations, as described in Section 7.3.8.1 and Section 8.2. For 2022 to 2023, SCE will continue to focus on opportunities to improve restoration by exploring new tools and technologies that support the IMT and field staff with restoration efforts. SCE will also be reviewing the de-energization and re-energization checklists after each event to ensure that they are being completedcorrectly and to identify any potential areas of improvement to the form or personnel training.

7.3.9.6 Protocols in place to learn from wildfire events

Following all IMT and IST activations, regardless of hazard, SCE conducts a debriefing of response participants to solicit feedback and lessons learned.

1. Risk to be mitigated / problem to be addressed:

Without a mechanism to capture lessons learned stemming from real-world events and be integrated into SCE's emergency response plan, SCE's response would not evolve as new opportunities for improvement are identified.

2. Initiative selection:

Feedback from SCE's debriefs is incorporated into an After-Action Report (AAR), which includes an Improvement Plan or a Corrective Action Plan. SCE maintains this continuous improvement process for all IMT activations, regardless of hazard. These protocols have helped with replicating identified successes for subsequent activations, and areas for improvement are captured, assigned, and monitored so that they are not duplicated in future incidents. SCE will continue to use AARs to assess opportunities for improvement, turn these opportunities into corrective actions, and assign actions to SCE personnel to remediate.

These activities are not intended to directly reduce the probability or consequence of ignitions or de-energizations, but rather support the essential task of SCE's response to emergencies, and therefore risk models were not used to select the scope of work, calculate RSE or target deployment.

3. Region prioritization:

SCE does not prioritize a region for this initiative as it is conducted regardless of where in the service area an incident occurred.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

AARs were completed or initiated for all IMT activations in 2021, including those related to wildfires or PSPS. These AARs have been successfully utilized to describe and assign necessary corrective actions and ensure the continuous improvement of SCE preparedness and response efforts. In 2022, SCE plans to continue utilizing these protocols and processes in order to assign corrective actions and continuously improve.

5. Future improvements to initiative:

SCE will continue to identify areas for improvement via lessons learned and will capture these in AARs in order to continuously improve emergency response capabilities. Improvements to SCE's response to emergencies may also include improvements to its feedback process as SCE remains on the lookout for opportunities to improve its lesson learned process.

SCE received a letter from CPUC President Batjer on January 19, 2021, identifying several areas where SCE's 2020 PSPS performance was not up to the standards expected by the Commission. SCE responded in a letter on January 22, 2021 and presented its 2021 PSPS execution and improvement plans at a public meeting on January 26, 2021.

SCE clearly heard the message from the public, regulators, and partners that it must do more to reducethe need for PSPS going forward, perform PSPS effectively when it is necessary, and communicate its wildfire and PSPS-related plan, process improvements, and support programs in a clear and useful manner. SCE submitted its PSPS action plan to the CPUC on February 12, 2021, followed by bi-weekly updates on the progress to implement the action plan throughout 2021. SCE also provided bi-weekly updates to CPUC staff of the SED and Safety Policy Division and Energy Safety about progress toward the actions. SCE will continue to submit updates to action plan until all the activities identified in the plan are complete, which is expected to be in Q1 2022. SCE is committed to continuously learning and improving its emergency operations, especially for PSPS events, and enhancing its communication on this topic with the public, the Commission, and other affected parties.

7.3.10 Stakeholder Cooperation and Community Engagement

7.3.10.1 Community Engagement

SCE conducts extensive outreach to key community and government stakeholders, state and federal agencies, and the public to increase awareness about SCE's wildfire mitigation work (e.g., grid upgrades, vegetation management, inspections, etc.), PSPS, emergency preparedness, customer programs and resources, and to receive feedback to make improvements to these programs where feasible. SCE also engages with jurisdictions to develop partnerships and receive assistance with expediting or resolving issues related to SCE's wildfire mitigation activities.

7.3.10.1.1 Customer Education and Engagement – Community Meetings (DEP-1.2)

SCE holds a variety of meetings and workshops to inform and educate stakeholders and customers about SCE's WMP, PSPS, customer programs and resources available to assist customers with emergency preparedness.

1. Risk to be mitigated / problem to be addressed:

Customers and communities require information to become better prepared for SCE'swildfire mitigation work and PSPS events, and to build resilience.

2. Initiative selection:

Table SCE 7-31 below describes the various types of customer and community engagement that SCE performs.

Table SCE 7-31

Types of Customer and Community Engagements

Type of Engagement	Description
Wildfire Safety Community Meetings (DEP-1.2)	SCE holds wildfire safety community meetings (DEP-1.2) to share information about PSPS, emergency preparedness, SCE's WMP and grid hardening updates. These meetings offer participants a chance to ask questions of SCE staff and share feedback and concerns.
Engagement with Local and Tribal Governments as well as Key State and Federal Agencies	SCE meets with local and tribal governments in its service area to share and provide updates on SCE's WMP, PSPS protocols and PSPS potential impacts to the community. These meetings focus on educating local and tribal governments about the PSPS de-energization process and how the SCE communicates and works with government agencies and emergency operations during de-energization events. SCE also engages with key state

Type of Engagement	Description
	and federal agencies to highlight SCE's wildfire mitigation priorities and PSPS-related work.
PowerTalks for Business and Residential Customers	SCE conducts PowerTalks, which are informational sessions held across SCE's service area to educate business and residential customers about all aspects of power outages including PSPS, maintenance and repair outages. During PowerTalks sessions, customers are introduced to what types of outages exist, why they occur, how customers can prepare, and how customers can stay informed. Recent PowerTalks focused on SCE's WMP and PSPS to help educate audiences about these topics.
Resiliency Workshops for Critical Facilities and Critical Infrastructure Customers	SCE hosts resiliency workshops to assist critical facilities and critical infrastructure (e.g., water, hospital, telecommunications, and K-12 school districts) customers with preparing their facilities. During the workshops, SCE discusses customer resiliency and highlights lessons learned from PSPS including insights received from customers. Specific discussions during these workshops include: (1) updates on SCE's grid hardening efforts and education on available customer tools and resources (e.g. trainings on the newly created Public Safety Portal website), (2) review of SCE's PSPS process and communication protocols, (3) sharing of technical issues encountered by customers (e.g., ensuring connection of back up generation were compatible, confirming critical equipment is connected to back-up generating sources), and (4) opportunities for mutual aid. SCE also has been conducting one-on-one meetings with telecommunication customers and providing most impacted PSPS circuit history and grid hardening efforts for their impacted facilities so that customers can be prepared with their resiliency plans in impacted areas.
Outreach via Partner Business and Government Associations	SCE partners with various external business and government associations to share information about its wildfire mitigation efforts and PSPS with their members.
Outreach via Partner Community-Based Organizations (CBOs)	SCE engages with CBOs to help educate and create awareness around safety preparedness in the event of a disaster that impacts SCE customers in HFRAs, especially customers with AFN, such as seniors, those with limited English proficiency, those with disabilities, and/or those who are transportation disadvantaged. Through its Community-Based Connections program, SCE partnered with CBOs to help SCE conduct outreach and communications to help educate constituents around wildfire and how to be prepared in the event of a disaster or a PSPS activation within their communities. SCE continues to support the CBOs with training on SCE's wildfire mitigation efforts and the customer resources available; hold monthly check-ins to review engagement efforts and address any challenges and quarterly webinars; and provide monthly messages for CBOs to share

Type of Engagement	Description
	through their communications channels, postings of CBO community meetings on SCE.com, digital and print resources, and a Community-Based Connection Newsletter.
Outreach via Partner Independent Living Centers (ILCs)	SCE works with Independent Living Centers (ILCs) within SCE's service area to conduct outreach activities to their respective areas and customers, including providing emergency preparedness and PSPS education and supplies, accessible materials and trainings and awareness of/assistance in applying for the MBL program.

Community meetings do not directly reduce the probability or consequence of ignitions or PSPS, but rather inform and support SCE's customers. Therefore, risk models were not used to select the scope of work or target deployment. As community meetings are enabling activities that support the customer programs including CRC/ CCVs, CCBB and rebates, SCE has included the costs of these efforts in the various RSE calculations they support. This is further detailed in Table SCE 4-11.

3. Region prioritization:

SCE conducts outreach to stakeholders and communities, including community meetings, across SCE's service area but prioritizes HFRAs since SCE's wildfire mitigation activities, including PSPS, are located primarily in HFRA. SCE also conducts workshops for all tribes in its service area, with a specific focus on PSPS emergency preparedness. PowerTalks are held across SCE's service area and were held virtually in 2021 due to COVID-19 stay-at-home orders. Some factors in deciding the locations included historical attendance, recent major outage events and/or requests by cities.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

Wildfire Safety Community Meetings (DEP-1.2)

From March through June 2021, SCE hosted 11 wildfire safety community livestream meetings for communities to learn more about SCE's wildfire mitigation plan, grid hardening updates, PSPS, and emergency preparedness. SCE exceeded its 2021 goal of hosting nine meetings. Table SCE 7-32 below details the 11 meetings that SCE held in 2021, as well as the number attendees for each.

Table SCE 7-32

List of Wildfire Safety Community Meetings in 2021

Date/Time	Communities	Number of Attendees
Tuesday, March 23, 2021 6:00 – 7:30 p.m.	Simi Valley and Moorpark	124
Thursday, March 25, 2021 6:00 – 7:30 p.m.	Santa Clarita Valley	56
Tuesday, March 30, 2021 6:00 – 7:30 p.m.	Acton, Agua Dulce, Lake Hughes, Green Valley	26
Tuesday, May 11, 2021 6:00 – 7:30 p.m.	Riverside County	64
Thursday, May 13, 2021 6:00 – 7:30 p.m.	Orange County	68
Wednesday, May 19, 2021 6:00 – 7:30 p.m.	Chatsworth	13
Thursday, May 20, 2021 6:00 – 7:30 p.m.	LA County	134
Tuesday, May 25, 2021 6:00 – 7:30 p.m.	Ventura & Santa Barbara Counties	204
Wednesday, May 26, 2021 6:00 – 7:30 p.m.	San Bernardino County	114
Wednesday, June 2, 2021 6:00 – 7:30 p.m.	Kern County	30
Thursday, June 3, 2021 6:00 – 7:30 p.m.	Mono, Inyo, Fresno, Tulare, Madera, and Tuolumne Counties	32

SCE’s presentations covered wildfire mitigation and PSPS action plans; the PSPS decision-making process; grid hardening, including expected PSPS improvements; PSPS notifications; customer care programs; and community engagement.

There was a total of 865 attendees across the 11 meetings, which included local, state, and federal government officials; major businesses; critical infrastructure providers; community organizations; and other stakeholders. SCE also invited county Emergency Operations Center directors to participate and share information on their county’s emergency preparedness resources.

SCE sent surveys to meeting attendees. Based on survey results, over 70% of attendees were satisfied with the presentation and felt better informed about what SCE is doing to reduce the need for PSPS and the customer programs that are available. SCE also followed up with customers who requested assistance after the meetings to help answer their questions or assist them with enrolling in customer programs.

Figure SCE 7-84
Wildfire Community Safety Meeting

The recordings of the meetings and presentation decks are posted on SCE's website at www.sce.com/wildfiresafetymeetings.

For 2022, SCE will host at least nine wildfire community safety meetings in targeted communities based on the impact of 2021 PSPS events and ongoing wildfire mitigation activities.

Engagement with Local and Tribal Governments as well as Key State and Federal Agencies

In 2021, SCE continued to engage and provide information to local and tribal governments on its WMP and PSPS. In advance of wildfire season, SCE briefed or provided information to local and tribal governments with circuits impacted by PSPS in its service area (125 local governments and nine tribal governments) as well as made presentations to city councils and county boards of supervisors on SCE's wildfire mitigation efforts and updates to help them prepare for PSPS. SCE also requested feedback on a number of items including identifying additional critical facilities, reaching out to AFN populations, identifying community safety concerns, identifying CRC/CCV locations, and feedback on services offered at CRC/CCV. SCE also provided information to local and tribal governments on how to register and access the new Public Safety Partner Portal as well as held eight training sessions on how to use the portal.

SCE hosted 13 meetings with each of the county operational areas in its service area to provide updates on SCE's PSPS protocols, request feedback on areas such as PSPS notifications and the Public Safety Partner Portal and discuss partnership opportunities to conduct outreach to AFN populations. SCE also held two rounds of virtual workshops for local and tribal governments, which included community choice aggregators (CCAs) and organizations serving AFN and disadvantaged communities, to provide information to assist with their resiliency planning efforts.

SCE also hosted workshops specifically for tribal governments to provide updates on the WMP, PSPS, and the Public Safety Partner Portal, as well as information on customer programs and resources to help tribal communities prepare for emergencies and outages. In 2022, SCE will continue to brief cities, counties, and tribes in HFRAs to provide updates and receive feedback on the WMP and PSPS.

In 2021, SCE also engaged with key state and federal agencies (e.g., Caltrans, CAL FIRE) include meeting with agency leadership to highlight SCE's wildfire mitigation priorities and PSPS-related work, coordinating site visits, partnering on wildfire mitigation work (e.g., through grants), developing programmatic strategies to streamline approval of priority wildfire activities, and participating in state and federal initiatives aimed at mitigating wildfire threats in California (e.g., Bureau of Land Management's Wildland-Urban Interface fuels treatment program).

PowerTalks for Residential and Business Customers

In 2021, SCE conducted 28 PowerTalks for a total of about 530 attendees. In 2022, SCE will continue to hold PowerTalks for customers to learn more about outages, including PSPS. SCE will also begin to provide topic-specific PowerTalks (e.g., aerial inspections, weather outlook).

Resiliency Workshops for Critical Facilities and Critical Infrastructure Customers

In 2021, SCE hosted eight resiliency workshops for critical facilities and critical infrastructure customers on topics such as PSPS, emergency preparedness and Public Safety Partner Portal. SCE also hosted five one-on-one meetings with telecommunication carriers (AT&T, Verizon Wireless, Cox Communications and T-Mobile) to identify circuits and equipment locations that are at risk for PSPS outages to assist the carriers deploy their backup power resources ahead of possible outages in impacted areas within their service area. SCE also provides carriers advance notice of PSPS events and access to SCE's Public Safety Portal to assist with their resiliency planning. In 2022, SCE will continue to partner with its critical facilities and critical infrastructure customers as well as telecommunications customers to help them prepare their resiliency plans prior to wildfire season.

Outreach via Partner Business and Government Associations

In 2021, SCE continued to partner with government and business associations to inform and educate members about SCE's wildfire mitigation, PSPS, and preparedness efforts. SCE made presentations at meetings, provided information for newsletters, and hosted panels at conferences. Some examples include SCE moderating or participating on panels on wildfire preparedness with local government, public safety, and CBO stakeholders for the Los Angeles County Business Federation (June 2021), the League of California Cities Annual Conference (Sept. 2021), the Orange County Council of Governments General Assembly (Nov. 2021), and for the South Orange County Economic Coalition (Nov. 2021).

Outreach via Community-Based Organizations (CBOs)

In 2021, SCE continued to partner with the 50 CBOs selected through the RFP process in 2020 to help educate constituents within their communities around wildfire and how to be prepared in the event of a disaster or a PSPS activation, targeting customers such as seniors, people with limited English proficiency, customers with disabilities, and/or those who are transportation disadvantaged. Together, the CBOs and SCE share information about SCE's wildfire mitigation plan and the importance of building resiliency plans for when emergencies occur. Other important topics that are regularly shared are programs like Critical Care Backup Battery program, MBL program and important rebates and incentives available to our customers. CBOs also regularly exchange and share communications on programs and services through social media, newsletters, e-blasts, blog posts, and direct stake holder engagement efforts like digital webinars. The selected CBOs track their outreach and engagement efforts and submit this information via monthly reports. These metrics are used to evaluate CBO performance, program effectiveness, and identify areas of improvement. In 2022, SCE will continue to partner with the 50 CBOs for wildfire safety, PSPS and emergency preparedness outreach.

SCE also continues to outreach to its network of over 1,600+ CBOs to share information about SCE programs and tools. To consolidate all the different resources and in support of wildfire and emergency preparedness, SCE put together a kit for AFN external partners with links to different approved messages, videos and infographics that highlight resources on topics such as outages, emergency preparedness, customer care programs, PSPS, video content and other online resources (e.g., AFN website, Energized.com and SCE's social media channels). In addition, SCE continues to attend CBO facilitated webinars or "live" events via Facebook and Instagram to share information on PSPS, outage alerts as well as emergency preparedness. SCE is including participation from CBOs in the PSPS County Briefing and the newly formed PSPS CBO coordination meeting during IMT activations. The intent is to provide CBOs real-time in-event information about potential PSPS events affecting counties they serve and give CBOs the opportunity to escalate any issues or ask questions relevant to the event.

Outreach via Partner Independent Living Centers (ILCs)

In 2021, seven ILCs continued to conduct outreach activities to provide preparedness education and assistance in applying for the MBL program. In 2022, SCE will expand its partnerships to include three additional ILCs, bringing the total to ten ILCs. The ILCs will continue to conduct outreach activities, including providing emergency preparedness and PSPS education and supplies, accessible materials and trainings, and awareness of/assistance in applying for the MBL program.

5. Future improvements to initiative:

SCE will continue to make improvements to its meetings and content based on feedback received from surveys, PSPS Advisory Board/Working Groups, stakeholders, and customers, as well as lessons learned from PSPS events in 2021. In addition, SCE is continuing to evaluate alternatives and refinements to its community engagement activities and will include changes in approach, scope or cost in Change Order Reports to this WMP.

SCE plans to continue to host community meetings for customers in HFRAs across its service area and may also target specific communities based on the impact of previous PSPS events and grid hardening activities. SCE will continue to share information about its wildfire mitigation activities, PSPS, customer programs, and other resources and updates to help customers be prepared for emergencies, including PSPS events. SCE will also encourage customers to sign up for PSPS/outage alerts and other programs, including MBL.

As SCE has done on an annual basis, SCE will send updates on its WMP and PSPS protocols to local and tribal governments in HFRAs, including requesting information such as updated contacts for PSPS notifications. SCE will also hold meetings with local and tribal governments as well as critical facilities and infrastructure customers to review updates, request feedback, and discuss opportunities for further partnership.

7.3.10.1.2 PSPS Working Groups and PSPS Advisory Board

SCE hosts PSPS Working Groups and Advisory Board meetings to expand the opportunities available for stakeholders to share lessons learned between IOUs and impacted communities on IOU de-energization protocols and to develop de-energization best-practices. The purpose of these meetings is to solicit feedback from external stakeholder groups described below to shape and inform enhancements to PSPS protocols.

1. Risk to be mitigated / problem to be addressed:

PSPS events may impact customers experiencing de-energization. To improve execution of PSPS events, the PSPS OIR Phase 2 Decision requires IOUs to (1) lead PSPS Working Groups that convene at least quarterly to help better inform the electric IOUs regarding how to plan and execute de-energization protocols; and (2) coordinate service area-wide Advisory Board meetings to provide valuable input into a utility's planning for de-energization events.[214]

2. Initiative selection:

The PSPS Working Groups provide a forum to share lessons learned between the impacted communities and the electric IOUs on IOU de-energization protocols. At least quarterly, SCE convenes regionalized PSPS Working Group meetings. Components of the de-energization protocols that are typically addressed by the Working Groups include the following topics: the provision of CRCs, communication strategies, information sharing, identification of critical facilities, strategies for supporting AFN people/communities, contingency plans, and PSPS education and outreach.

The PSPS Advisory Board also meets at least quarterly to provide similar updates on PSPS enhancement efforts and solicit input on areas that may require improvement in how SCE approaches PSPS overall and provides a forum for stakeholders to propose ways to improve all aspects of PSPS.

The coordination of PSPS-related activities with the Working Groups and Advisory Board is required by the Commission in the PSPS OIR Phase 2 Decision.

3. Region prioritization:

SCE used the existing Cal OES regional structure to create three Working Groups to represent stakeholders from the entire SCE service area, including Central Region (Region V), Los Angeles Metropolitan & Coastal

[214] D.20-05-051[E28], Ordering Paragraphs 1-5.

Region (Region I), and Inland Empire & Northern Region (Region VI). SCE meets with small multi-jurisdictional electric utilities, CCAs, publicly owned electric utilities, communications and water service providers, CPUC staff, tribal and local government entities, public safety partners, and representatives of people/communities with AFN and vulnerable communities. Additionally, SCE added stakeholders to represent transmission-impacted publicly owned utilities and electric cooperatives.

The service area-wide Advisory Board is represented by participants from public safety partners, communications and water service providers, local and tribal government officials, business groups, non-profits, representatives of AFN and vulnerable people/communities, and academic organizations.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

SCE held a set of regional PSPS Working Group meetings each quarter in 2021, as detailed in Table SCE 7-33 below.

Table SCE 7-33

List of PSPS Working Group Meeting Dates and Topics

PSPS Working Group Meeting Dates	Topics
Q1 2021 Meetings (March 2, 3, and 4) and additional breakout sessions (March 25 and 31)	Topics for the March 2, 3 and 4 meetings included: • Overview of the 2021 PSPS Action Plan • Focus on reducing the need for PSPS March 25 breakout session focused on: • PSPS notification cadence and language March 31 breakout session focused on: • Feedback for the Public Safety Partners Portal under development and other online tools Both breakout sessions were held in a focus group type fashion, dedicating 90 minutes for stakeholders to give feedback to SCE on these important tools as they were under development for revisions.
Q2 2021 Meetings (June 1, 2 and 3)	Topics included: • Updates on SCE's efforts for reducing the need for PSPS • Seeking additional input and discussing plans for Public Safety Partners Portal • Discussing on-going plans to improve PSPS notifications • Overview of SCE's PSPS decision-making process.
Q3 2021 Meetings (August 31, September 1 and 2)	Topics included: • Overview of SCE's PSPS education and outreach programs and efforts • Community safety • PSPS enhancements • SCE's plans and resources for concurrent emergency plans

PSPS Working Group Meeting Dates	Topics
Q4 2021 Meetings (November 30, December 1 and 2)	Topics included: • Updates of PSPS enhancements (e.g., address-level alerts • Weather outlook webpage • PSPS in-bound call tool • PSPS education and outreach efforts • PSPS surveys • 2022 Access & Functional Needs PSPS plan • Recent PSPS events

The majority of the feedback SCE receives during the meetings include clarifying questions on the content presented, for example, seeking to better understand technical weather forecasting terms that were included in a presentation. These types of clarifying questions were resolved during the meeting. Another set of questions included requests for additional details, such as how many batteries were deployed to AFN customers and how many circuits are in SCE's service territory. Similarly, responses for these types of questions were provided during the meeting. Some other feedback included the need for social media toolkits. In response, SCE is developing a suite of social media toolkits for our education material that cities/counties, CBOs, and others can leverage to help educate customers on PSPS. SCE plans to share the social media toolkits with the working group members in early 2022. There was also feedback given about communication, especially in more rural communities. In August of 2021, SCE met individually with each telecom provider in the service territory, sharing information on circuits impacting their territory and requesting them to partner with SCE in the future. Conversations are currently on-going, and telecom providers continue to adhere to their mandated resiliency requirements. Details on all the feedback SCE received and corresponding action taken by SCE can be found in the Quarterly Working Group and Advisory Board Report.

Table SCE 7-34

List of PSPS Advisory Group Meeting Dates and Topics

PSPS Advisory Group Meeting Dates	Topics
Q1 2021 Meeting (March 9)	Topics included: • 2021 PSPS fire season forecast • 2021 PSPS Action Plan • Public Safety Partner Portal • PSPS notifications
Q2 2021 Meeting (June 8)	Topics included: • Update on its PSPS Action Plan • Public Safety Partner Portal • PSPS notifications

PSPS Advisory Group Meeting Dates	Topics
Q3 2021 Meeting (September 14)	Topics included: • Update on PSPS weather • Public safety partner engagement and communications • Grid hardening progress • Customer programs and engagement (e.g., outreach to AFN populations) • local public affairs outreach
Q4 2021 Meeting (December 8)	Topics included: • PSPS season outlook • PSPS Action Plan updates and outlook for 2022 • Overview of recent PSPS events, grid hardening updates • Access & Functional Needs planning • Communication tools and public safety partner engagement

SCE will continue to hold these quarterly meetings in 2022.

At the end of 2020 and early 2021, SCE benchmarked with other IOUs on a regular basis to align on agenda items, topics, meeting structure, and ways to increase participation, encourage feedback and improve effectiveness of the meetings. With the establishment of the Joint IOU Working Groups, outreach work including the regional Working Groups and Advisory Board are part of the external engagement subcommittee; in those meetings, the IOUs will continue to align on topics and lessons learned.

SCE provides additional information on the various topics discussed, questions raised by the members and the outcomes in its Working Group and Advisory Board Quarterly Update Report submitted to the CPUC on a quarterly basis.

5. Future improvements to initiative:

After each quarterly Working Group and Advisory Board meetings held in 2021, SCE provided a survey to the participants to solicit feedback on areas of improvement for the meetings. Responses were limited; however, out of a scale from 1 to 5, with 5 representing high satisfaction, the average results were 4.2 for the Working Group responses, and “very satisfied” for the Advisory Board responses. In general, respondents liked the format of the meeting and content. Any follow up items pertained to customer-specific issues which were addressed individually. Based on the feedback received from the participants, SCE will continue to refine how these meetings are conducted, such as meeting structure or cadence, and work to address stakeholder concerns. SCE will continue to leverage feedback from post-meeting surveys to identify potential improvement opportunities as well as ideas for future topics.

7.3.10.1.3 Marketing Campaign (DEP-1.3)

SCE's multilingual marketing campaign, which includes radio, digital, social media, search ads, and direct customer mailings, seeks to educate customers and the public on PSPS, including the conditions that trigger a PSPS, how to prepare for a PSPS, what SCE has done and continues to do to mitigate the risk of wildfires, and how to prepare for emergencies.

1. Risk to be mitigated / problem to be addressed:

PSPS events may impact customers if they experience de-energization. It is critical to increase customer awareness and understanding of PSPS events, including how to prepare for events in order to reduce potential negative impacts.

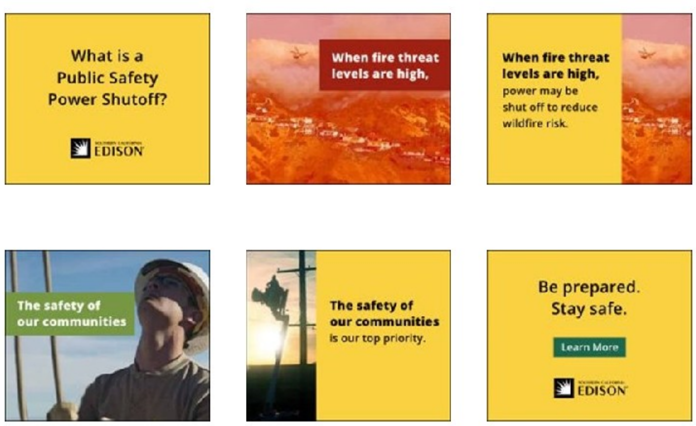
2. Initiative selection:

The marketing campaign seeks to educate customers about PSPS and emergency preparedness and reduce the impact of a PSPS or a wildfire primarily through three methods: (1) advertising campaign; (2) social media; and (3) direct customer mailings.

1. Advertising Campaign: The advertising campaign aims to convey key messages that collectively help educate customers about PSPS and emergency preparedness. These advertisements run on a variety of channels including print/newspaper, digital banners, digital video, connected TV, social media, search, digital audio and broadcast radio. The 2021 advertising campaign centered on four message themes: Emergency Preparedness, PSPS Definition/Condition, Wildfire Mitigation, Alert Sign-Up, MBL Program, and Customer Resources and Support. The 2021 ad campaign generated about 832 million total impressions. In 2022, SCE will run its in-language and English advertisements concurrently area-wide.[215]

Figure SCE 7-85

PSPS Awareness Ad Sample



[215] For the list of SCE's in-language capabilities, including for the marketing campaign, see Section 8.4.

See additional samples on: sce.com/wildfire/wildfire-communications-center

2. Social Media: SCE uses social media as part of its marketing campaign with paid and organic posts informing customers about PSPS, emergency preparedness tips, how to sign up for PSPS alerts and information on SCE's wildfire mitigation efforts. Also, information about SCE's CCVs and CRCs is shared on Facebook, Twitter, Instagram and Nextdoor.

Figure SCE 7-86

Social Media Post Samples

3. Direct Customer Mailings: As part of the direct customer mailing strategy, SCE sent the 2021 PSPS Newsletter[216] to all SCE customers in both HFRAs and non-HFRAs in April and May, with content adjusted for those in HFRA. Like 2020, the 2021 newsletter sent to customers in HFRA focused on PSPS, including SCE's decision-making factors for PSPS as well as information regarding available customer programs and rebates. Customers in non-HFRA received materials focused on emergency preparedness that also included an overview of PSPS. Both versions provided an update on SCE's wildfire mitigation efforts, helpful emergency preparedness websites, and ways to sign up for alerts and customer support programs. Translated versions of the HFRA and non-HFRA PSPS Newsletters in all 19 prevalent languages are accessible to customers via SCE's new "Wildfire Communications Center" webpage (referred to in previous filings as "Multicultural Communications Center") that launched in April 2021.

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[216] The PSPS Newsletter was previously referenced as the Dear Neighbor Letter DEP-1.1 in SCE's 2020 WMP. As this effort is a part of SCE's overall wildfire marketing campaign it has been included with DEP-1.3 in SCE's 2021 and 2022 WMP Update.

Figure SCE 7-87

2021 PSPS Newsletter

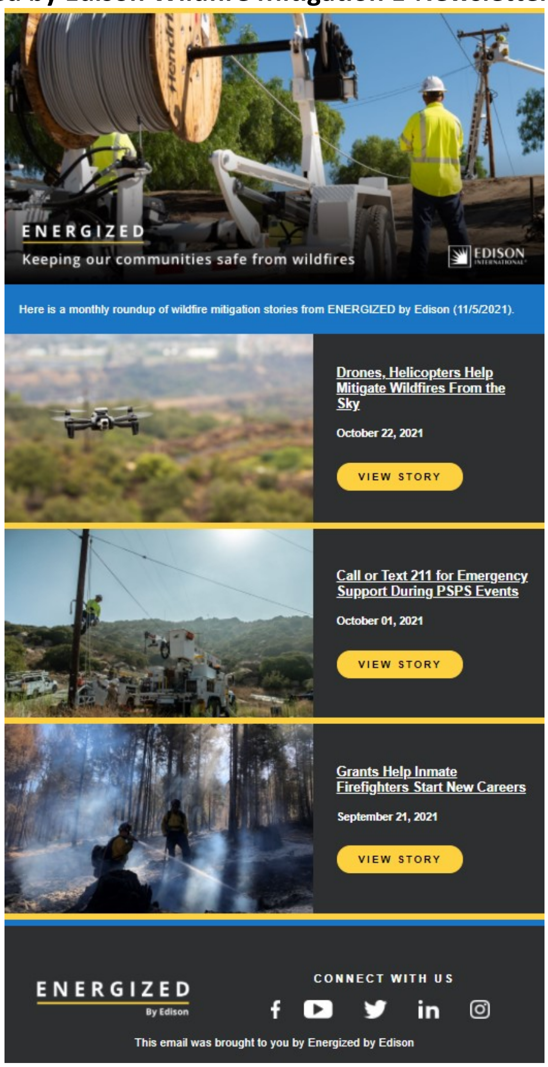
See full newsletter on: sce.com/wildfire/wildfire-communications-center

Other direct customer mailings included approximately 5,200 letters and flyers to SCE customers who are mastered-metered property owners/landlords. These letters and flyers were mailed on August 10, 2021 and requested landlord/property owners' assistance with educating their sub-metered tenants about wildfire and PSPS, including steps they can take to plan, prepare and stay safe in advance and during a PSPS outage, in addition to requesting that landlords post the provided flyers for tenant awareness. The letter and the flyer are bilingual (English/Spanish). Translated versions of the flyer in Chinese, Vietnamese, Korean and Tagalog (in addition to Spanish) are accessible for download via SCE's Wildfire Communications Center webpage.

While not part of the marketing campaign, SCE shares stories and videos about its wildfire mitigation and PSPS efforts on its public storytelling platform, Energized by Edison, and on SCE's YouTube channel.[217] Customers can also sign up for the monthly Energized by Edison Wildfire Mitigation e-newsletter to receive email digests to stay current on recent SCE activities. Feature stories may include topics such as wildfire mitigation activities, vegetation management, aerial and ground inspections, PSPS events, emergency preparedness, CRCs/CCVs, CCBB Program, other customer care programs, and philanthropic efforts supporting wildfire mitigation. These external stories are actively pitched to media for earned media coverage and shared on SCE's social media channels.

Figure SCE 7-88

Energized by Edison Wildfire Mitigation E-Newsletter Sample



[217] See Energized by Edison, available at www.energized.edison.com. SCE's YouTube channel available at www.youtube.com/sce.

While the marketing campaign provides information to help customers prepare to respond to a PSPS or emergency, it does not directly reduce the probability or consequence of ignitions or PSPS. Therefore, risk models were not used to select the scope of work or target deployment. As the marketing campaign is an enabling activity that supports customer programs including CRC/CCVs, CCBB, rebates and 211 partnerships, SCE has included the costs of these efforts in the various RSE calculations they support. This is further detailed in Table SCE 4-11.

3. Region prioritization:

The marketing campaign is targeted to all residential and business customers throughout SCE's service area, with PSPS messaging heavily targeted to customers residing in HFRAs, including vulnerable and populations and persons speaking other prevalent languages.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

In 2021, SCE met its marketing campaign goal to achieve 50% awareness about the PSPS program among the approximately 5,000,000 customer accounts reached, based on Customer Attitude Tracking (CAT) survey results, which is a monthly customer survey capturing awareness and perception metrics across a representative sample of SCE's customers in its service area. Through 2021, customer awareness about the PSPS program averaged 60%, driven by dedicated advertising, news coverage and community outreach. Customer perception that SCE takes proactive action to protect communities from wildfires was at 67%, compared to 64% in 2020. Based on 2021 and 2020 performance, the 2022 awareness goal will be maintained at 50%.

In 2021, SCE targeted ad creatives and messaging to vulnerable populations to increase MBL enrollment and customer program participation. SCE also partnered with local multi-ethnic newspapers to promote emergency preparedness information. SCE will continue to develop new ads with relevant messages and continue to communicate these messages to its customers in multi-channel and multiple languages over the next few years. For the 2022 campaign, SCE is refining messages and channels based on 2021 performance data, including targeting Alert Sign-up ads to renters to increase premise-level notification sign-ups and refreshing ad creatives and messaging to promote progress on SCE's grid hardening efforts.

5. Future improvements to initiative:

SCE will continue to leverage the results of its monthly CAT survey to determine improvements in messaging, communication channels, and prioritization of customers who may need additional or targeted outreach. In addition, SCE is continuing to evaluate alternatives and refinements to its PSPS-related marketing activities to educate customers and increase program enrollment and will include changes in approach, scope or cost in Change Order Reports to this WMP as applicable.

SCE's marketing campaign continues to emphasize PSPS readiness and customer programs, specifically for vulnerable customers. The marketing campaign is discussed in additional detail in Section 8.4.

7.3.10.1.4 Customer Research and Education (DEP-4)

This activity captures customer feedback on SCE's broad WMP initiatives with a special emphasis on PSPS activities.

1. Risk to be mitigated / problem to be addressed:

SCE seeks to improve its understanding of how it can make adjustments to reduce the impacts of wildfires, PSPS and wildfire mitigation work for its customers.

2. Initiative selection:

SCE develops surveys which capture customer feedback on areas of interest. SCE's 2021 goal was to conduct the following four surveys:

1 The PSPS Tracker is an annual survey conducted at the end of wildfire season to assess and understand customer awareness, experience and opinions of SCE's PSPS and wildfire mitigation activities, focusing on customers affected by PSPS events. Five customer segments are targeted:
   - Customers not notified but de-energized
   - Customers notified and de-energized
   - Customers notified but not de-energized
   - Customers not notified and not de-energized
   - Customers who do not live in a HFRA

2 Wildfire safety community meeting surveys conducted among attendees of the meetings to receive feedback on their experience and the information provided.

3 CRC/CCV visitor surveys conducted among customers who visited a CRC/CCV during a PSPS event to receive feedback on their experience, and the resources and support provided.

4 In-Language Wildfire Mitigation Communications Effectiveness Surveys that measured the communications and outreach effectiveness prior to and coincident with the wildfire seasons by prevalent language. This survey is discussed in Section 8.4 of this WMP.

Customer research and education activities do not reduce the probability or consequence of ignitions or PSPS, but rather support and inform SCE's wildfire mitigation efforts as well as minimize the impacts of PSPS by helping customers be more prepared, and therefore risk models were not used to select the scope of work or target deployment, and SCE did not calculate an RSE for these activities.

3. Region prioritization:

The PSPS Tracker's primary focus is customers who were de-energized in HFRA areas, with secondary focus on non-HFRA areas as a point of comparison.

The wildfire safety community meeting surveys gathers responses from the participants from the meetings held for communities impacted by PSPS in HFRAs.

CRC/CCV visitor surveys are conducted among customers who are seeking support during or in preparation for a potential PSPS event in HFRAs.

The In-Language Wildfire Mitigation Communications Effectiveness surveys are conducted service area-wide using random sampling methodology.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

In 2021, SCE conducted nine surveys, exceeding its goal of completing four surveys, to capture customer feedback and insights related to PSPS and wildfire mitigation activities, focusing on our HFRAs, including:

1) PSPS Tracker: Both residential and business customer surveys have been completed and SCE has performed quantitative analysis on the information collected. For residential and business customers in HFRA, we found majority of the customers are aware of PSPS but are not as informed on other SCE wildfire mitigation activities. SCE will look to improve customer education on each of SCE’s wildfire mitigation programs.
2) Wildfire safety community meeting surveys: SCE administered a survey at all wildfire safety community meetings in early 2021. Over 70% of meeting attendees stated they felt better informed about what SCE is doing to reduce the risk of wildfires and the use of PSPS as well as customer programs to help prepare for PSPS.
3) CRC/CCV visitor surveys: CRC/CCV visitor surveys conducted among customers who visited a CRC/CCV during a PSPS event to receive feedback on their experience, and the resources and support provided. Year to date and on a scale of 1-10, 10 being extremely satisfied, 306 customers have provided a mean score of 8.6 in overall satisfaction with their experience at CRCs and CCVs, with almost 53% of the respondents rating their experience a 10. More than half of the respondents visited CRCs and CCVs to obtain outage preparedness information and 99% of respondents preferred to receive communication in English. In addition to requesting feedback via email, SCE launched a survey by QR code at the CRCs and CCVs in October, which will continue through 2022. The intention is to enable customers to provide immediate feedback at the CRC and CCV.
4) In-Language Wildfire Mitigation Communications Effectiveness Pre-/Post- Surveys: SCE completed the pre-wildfire season survey with residential and business customers territory-wide and in HFRA. The survey was conducted in July and August and specifically measured sentiment regarding SCE’s wildfire communications and PSPS preparedness efforts – whether in English or other prevalent non-English languages. Respondents were able to take the survey in their language of choice (English or 19 non-English languages). Results were reported in mid-September and compared with the 2020 pre-survey – most results being comparable to last year’s pre-study.
5) AFN Customer and CBO Research Study: As part of SCE’s PSPS Action Plan, in July 2021, SCE conducted customer research via in-depth interviews with identified AFN customers as well as CBO representatives (i.e., 211s, ILCs and Area Agency on Aging) to: understand what AFN customers need to be as prepared as possible in the event of a PSPS; determine AFN customer expectations of SCE before, during, and after a PSPS outage; and understand how SCE might collaborate with AFN CBOs to better serve AFN customers

during PSPS events. This research identified four key areas of opportunity moving forward: education (e.g., informing AFN customers why PSPS events occur, how they should better prepare for PSPS events), resourcing (e.g., SCE programs and services, CBO support, SCE's recent 211 partnership), communication (e.g., timely and relevant), and collaboration (e.g., CBOs and fire departments).

6) AFN Webpage User Experience research: SCE conducted research with the AFN statewide council and customers to assess the new AFN webpage and make enhancements based on the feedback provided, such as making the webpage more customer friendly through better organization, additional graphics, and concise verbiage.
7) PSPS Working Group/Advisory Board Surveys: Refer to Section 7.3.10.1.3.
8) PSPS Post-Event Surveys for Public Safety Partners: SCE captured feedback from public safety partners after PSPS events. Surveys were sent out for the six events that occurred from October 2021 onwards with a total of 23 completed surveys obtained. Overall, the public safety partners were satisfied with SCE's engagement during those events as evidenced by a 70% rating of either "Good" or "Excellent."
9) Voice of Customer Surveys: SCE administers a transactional survey as part of our Voice of Customer (VOC) program to residential customers impacted by PSPS under two scenarios: (1) customers de-energized due to a PSPS event, and (2) customers notified of a possible PSPS event but who did not have their power shut off. The de-energization survey launched in fall 2020, and the notified but not de-energized survey launched in Oct 2021.

   For the 2021 wildfire season, SCE received 317 completed VOC surveys for de-energized customers, and 865 completed surveys for notified but not de-energized customers. De-energized customers had a satisfaction score of -84.9 on a -100 to 100 scale, and customers notified but not de-energized had a satisfaction score of 12.7 on a -100 to 100 scale.

Top themes for de-energized customers included:

- Need accurate and timely communication
- Reduce duration and restore service timely after event/wind is done
- Inconveniences on holiday (Thanksgiving), food spoilage
- Accurate de-energize planning (wires are underground, across street different treatment)
- Improve SCE infrastructure

Top themes for notified but not de-energized customers included:

- Communication is not consistent: few/more notices, well ahead/cut close to start
- Notifications were confusing and not accurate
- Customers say they were not notified

In 2022, SCE will continue to conduct customer research on PSPS-related activities to obtain insights and recommendations for enhancements to PSPS-related programs and services offered to customers. SCE plans to conduct at least six PSPS or wildfire mitigation-related surveys in 2022, including the PSPS Tracker, wildfire safety community meeting feedback survey, CRC/CCV feedback survey, In-Language Wildfire Mitigation Communications Effectiveness surveys, PSPS Working Group/Advisory Board surveys, and the Voice of Customer surveys.

5. Future improvements to initiative:

SCE seeks to bolster the assessment of customer attitudes, perceptions and behaviors towards wildfire prevention programs and PSPS events, by expanding the scope of customer research conducted across various teams within SCE to grow the pipeline of customer feedback. SCE increased its 2021 goal of four surveys to six surveys in 2022. SCE is also working to improve its ability to capture and incorporate important feedback to help improve customer resources (e.g., CRC/CCV) and/or address challenges faced by customers during those events. To accomplish this, SCE may conduct additional quantitative and/or qualitative research, as needed, to gain more insights through customer feedback.

7.3.10.2 Cooperation and best practice sharing with agencies outside CA

SCE participates in industry and other forums to provide regular opportunities to share best practices for wildfire mitigation.

1. Risk to be mitigated / problem to be addressed:

SCE continues to seek improvements to its wildfire mitigation approaches and further reduce wildfire risk by increasing opportunities to collaborate and exchange ideas with other utilities, technology developers, communities and governmental agencies.

2. Initiative selection:

This initiative includes memberships in industry organizations, outreach to commercial customers with national accounts, participation in technical forums and meeting regularly with electric utilities nationally and abroad. In 2020, due to the COVID-19 pandemic and its associated travel restrictions, SCE shifted to digital platforms to maintain its engagement and participated in webinars that have audiences from outside of California. SCE has continued this engagement through 2021.

SCE has regular check-ins with other utilities through the International Wildfire Risk Management Consortium (IWRMC). IWRMC's mission is to facilitate a system of working and networking channels between members of the global utility community to support ongoing sharing of data, information, technology, and practices, and proactively address the wildfire issue through learning, innovation, analysis, and collaboration. SCE, along with SDG&E and PG&E in the US, and Powercor and AusNet Services in Australia, is a founding member and participant in the IWRMC Executive Steering Group. Today, over a dozen other utilities facing significant wildfire risks currently participate in the IWRMC, with members hailing from the United States, Canada, South America, and Australia.

IWRMC member companies address wildfire issues through participation in tactical working groups, quarterly best practice sharing webinars, and direct discussions with their peers. Through this arrangement, the consortium is designed to accelerate learning and improve existing models and approaches by providing access to more and better data while allowing for swift re-orientation and prioritization of issues as the industry adapts to the unique set of issues that arise each year. The IWRMC is oriented around four strategic areas: 1) risk management; 2) asset management; 3) vegetation management; and 4) operations & protocols. In 2021, dedicated sessions were also held that focused on Data Governance and Stakeholder Engagement. IWRMC working groups routinely conduct member surveys on specific topic areas to supplement and enhance the direct discussions that occur during working group meetings.

3. Region prioritization:

SCE engages and shares best practices with agencies and industry trade associations within and outside of California, such as EPRI, Western Energy Institute (WEI), and Edison Electric Institute (EEI).

IWRMC's membership currently includes over a dozen utilities facing the most extreme wildfire challenges in the US, Australia, Canada, and South America, with more than 20 other utilities providing program design feedback and expressing broader interest in participation in 2021 and beyond.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

In 2021, SCE engaged and shared best practices for utility wildfire mitigation and response with agencies and industry trade associations outside of California, including but not limited to: EEI, Electricity Subsector Coordinating Council (ESCC), FEMA, NERC, WEI, WECC, American Society of Mechanical Engineers (ASME), California Utilities Emergency Agency (CUEA), Portland General Electric, California Catastrophe Response Council, EPRI, and telecommunications companies, among others. For the full list of engagements and meeting dates, please see Appendix 9.6: SCE External Engagements with Agencies Outside of California.

In 2021, IWRMC held a dedicated program virtual conference, conducted more than 65 meetings, webinars, and deep-dive discussions, and established numerous working relationships with industry associations that are also focused on wildfire issues. The latter includes organizations such as Energy Networks Australia (ENA), the Commonwealth Scientific and Industrial Research Organization (CSIRO), the Berkeley and Argonne National Laboratories, the Canadian Electricity Association (CEA), and the Utility Arborist Association (UAA).

Collaborative work performed within the IWRMC during 2021 also included:

- Development of a wildfire risk mitigation capability/maturity model – designed to help utilities understand their wildfire risk exposure along with the key organizational capabilities required to address that risk, and
- Development of a register of wildfire risk mitigation technologies in use by utilities around the works, along with some initial feedback on the effectiveness of each.

For 2022, IWRMC is looking to expand program participation across all markets (i.e., existing (North America, South America, Australia) and new (Europe, Africa, South Asia, etc.) and among smaller companies and Public Utility Districts, expand its outreach and strengthen relationships with industry groups, associations, and academic institutions and undertake deep-dive projects to study and address key wildfire risk mitigation issues. The consortium will also be widely deploying and further refining its wildfire risk mitigation capability/maturity model.

5. Future improvements to initiative:

SCE will continue to look for ways to expand its engagement with agencies outside of California, including supporting IWRMC's efforts to both expand its utility membership base and appoint leaders to its Executive Steering Group.

7.3.10.3 Cooperation with suppression agencies (Aerial Suppression DEP-5)

SCE is temporarily providing standby costs for aerial suppression resources in its service area to meet fire suppression needs.

1. Risk to be mitigated / problem to be addressed:

Since 2017, the increased size and scope of fire activity has created significant resource drawdown of fire suppression resources statewide. With multiple fires occurring at the same time across the western states, aerial resource drawdown has been increasing over the years. With that, an increasing number of aircraft normally available to respond to fires in SCE's service area have been deployed to fires outside of SCE's service area, resulting in less resources available in SCE's service area. This led to limited availability of fire agency resources, which has hindered fire suppression activities and increased the potential for major wildfires, putting SCE's infrastructure and communities at greater risk. As such, SCE seeks to help the fire community by assisting in the acquisition of additional assets to be used during the height of fire season.

2. Initiative selection

Due to the limited availability of fire suppression resources available statewide, SCE is providing aerial suppression resources to reduce wildfire risk to SCE's system and help protect SCE's infrastructure and communities. While aerial suppression resources will not be able to stop a fire at the onset, they can be used to reduce the area and assets burned and enable faster response times. In addition, aerial suppression resources help lower emergency response support costs and help minimize the impact of redirecting work crews from previously scheduled maintenance and construction work to emergency response. SCE will continue to monitor access to aerial resources in SCE's service area and will revisit annually to determine if SCE's approach in providing support should be adjusted based on the availability of statewide suppression assets.

In 2019 and 2020, SCE provided funding to lease firefighting equipment for its pilot project with Orange County Fire Authority (OCFA), which provided a Type 1 Sikorsky S-61N helitanker that worked in tandem with Type 2 Sikorsky S-76B helicopter.

In 2021, SCE expanded its funding and partnered with Los Angeles County Fire Department, OCFA and Ventura County Fire Department to create a quick reaction force (QRF) of aerial firefighting assets across counties in SCE's service area to coordinate and reach wildfires in their early stages. This included two Coulson-Unical CH-47 helitankers that can each carry up to 3,000 gallons of water or retardant, a Sikorsky-61 helitanker that can carry up to 1,000 gallons of water or retardant, a Sikorsky-76 intelligence and recon helicopter, as well as a mobile retardant base that can actively mix up to 18,000 gallons of retardant per hour. The helitankers have unique water and fire-retardant-dropping capabilities and can fly day and night.

SCE entered into Memorandum(a) of Understanding (MOUs) covering the duration of the highest fire risk months with the three county fire agency partners to provide standby cost funding for aerial suppression resources strategically placed around the SCE service area that will be prioritized and deployed by the agencies. In consultation with the fire agencies, SCE identified the optimal strategy for the placement of these resources, based on SCE's budget parameters, placing one resource in Ventura County, one in Los Angeles County and two in Orange County. The MOUs specify "use parameters" to help ensure that the aerial suppression resources are supporting initial attack and extended attack missions within the SCE service area. A regional fire agency coordination center would maintain responsibility for directing the aerial suppression resources, using their existing prioritization and deployment process and thereby providing a societal benefit to communities on extended attack fires.

The RSE calculated for aerial fire suppression is high. Therefore, SCE determined that it was prudent to continue to engage in this activity because it mitigates the consequences of a wildfire, regardless of the risk drivers that caused the ignition (e.g., balloon contact, etc.). This results in higher reliability and public safety. The decision to engage in this activity was further informed by fire agencies' input as well as SCE's experience with providing funding for aerial fire suppression assets in 2019-2021.

Figure SCE 7-89

Coulson-Unical CH-47 Helitanker

Orange County Fire Authority, LA County Fire Department, Ventura County Fire Department and SCE at an event in June 2021 at Joint Forces Training Base in Los Alamitos to debut the aircraft fleet

3. Region prioritization:

SCE continues to meet with county fire agencies to provide updates on key elements of SCE's WMP and to solicit input on the plan's fire suppression activities and the optimal placement and use of the aerial suppression resources. SCE engages with Southern California fire agencies as well as CAL FIRE and USFS on potential future collaboration.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

From June through December 2021, the helitankers saw 433 hours of flight time, making 1,836 drops for a total of 2.6 million gallons of water and 123,455 gallons of retardant, helping significantly reduce the consequences of wildfires, particularly in wind-driven wildfires, in California. Table SCE 7-35 provides a summary of the number of water/retardant drops, total amount delivered and the flight time of the helitankers in 2021.

Table SCE 7-35

2021 Performance of the Helitankers

	Day				Night			
Fire Agency	Total Drops	Total Water Delivered (gallons)	Total Retardant Delivered (gallons)	Flight Time (hours)	Total Drops	Total Water Delivered (gallons)	Total Retardant Delivered (gallons)	Flight Time (hours)
Ventura	420	222,612	6,533	84.60	181	98,936	9,018	52.20
Orange	341	537,800	78,350	75.20	143	268,600	6,900	44.40
Los Angeles	582	1,108,859	15,704	118.43	169	370,690	6,950	58.50
TOTALS	**1,343**	**1,869,271**	**100,587**	**278.23**	**493**	**738,226**	**22,868**	**155.10**

Day + Night	Total
Drops	1,836
Water Delivered (gallons)	2,607,497
Retardant Delivered (gallons)	123,455
Flight Time (hours)	433

The QRF of the aerial firefighting assets responded to and made drops on more than 50 fires within SCE's service area, beyond the Orange, LA and Ventura counties, as indicated in Figure SCE 7-90 below. The helitankers were able to stop the forward progress on these fires on the first day of the fire.

Figure SCE 7-90

Quick Reaction Force Incidents 2021

COULSON

For 2022, SCE plans to continue supporting the same three county fire agencies by providing aerial suppression resources to be placed at strategic locations within SCE's service area. We also plan to continue with the 2021 configuration of the QRF of aerial resources.

5. Future improvements to initiative:

SCE will continue to partner with county fire departments on deployment activity and ongoing refinement to the aerial suppression program to ensure proper coordination between SCE and other stakeholders.

7.3.10.4 Forest service and fuel reduction cooperation and joint roadmap

SCE works with federal, state and local regulatory and land management agencies on fuel reduction, vegetation management and other forest management efforts.

1. Risk to be mitigated / problem to be addressed:

There are cases in which SCE needs to coordinate its vegetation management and fuel reduction efforts with others, especially in USFS lands, to mitigate the risk of vegetation contact with the grid.

2. Initiative selection:

SCE has well-established relationships with the USFS and regularly interacts with its staff and leadership (at the Forest and Region 5 level). Additionally, SCE has a cost recovery agreement with the USFS to help ensure resources are available to assist SCE in its fuel reduction efforts. Since mid-2019 and in support of SCE's wildfire mitigation efforts, SCE has been collaborating with all the USFS to reduce fuels in and around powerlines. In addition, SCE is looking at ways to address fuel reduction outside of its ROW in coordination with the USFS.

SCE also works with state regulatory and land management agencies to address various forest health and safety concerns.

3. Region prioritization:

SCE continues to work with each National Forest agency to implement its vegetation management work throughout USFS lands that are within SCE's service area. In addition, SCE works closely with the USFS Forests and Regional Office to identify opportunities to partner on fuel reduction efforts outside of SCE's ROW.

4. Progress on initiative (amount spent, regions covered) and plans for next year:

As part of SCE's vegetation management program, SCE is currently working on several activities that reduce fuel within and near its existing ROWs and adjacent fire-prone corridors, including on USFS land. SCE's fuel reduction efforts on USFS land are managed under SCE's USFS Master Special Use Permit (MSUP), which was developed in collaboration with the USFS. SCE's wildfire-related activities under the MSUP include removing, thinning, or treating vegetation (as described in more detail below) and involve ongoing collaboration with the USFS.

IVM: SCE has long-term goals to reduce incompatible fuels within our ROW. SCE is continuing to develop its IVM Plan. The goal of IVM is to develop sustainable shrub or grassy areas that do not interfere with overhead power lines, pose a fire hazard, or restrict access on SCE's transmission ROW or applicable distribution easements. IVM promotes desirable, stable, low-growing plant habitat that reduces grow-in, fall-in or blow-in risk from tree species through appropriate, environmentally sound, and cost-effective control methods. These methods can include a combination of chemical, biological, cultural, mechanical, and/or manual treatments. This approach can potentially reduce costs over the long-term and reduce the risk of outages and fires, while improving wildlife habitat. SCE had a meeting with USFS Regional Leadership in November 2021 requesting a dedicated team with the appropriate specialists to support expanding our MSUP to address these activities, however implementation of these activities by forest have not been successful given limited USFS staff resources. SCE is working with the Regional Office at the USFS to address and gain support for these efforts.

Dead and Dying Tree Removals: The program (formerly called the Drought Relief Initiative (DRI)) was established as a result of the epidemic of dead and dying trees brought on by bark beetle infestations and climate change causing and years of drought. Under this program, SCE conducts patrols in Tier 2 and Tier 3 HFRA to identify and remove dead, dying, or diseased trees affected by drought conditions and/or insect infestation. SCE performs inspections at least annually, and often more frequently, in accordance with program requirements. All trees within strike distance of SCE overhead facilities that are dead or expected to die within a year are removed, including trees outside of SCE’s ROWs. SCE has removed more than 50,000 trees on USFS land from 2015-2021. Dead and dying tree removals continued through 2021, and inspections will continue throughout 2022. Resulting debris from removal work will be addressed according to best management practices to mitigate fuel loads.

Hazard Tree Removals: In 2019, SCE expanded its vegetation program to include the assessment of live trees that reach a certain height and a feasible path to strike electrical lines or equipment, where significant visible defects may be present. SCE will perform mitigation, up to and including removal of the trees. SCE’s plans for 2021 included assessing between 120,000 and 130,000 subject trees outside SCE’s ROWs with strike potential within our service area. From 2019-2021, SCE has assessed approximately 370,000 subject trees. Based on the results of these assessments Hazard Tree mitigations are prescribed and planned. Tree removals on USFS land are managed through the MSUP. As of end of 2021, SCE has removed over 6,000 hazard trees within our ROWs on USFS land. Resulting debris from removal work will be addressed according to best management practices to mitigate fuel loads. Additionally, SCE has timber sales agreements with both the Inyo National Forest and Sierra National Forest that require SCE to compensate the forests when removing significant amounts of wood products such as during hazard tree removal.

Pole Brushing: SCE expanded its pole brushing activities to clear brush to a 10-foot radial clearance from distribution poles in HFRA, beyond those poles required by regulation. Of the approximate 12,500 poles located within the National Forests, SCE has identified the highest fire risk structures for pole brushing in 2022. Applicable work for this activity will be submitted to USFS offices under SCE’s MSUP in 2022.

Fuel Management Programs: SCE is collaborating with Region 5 of the USFS and each individual forest on preparing a fuel management program on how to dispose of fuel (i.e., left over plant matter) after routine vegetation management activities. SCE reduces slash (e.g., cut limbs and other woody debris) from vegetation management activities by removing debris generated from our work activity off-site, chipping and broadcasting, or recycled by pruning/removal contractors. Where constraints exist at preventing SCE from executing the actions listed, SCE mitigates the potential fuel risk by scattering the debris according to best management practices and/or following any fuel management plan applicable to the work site (refer to Section 7.3.5.5).

Post Fire Restoration: There have been significant fires impacting several forests in which SCE has facilities. To support USFS restoration efforts, SCE is partnering with USFS in impacted forests and removing felled trees, to the extent feasible. For more detailed information, refer to Section 7.3.5.21.

Creative Fuel Reduction Efforts: Within forests with large tree removal activities, SCE is working closely with the USFS on methods for reducing felled trees outside of the ROW. Some of these alternative methods include firewood donation to the public and wood donation to the local native American tribes.

Fuel Reduction outside of SCE ROWs: SCE is exploring opportunities for a partnership that arose out of the recently released CA Wildfire and Forest Resilience Action Plan developed by the CA Forest Management Task Force (Jan 2021). The Plan is designed to strategically accelerate efforts to: restore the health and resilience of California forests, grasslands and natural places; improve the fire safety of our communities; and sustain the economic vitality of rural forested areas. The hundred plus actions outlined in the plan align with a $1 billion investment included in Governor Gavin Newsom's proposed 2021-2022 California state budget. The Task Force is co-chaired by the CA Natural Resources Agency Secretary, CA Environmental Protection Agency Secretary, and CA Department of Forestry and Fire Protection Director, with whom SCE works closely.

All of the USFS forests acknowledge the large amount of vegetation management work going on within each of the forests. As a result, SCE has become a partner to many of the local non-profits doing extensive fuel projects in and around the forests. There are two large collaborative efforts under way within the Inyo National Forest, around Mammoth Lakes, and in Southern California within San Bernardino National Forest. SCE is working closely with these organizations and engages in collaborative efforts to ensure fuel reduction is addressed on a larger scale, protecting SCE infrastructure and customers, while also addressing the larger landscape-level efforts.

In addition to the work described above, SCE is working in partnership with EPRI to perform a study identifying global practices for fuel management. As one of the industry's premier thought leaders, EPRI's wide-ranging collaborative research, development and demonstrations help guide strategic planning and inform technical and business decision-making. SCE kicked-off the study with EPRI in December 2020.

5. Future improvements to initiative:

SCE will submit a copy of the EPRI fuel study to determine the best management practices for fuel reduction following completion of the report which is expected at the end of Q1 2022. This report will continue to bolster SCE's ongoing efforts to identify how to best address fuel management in partnership with the USFS. SCE plans to consider refinements, where applicable, to its operational procedures to address any actionable findings in the report. In addition, SCE is actively engaged in larger collaborative efforts in partnership with the forests, nonprofits, and water agencies to address these concerns at a larger landscape level.

8 PUBLIC SAFETY POWER SHUTOFF, INCLUDING DIRECTIONAL VISION

This chapter details SCE's PSPS activities and its overall vision for the use of PSPS in the future. As discussed throughout this WMP, climate change continues to create significant challenges for society, not least of which are the immediate and unprecedented safety risks from catastrophic wildfires. In the face of such conditions, SCE's foremost mission is the safety of the public, our customers, and our employees. To that end, SCE's PSPS actions are guided by four fundamental objectives: (1) to protect public safety; (2) to keep the power on for as many customers as possible; (3) to communicate clearly and accurately; and (4) to minimize the impact of de-energizations through customer programs.

SCE understands and takes seriously the impact PSPS events can have on customers and communities. As such, SCE is focused on reducing these impacts by continuing to undertake significant efforts to further advance its robust infrastructure and operational program to manage wildfire-related risks. The infrastructure program is aimed at hardening the grid to reduce wildfire risks (i.e., reducing the number of ignitions), while also enhancing system resiliency (i.e., reducing electrical infrastructure damage and improving power restoration time during and after a fire event) as well as reducing the need for PSPS in SCE's service area. As described in Section 7.1.2.1, SCE's Integrated Grid Hardening Strategy considers PSPS impacts and windspeeds in the deployment of mitigations that will reduce the need for PSPS. In addition, SCE has improved its customer care activities to reduce the impact to customers affected by PSPS events.

In 2021[218] SCE demonstrated progress in both the reduction of PSPS events and associated impacts to customers, and the protection of public safety, including life and property. In 2021, SCE customers experienced a decrease in PSPS impacts compared to the 2020 season: nine PSPS activations, ~88,000 customer de-energizations, and ~105M CMI, with no major wildfires in HFRA associated with SCE infrastructure. Table SCE 8-1 below provides a comparison of PSPS events in the 2020 and 2021 fire seasons.

Table SCE 8-1

2020 and 2021 PSPS Event Statistics

	Activations	Customers De-energized	Circuits De-energized	CMI
2020 Season	13	348,253	584	388.1M
2021 Season	9	84,055	124	104.8M
Change	-31%	-76%	-79%	-73%

Through back-casting analysis of 2021 PSPS events, SCE estimates that its efforts in grid hardening, situational awareness, and improved risk modeling (which allowed for adjustments to PSPS thresholds)

[218] SCE's 2021 PSPS season is defined as beginning in April 2021 and ending with the calendar year 2021. Updated statistics for SCE's 2021 PSPS season will be provided in SCE's March 1, 2022 Post Season Report.

helped reduce CMI by 45%, number of customers de-energized by 44%, and number of circuits de-energized by 33% from what they otherwise would have been under the same weather conditions.[219]

Furthermore, SCE expanded customer offerings and improved communications with public safety partners to help mitigate the impacts of PSPS. These efforts included:

- Deployment of 6,014 free portable batteries to MBL customers in HFRA; 6,734 cumulative since 2020; nearly half of eligible MBL customers in the HFRA have received a free portable backup battery to temporarily power medical equipment through the Critical Care Backup Battery program
- Expanded outreach, community resiliency, customer rebate offerings; launched new AFN IMT role, AFN webpage, and 211 program to respond to customer needs during PSPS events
- Improved availability of emergency information through new Public Safety Partners Portal and enhancements to customer notifications during PSPS
- Designed and tested automated solutions on Palantir's Foundry platform to improve efficiency during IMT activations, including end-to-end process integration for customer notifications

These activities were described in detail in SCE's February 12, 2021 Corrective Action Plan (Action Plan) and were included in SCE's revision to its 2021 WMP Update. SCE's Action Plan included the goals of reducing the need for PSPS, executing PSPS events more effectively with transparency into the decision-making process, mitigating the impacts of PSPS events, keeping partners and customers clearly and consistently informed, and enhancing and improving post-event reporting. As of the end of 2021, SCE had largely completed the activities identified in the Action Plan. Additional information is included in Section 8.2.1 below.

Despite these improvements, SCE recognizes that we must continue to do more to reduce the need for PSPS going forward, perform PSPS effectively when it is necessary, and effectively communicate our wildfire mitigation and PSPS-related plans, process improvements, in a clear and useful manner and support our customers—especially MBL customers and customers with AFN—with more resiliency options.

The sections below describe SCE's vision for the PSPS program, its PSPS protocols, the lessons learned, improvements made and planned, and our commitment to reduce the use and impact of PSPS.

8.1 PROTOCOLS ON PUBLIC SAFETY POWER SHUT-OFF

Describe protocols on PSPS or de-energization, highlighting changes sincethe previous WMP submission:

1. Method used to evaluate the potential consequences of PSPS and wildfires. Specifically, the utility is required to discuss how the relative consequences of PSPS and wildfires are compared and evaluated. In addition, the utility must report the wildfire risk thresholds and decision-making process that determine the need for a PSPS.

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[219] SCE modeled 2021 weather and fuel conditions with 2020 protocols to identify how much worse 2021 PSPS outcomes could have been, if not for accelerated PSPS mitigations, which yielded improved protocols.

2. Strategy to minimize public safety risk during high wildfire risk conditions and details of the considerations, including but not limited to a list and description of community assistance locations and services provided during a de-energization event.

3. Outline of tactical and strategic decision-making protocol for initiating a PSPS/de-energization (e.g., decision tree).

4. Strategy to provide for safe and effective re-energization of any area that is de-energized due to PSPS protocol.

5. Company standards relative to customer communications, including consideration for the need to notify priority essential services – critical first responders, public safety partners, critical facilities and infrastructure, operators of telecommunications infrastructure, and water utilities/agencies. This section, or an appendix to this section, must include a complete listing of which entities the electrical corporation considers to be priority essential services. This section must also include a description of strategy and protocols to ensure timely notifications to customers, including AFN populations, in the languages prevalent within the utility's service territory.

6. Protocols for mitigating the public safety impacts of these protocols, including impacts on first responders, health care facilities, operators of telecommunications infrastructure, and water utilities/agencies.

SCE developed robust processes and protocols based on the OIR Phase 1, Phase 2 and Phase 3 decisions in order to reduce the impact of PSPS on its customers. We have refined these processes and protocols based on lessons learned and continue to do so in order to continue to reduce the impact to our customers and communities.

8.1.1 Method Used to Evaluate the Potential Consequence of PSPS and Wildfires

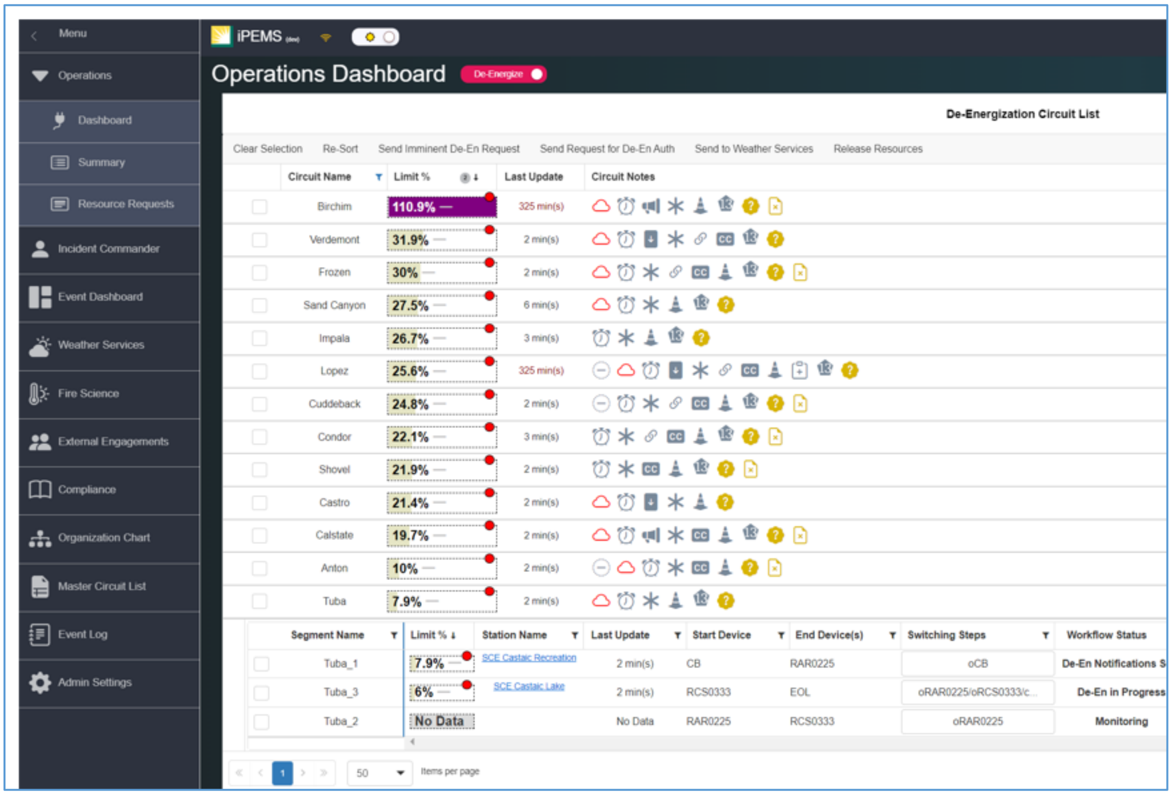
Method used to evaluate the potential consequences of PSPS and wildfires. Specifically, the utility is required to discuss how the relative consequences of PSPS and wildfires are compared and evaluated. In addition, the utility must report the wildfire risk thresholds and decision-making process that determine the need for a PSPS.

For each de-energization event, SCE assesses and compares potential public safety risks associated with proactive de-energization (PSPS risk) and simulated wildfire risk (PSPS benefit in avoiding a wildfire) for all circuits in scope, using its PSPS In-Event Risk Comparison Tool.[220] Inputs into this Tool include, among others, in-event weather, wildfire simulation models, as well as circuit-specific data. The results of the analysis are displayed on the IPEMS dashboard, shown below, and is used by Incident Commanders to inform de-energization decisions, in conjunction with other relevant quantitative and qualitative factors. These factors, along with SCE's thresholds and decision-making process are described in Section 8.2.3.

[220] SCE will continue to refine the In-Event PSPS Risk Comparison Tool based on real-time experience, additional data, and ongoing benchmarking with other IOUs. Estimates and assumptions described herein are based on risk models reflecting current industry best practices and are subject to being updated as the modeling improves.

Figure SCE 8-1

View of Commander IPEMS Dashboard



The comparative PSPS and wildfire risk estimates are based on the following circuit-specific criteria and information:

1. PSPS Risk: Customers served, estimated population, and the relative ranking of the circuits in scope by the percentage of AFN and NRCI customers.
2. Wildfire Risk: Wildfire simulations (using Technosylva FireCast[221] modeling) for potential ignitions based on dynamic, in-event weather and wind conditions in proximity to the circuits in scope for de-energization. These conditions are used to determine the extent of an estimated fire footprint (or fire shed). Within that fire shed, the risk of a wildfire is calculated based on the number of structures, population, and acres potentially threatened within the impacted area.

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[221] Technosylva is a suite of wildfire simulation models or tools. While relying on a similar underlying fire propagation engine, each model is designed to support a unique use case. FireCast is specifically designed to forecast ignition risk associated with electric utility assets over a 3-day horizon based on expected short-term weather conditions.

This information is used to calculate potential Safety, Financial, and Reliability impacts (or attributes) of: (1) a wildfire and (2) a proactive de-energization event, as summarized in the table below:

Table SCE 8-2

Risk and Consequences

Risk Attribute	Wildfire Consequences	PSPS Consequences
Safety	SCE calculates the estimated number of fatalities and serious injuries based on a forecast of impacted population within the Technosylva wildfire consequence simulation. This number, in turn, is converted into the Safety index.	SCE leverages epidemiological studies and information drawn from past widespread power outage events including the 2003 Northeast Blackout, the 2011 Southwest Blackout, and the IOUs' 2019 PSPS post-event reports.[222] The resulting estimates of fatalities and serious injuries per CMI are intended to approximate potential safety consequences due to the power outage, such as illnesses resulting from food spoilage or exacerbation of existing underlying health conditions. SCE enhanced the PSPS safety attribute through the application of a circuit-specific AFN/NRCI multiplier. This multiplier represents the relative ranking of each circuit based on the number of AFN and NRCI customers on the circuit.
Reliability	SCE assumes 24 hours without power per customer on each circuit in scope due to wildfire. This duration was used to maintain consistency with Technosylva 24-hour fire propagation simulation, as well as the PSPS impact duration.	SCE estimates the total CMI due to proactive de-energization on a circuit. It is the product of the number of customers on a circuit and the total number of minutes of estimated interruption. SCE assumes 1,440 CMI per customer (24 hours x 60 minutes) to represent de-energization over a 24-hour period.

[222] *See, e.g.,* Anderson, G.B., Bell, M.B (2012). Lights Out: Impact of the August 2003 Power Outage on Mortality in New York, NY, *Epidemiology* 23(2) 189-193. doi: 10.1097/EDE.0b013e318245c61c.

Risk Attribute	Wildfire Consequences	PSPS Consequences
Financial	SCE calculates the financial impact of wildfire by assigning a dollar value to the buildings and acres within the fire shed potentially threatened by wildfire. For buildings, SCE uses a system average replacement value assumption. For acres, SCE uses assumed costs of suppression and restoration.[223]	SCE conservatively assumes $250[224] per customer, per de-energization event to quantify potential financial losses for the purpose of comparing PSPS risk to wildfire risk. The figure represents potential customer losses, such as lost revenue/income, food spoilage, cost of alternative accommodations, and equipment/property damage. This value is based on a VoLL, which is a widely accepted industry methodology to estimate a customer's willingness to accept compensation for service interruption. VoLL is dependent on many factors, including the type of customer, the duration of the outage, the time of year, the number of interruptions a customer has experienced. SCE's VoLL estimate is consistent with academic and internal studies to estimate VoLL for a single-family residential customer for a 24-hour period.

SCE quantifies the resulting PSPS risks and wildfire risks using natural unit consequences for each risk type or attribute—structures impacted, acres burned, CMI, serious injuries and fatalities, etc. "Safety" risk is expressed as an index, "Reliability" risk is measured in terms of CMI, and "Financial" risk is measured in dollar amounts.

SCE then applies a MARS framework to convert these natural unit consequences to unitless risk scores—one score for PSPS risks and one score for wildfire risks.[225] These risk scores are compared to each other by dividing the wildfire risk score (i.e., the potential benefit of PSPS) by the PSPS risk score (i.e., the potential public harm of PSPS), yielding a benefit/risk ratio for each circuit in scope of the PSPS event. If the resulting ratio is equal to 1, the risks are equivalent. If the ratio is greater than one, the wildfire risk exceeds the PSPS risk (the higher the resulting number, the more the wildfire risk outweighs the PSPS risk). If the ratio is less than 1, the PSPS risk outweighs the wildfire risk.

[223] *See* SCE 2018 Risk Assessment Mitigation Phase (RAMP (I.18-11-006) Workpapers, Chapter 10.

[224] SCE utilizes $250 per customer, per de-energization event to approximate potential financial losses on average, recognizing that some customers may experience no financial impact, while other customers' losses may exceed $250. The $250 value is a conservative assumption used for the limited purpose of estimating the potential financial consequences of PSPS as one of many inputs into SCE's PSPS In-Event Risk Comparison Tool. It is not an acknowledgment that any given customer has or will incur losses in this amount, and SCE reserves the right to argue otherwise in litigation and other claim resolution contexts, as well as in CPUC regulatory proceedings.

[225] MARS is SCE's version of MAVF and is further described in Chapter 4.2.

Strategy to minimize public safety risk during high wildfire risk conditions

Strategy to minimize public safety risk during high wildfire risk conditions and details of the considerations, including but not limited to list and description of community assistance locations and services provided during a de-energization event.

SCE's WMP strategy is designed to prevent, combat and respond to the threat of wildfires and consists of the following four main pillars: (a) enhancing operational practices, (b) bolstering situational awareness, (c) hardening the grid, and (d) providing services during a de-energization event. Each of these wildfire mitigation focus areas include initiatives designed to minimize public safety risks during high wildfire risk conditions.

Table SCE 8-3

Strategies to Minimize Public Safety Risk

WMP Strategy	Description	WMP Reference
Enhancing operational practices	• Implementation of operating restrictions and PSPS protocols • Blocking reclosers to prevent automated reclosing devices from re-energizing circuits when conditions may be hazardous • FC settings reduce the fault energy to more quickly de-energize when a short circuit has been detected	7.3.3
Bolstering Situational Awareness	• Investing in tools, technologies, and practices to better forecast potential wildfire conditions and to be more effective in responding to fire events • A Situational Awareness Center that during emergencies and incidents is staffed around the clock with meteorologists and GIS professionals • Additional weather stations that provide real-time information about wind, temperature, and humidity to help SCE make decisions during potential fire conditions • Live fire-monitoring cameras to help IMTs and first responders more quickly assess and respond to reported fires • Development of 61 ML models, which leveraged new technology to double weather forecast resolution, and added new weather modeling capabilities to enhance forecast precision and accuracy. 500 more ML weather models planned in 2022. • Using a total of four super computers, two which were installed in 2021, will considerably increase the resolution and accuracy of its forecast capabilities • The creation of an incident commander dashboard has helped to aggregate all these crucial data	7.1

WMP Strategy	Description	WMP Reference
	points, allowing them to be presented in a data visualization viewer so that SCE's IMTs can make the most informed, up-to-date decisions	
Hardening the grid	• Installation of covered conductors that lower the probability of faults or short circuits that can lead to ignitions • FRP wraps that are more resilient than wood poles • Fast-acting fuses that can react more quickly to minimize fire risks	7.1
Providing services during de-energization events	• Education and Outreach • Notifications and Alerts • CRC/CCVs to provide services in impacted communities • Customer Resiliency Incentive and Rebate Programs • Connecting customers to transportation, shelf stable food, hot meal, and/or temporary shelter through 211 for customers with AFN requiring support	• 8.4.1 • 8.1.4 • 7.3.6

In 2021, SCE activated 50 CRCs and deployed CCVs 66 times in multiple counties (Mono, Inyo, Kern, Ventura, San Bernardino, Orange, Los Angeles, Santa Barbara and Riverside) in support of community members during PSPS events. Approximately 6,500 customers visited the CRCs and CCVs during PSPS events in May through December 2021.

As of the end of 2021, SCE had 62 contracted indoor CRC locations and eight mobile CCVs. To support customers in remote communities, SCE reached out to more than 15 sites to install transfer switches that enable back-up power connection during a PSPS event. Of the locations SCE reached out to, seven sites already had transfer switches or were planning to install their own resiliency, and two CRCs accepted SCE's offer to install a transfer switch (the Acton Community Center and the James A. Venable Community Center [also known as Family Service Association] in the city of Cabazon). SCE has completed transfer switch installation at these two locations.

In 2020, SCE created the Resiliency Zones Pilot, which funded the installation of Manual Transfer Switches at essential service locations in remote communities. In 2021, SCE completed six (6) Resiliency Zone project site installations and executed four additional contracts for a total of eight (8) Resiliency Zone sites. Project work on the site in Bridgeport will be completed in Q1 2022. These locations, listed below, are essential service sites such as gas stations, mini mart grocery stores, etc. SCE will deploy a backup generator to these locations during a PSPS event if necessary.

Table SCE 8-4

Resiliency Zones

Agua Dulce Hardware Sweetwater Bar & Grill Bullwinkel's Gifts/ Antiques	33310-33314 Agua Dulce Canyon Road Santa Clarita, CA 91390-4622	Los Angeles
Well Water for Hardware, Bar & Grill, Gifts	33246 Agua Dulce Road Santa Clarita, CA 91390-4622	Los Angeles
Peppertree Market & Gas Station	9661 Sierra Hwy Santa Clarita, CA 91390	Los Angeles
Cabazon Fuel Center	300 N Fern Street Cabazon, CA 92230-3231	Riverside
Lee Vining Chevron	51557 US 395 Lee Vining, CA 93541	Mono
Union 76 (formerly Shell)	3670 Main Street Mammoth Lakes, CA 93546	Mono
Chevron Gas Station & General Store	27750 Stallion Springs Dr. Tehachapi, CA 93561	Kern
Bridgeport General Store & Deli	242 Main Street Bridgeport, CA 93517	Mono

As described further below, beginning in 2021, CRC and CCV activations featured language translation services for live translation including American Sign Language for customers who arrive at centers who are unable to communicate in verbal English.

In December 2021, SCE received insulated medical bags for distribution at CRCs and CCVs to customers who have a need to keep medication cold.

SCE will continue to assess the need for additional contracted CRCs based on PSPS event history, grid hardening efforts, stakeholder feedback, and evolving needs. SCE has continued to reach out to tribal communities for interest in participating as CRCs and continues to collect customer feedback on CRCs through post-event surveys.

The following is a complete list of CRCs activated and CCVs deployed during the 2021 season:

Table SCE 8-5

2021 CRC Locations Activated by PSPS Event

Event Date	City	Location
18-Jan	Tehachapi	Bear Valley Police Dept. parking lot
18-Jan	Agua Dulce	Agua Dulce Women's Club parking lot
18-Jan	Idyllwild	Idyllwild Community Center
18-Jan	Simi Valley	Simi Valley Senior Center
19-Jan	Tehachapi	Bear Valley Police Dept. parking lot

19-Jan	Agua Dulce	Agua Dulce Women's Club parking lot
19-Jan	Idyllwild	Idyllwild Community Center
19-Jan	Simi Valley	Simi Valley Senior Center
20-Jan	Agua Dulce	Agua Dulce Women's Club parking lot
20-Jan	Simi Valley	Simi Valley Senior Center
21-Jan	Agua Dulce	Agua Dulce Women's Club parking lot
14-Jun	Goleta	Residence Inn Goleta
14-Jun	Santa Barbara	ILRC SB
15-Jun	Goleta	Residence Inn Goleta
15-Jun	Santa Barbara	ILRC SB
11-Oct	Simi Valley	Simi Valley Senior Center
12-Oct	Simi Valley	Simi Valley Senior Center
11-Oct	Fillmore	Fillmore Active Adult Community Center
12-Oct	Fillmore	Fillmore Active Adult Community Center
11-Oct	Acton	Acton Community Center
12-Oct	Acton	Acton Community Center
11-Oct	Stevenson Ranch	Residence Inn
12-Oct	Stevenson Ranch	Residence Inn
21-Nov	Beaumont	Holiday Inn Express & Suites
21-Nov	Fontana	Jessie Turner Community Center
21-Nov	Santa Paula	Santa Paula Community Center
22-Nov	Santa Paula	Santa Paula Community Center
21-Nov	Ventura	Ventura Beach Marriott
22-Nov	Ventura	Ventura Beach Marriott
24-Nov	Tehachapi	Bear Valley Police Dept.
25-Nov	Tehachapi	Bear Valley Police Dept.
24-Nov	Acton	Acton Community Center
25-Nov	Acton	Acton Community Center
26-Nov	Acton	Acton Community Center
24-Nov	Stevenson Ranch	Residence INN
24-Nov	San Fernando	San Fernando Community Center
25-Nov	San Fernando	San Fernando Community Center
26-Nov	San Fernando	San Fernando Community Center
24-Nov	San Jacinto	San Jacinto Community Ctr.
25-Nov	San Jacinto	San Jacinto Community Ctr.
26-Nov	San Jacinto	San Jacinto Community Ctr.
24-Nov	Cabazon	James A Venable Community Center
25-Nov	Cabazon	James A Venable Community Center
26-Nov	Cabazon	James A Venable Community Center
24-Nov	Fontana	Jessie Turner Community Center
25-Nov	Fontana	Jessie Turner Community Center
26-Nov	Fontana	Jessie Turner Community Center
24-Nov	Fillmore	Fillmore Active Adult & Community Center
25-Nov	Fillmore	Fillmore Active Adult & Community Center

26-Nov	Fillmore	Fillmore Active Adult & Community Center

Table SCE 8-6

2021 CCV Locations Dispatched by PSPS Event

Event Date	City	Location
14-Jan	Agua Dulce	Agua Dulce Women's Club parking lot
14-Jan	Chatsworth	Chatsworth Lake Church parking lot
14-Jan	Moorpark	Boys and Girls Club of Moorpark parking lot
15-Jan	Silverado	Library of the Canyons parking lot
15-Jan	Acton	Acton Community Center parking lot
15-Jan	Agua Dulce	Agua Dulce Women's Club parking lot
15-Jan	Chatsworth	Chatsworth Lake Church parking lot
15-Jan	Idyllwild	Idyllwild Community Center
15-Jan	San Bernardino	Cal State University San Bernardino parking lot D
15-Jan	Moorpark	Boys and Girls Club of Moorpark parking lot
16-Jan	Chatsworth	Chatsworth Lake Church parking lot
16-Jan	Silverado	Library of the Canyons parking lot
16-Jan	San Bernardino	Cal State University San Bernardino parking lot D
16-Jan	Moorpark	Boys and Girls Club of Moorpark parking lot
17-Jan	Silverado	Library of the Canyons parking lot
17-Jan	Chatsworth	Chatsworth Lake Church parking lot
17-Jan	San Bernardino	Cal State University San Bernardino parking lot D
17-Jan	Moorpark	Boys and Girls Club of Moorpark parking lot
18-Jan	Acton	Acton Community Center parking lot
18-Jan	Chatsworth	Chatsworth Lake Church parking lot
18-Jan	Silverado	Library of the Canyons parking lot
18-Jan	Calimesa	Calimesa City Hall parking lot
18-Jan	San Bernardino	Cal State University San Bernardino parking lot D
18-Jan	Fillmore	Fillmore Active Adult Community Center parking lot
19-Jan	La Canada	Mayor's Discovery Park
19-Jan	Acton	Acton Community Center parking lot
19-Jan	Chatsworth	Chatsworth Lake Church parking lot
19-Jan	Silverado	Library of the Canyons parking lot
19-Jan	Calimesa	Calimesa City Hall parking lot
19-Jan	San Bernardino	Cal State University San Bernardino parking lot D
19-Jan	Carpinteria	Carpinteria Middle School parking lot
19-Jan	Fillmore	Fillmore Active Adult Community Center parking lot
20-Jan	Acton	Acton Community Center parking lot
20-Jan	La Canada	Mayor's Discovery Park
20-Jan	Chatsworth	Chatsworth Lake Church parking lot
20-Jan	Santa Clarita	The Centre Pointe parking lot

Event Date	City	Location
20-Jan	Carpinteria	Carpinteria Middle School parking lot
20-Jan	Fillmore	Fillmore Active Adult Community Center parking lot
13-Apr	Bishop	Millpond Recreational Area
11-Oct	Calabasas	Calabasas City Hall
12-Oct	Calabasas	Calabasas City Hall
11-Oct	Frazier Park	Frazier Mountain Park
12-Oct	Frazier Park	Frazier Mountain Park
15-Oct	Simi Valley	Simi Valley Senior Center parking lot
21-Nov	Malibu	Michael Landon Community Center parking lot
21-Nov	Agua Dulce	Agua Dulce Women's Club parking lot
22-Nov	Agua Dulce	Agua Dulce Women's Club parking lot
21-Nov	Chatsworth	Chatsworth Lake Church parking lot
22-Nov	Chatsworth	Chatsworth Lake Church parking lot
21-Nov	Silverado	Library of the Canyons parking lot
21-Nov	Nuevo	Riverside County Fire Station #3 parking lot
21-Nov	Jurupa Valley	Centennial Park
25-Nov	Malibu	Bluffs Park
26-Nov	Malibu	Bluffs Park
24-Nov	Chatsworth	Chatsworth Lake Church parking lot
25-Nov	Chatsworth	Chatsworth Lake Church parking lot
26-Nov	Chatsworth	Chatsworth Lake Church parking lot
24-Nov	Silverado	Library of the Canyons parking lot
25-Nov	Silverado	Library of the Canyons parking lot
26-Nov	Silverado	Library of the Canyons parking lot
24-Nov	San Bernardino	CSUSB - Parking Lot D
25-Nov	San Bernardino	CSUSB - Parking Lot D
26-Nov	San Bernardino	CSUSB - Parking Lot D
24-Nov	Moorpark	Moorpark City Hall
25-Nov	Moorpark	Moorpark City Hall
26-Nov	Moorpark	Moorpark City Hall

8.1.2 Tactical and strategic decision-making protocol for initiating a PSPS/de-energization.

A description of SCE's tactical and strategic decision-making protocol for initiating a PSPS de-energization event, including a decision tree, is provided in Section 8.2.3 above.

8.1.3 Strategy for safe and effective re-energization

Strategy to provide for safe and effective re-energization of any area that was de-energized due to PSPS protocol.

After weather conditions resulting in elevated fire ignition risk have abated, SCE's IMT dispatches qualified personnel to perform restoration patrols on all circuits that experienced PSPS de-energization. While a circuit is de-energized, SCE does not get the same indicators of potential hazards that it might normally, therefore necessitating patrols prior to re-energization. For example, if a foreign object were to come into contact with a line while energized, SCE would see a fault on the system and would be alerted to the hazard. During a PSPS outage, SCE has diminished awareness of potential failure modes on a circuit, and thus must patrol the circuit to assess its condition and determine that it is safe to restore service. Failure to do so could result in an attempted re-energization that is unsafe or ineffective.

As discussed in Section 7.3.6.4, SCE has implemented procedures as required by the PSPS OIR Phase 1 and Phase 2 Decisions that electric service to circuits de-energized due to PSPS will be restored as soon as safely possible and within 24 hours whenever safely possible. Once dangerous weather conditions have abated and it is safe to do so, SCE restores service and reports to the Commission instances when it is unable to meet the 24-hour goal. In 2019 and 2020, the average time of restoration, measured from the time it is safe to begin the restoration process, was approximately six hours. In 2021, the average time of restoration, measured from the time it is safe to begin the restoration process, was approximately nine hours. We attribute this slower restoration time due to the larger and more complex Thanksgiving holiday PSPS event, which accounted for much of the PSPS event activity in the 2021 season. Many of the challenges faced during this event are now lessons learned, detailed above, with various learnings and remedies now in place or being developed ahead of the 2022 season.

8.1.4 Company standards relative to customer communications

Company standards relative to customer communications including consideration for the need to notify priority essential services – critical first responders, Public Safety Partners, critical facilities and infrastructure, operators of telecommunications infrastructure, and water utilities/agencies. This section, or an appendix to this section, shall include a complete listing of which entities the electrical corporation considers to be priority essential services. This section shall also include a description of strategy and protocols for providing timely notifications to customers, including AFN populations in the languages prevalent within the utility's service area.

SCE utilizes several communication channels for its customers, Public Safety Partners and other stakeholders regarding PSPS including: 1) PSPS event notifications to SCE customers, including Critical Infrastructure customers, and Public Safety Partners; 2) notifications to local jurisdictions, Local City/County/Tribal Officials, CAL FIRE, Cal OES, CCA Administrators, State and Federal Legislative District Offices, 211 Operators, Independent Living Centers, and other stakeholders with longer range emergency planning responsibilities 3) posting on the Public Safety Partner Portal for emergency providers and Critical Infrastructure customers; 4) SCE.com; social media outreach; and address-level alerts available to non-SCE-account holders for any address that could be impacted by PSPS. In addition, SCE engages in a suite of outreach activities, including community meetings (DEP-1.2), marketing campaign (DEP-1.3) and customer research and education (DEP-4), that are described in Section 7.3.10.1.

PSPS Event Notifications to SCE Customers and Other Stakeholders:

SCE provides PSPS event notifications pursuant to the PSPS guidelines provided by the Commission, as shown in the table below. SCE understands its stakeholders have different needs and require varying methods of alerts and notifications. For example, first responders, Public Safety Partners, and local governments require as much lead time as practical to begin contacting constituents and preparing to respond to potential de-energizations. To support this need, SCE provides priority notification to these agencies between 48 to 72 hours before a potential PSPS de-energization, if weather conditions can be predicted this far in advance. This information is also posted to sce.com at the 72-hour mark when possible. Additional alerts and warning update notifications are then made at 24-hour intervals with these agencies to maintain operational coordination. SCE sends initial alerts and warning messages to remaining customers up to 48 hours in advance of a potential PSPS event via their preferred method of communication (e.g., text, e-mail, voice call, and TTY). Notifications are then made to these customers in 24-hour intervals if there is updated information regarding the ongoing potential PSPS event. Notifications are offered in multiple languages as described in Section 8.4, below.

Table SCE 8-7

De-Energization Notification Requirements

Stakeholder	Initial Notification (Alert)	Update Notification (Alert)	Imminent Shut Down (Warning) [226]	De-Energized (Statement)	Preparing for Re-Energization (Statement) [227]	Re-Energized (Statement)	PSPS Averted (Statement)
First/ Emergency Responders/ Public Safety Partners, local governments, and tribal governments	72 hours before	48 & 24 hours before	1-4 hours before	When De-Energization is Authorized	When weather threat has receded and patrol and inspection is authorized	When Re-Energization Occurs	When circuits are no longer being considered for PSPS
Critical Infrastructure Providers	72 hours before	48 & 24 hours before	1-4 hours before	When De-Energization is Authorized	When weather threat has receded, and patrol and inspection is authorized	When Re-Energization Occurs	When circuits are no longer being considered for PSPS
Customers	48 hours before	24 hours before	1-4 hours before	When De-Energization Is Authorized	When weather threat has receded and patrol and inspection is authorized	When Re-Energization Occurs	When circuits are no longer being considered for PSPS
*SCE will target the schedule above to notify customers. Erratic or sudden onset of hazardous conditions that jeopardize public safety may impact SCE's ability to provide advanced notice to customers.							

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[226] SCE will make every attempt to notify customers of imminent de-energization at the 1- to 4-hour warning stage. Given the unpredictability of shifting weather during PSPS, implementation of this imminent notification timeframe may vary.

[227] SCE will attempt to notify customers before re-energization when possible.

SCE implemented the EONS in 2019 to execute high-volume targeted notifications within very short timeframes, enabling SCE to reach a large number of customers in areas potentially subject to PSPS. In 2019, SCE enhanced EONS' capabilities to expand in-language notifications based on customer preference including Spanish, Mandarin, Cantonese, Tagalog, Vietnamese and Korean. In 2021, SCE further enhanced the system to include information on customer language preferences in the Palantir system described above,[228] allowing for automated communications in the language of a customer's choice.

SCE also communicates with customers enrolled in SCE's MBL program and whose physician has indicated medical equipment is used for life support purposes prior to disconnection or service interruption, including using in-person notifications, if necessary. In 2021, SCE expanded the in-person notification service from critical care customers to customers enrolled in the MBL program and customers who self-certified as sensitive[229]. When SCE identifies that a PSPS notification has not been delivered to a MBL customer, SCE attempts to contact the customer. Undelivered alerts and notifications are sent to SCE's Consumer Affairs on-duty resources, who research the account and make further attempts to directly reach the customer to deliver the alert or warning message and todiscuss the customer's preparations for remaining resilient during the PSPS event. In circumstances where Consumer Affairs is unable to contact the MBL customers, SCE will send a representative to the customer's home to attempt to deliver an in-person notification. If the representative is unable to make contact with the customer directly at the home, they will leave a door hanger at the property asking the customer to call SCE at the phone number provided.

2021 PSPS Notifications Improvements:

In 2021, SCE initiated the PSPS IMT Process Automation & Customer Notifications project, which is focused on IT improvements in customer notifications (digital & process transformation), such as the automation of reports and customer notifications.

SCE engaged with customers to better understand how much information customers want, how frequently they want it, and the best way to message the notification content for clarity and transparency. This helped us understand the current-state customer notification experience and where we are falling short from the customer perspective, through both direct customer research and work with third-party communicationexperts. SCE mapped the customer experience from first notification through event all-clear, including thecadence, content, language, and delivery methods, and developed a plan for customer experience improvements. The plan included the re-design of the notification content and process.

SCE also evaluated the notification process to find ways to better adhere to timing and reporting guidelines for PSPS notifications. Through this evaluation, SCE identified opportunities to further integrate the workflows between our operational (grid-focused) team and our customer-facing (notification and communications) team. This resulted in a project to use Palantir's Foundry system to build automation

[228] This effort was completed in 2020 and was discussed as WMP Activity PSPS-1.4 De-energization notifications in SCE's 2020 WMP.

[229]Customers can self-certify as "Sensitive", meaning that they, or a member of their household, have a serious illness or condition that could become life-threatening if electricity is disconnected. Self-certify sensitive program is intended to capture customers that require in-person notification prior to disconnection for non-payment or that self-certify as having a person with a disability in the household. See D.19-05-042, p. A12-14; D.20-05-051, p. A-8. [E34]

into the process to better integrate PSPS, customer, and grid data, thereby eliminating most of the manual efforts and handoffs. Key process changes and automations were delivered in Dec 2021 that enable streamlined PSPS processes for forecasting scope and notifications. These capabilities and others such as Risk Analysis, Situational Awareness, and Post Event Reporting will continue to be enhanced through Palantir throughout 2022.

In addition, SCE also reviewed the language used in the PSPS notifications for (a) text messages, (b) voice messages, and (c) emails for each of the notifications provided to Public Safety Partners and customers. Based on feedback gathered, we re-wrote the various notification messages to improve clarity and comprehension. We tested these new messages and cadence via focus group meetings with residential and business customers. As of October 21, 2021, PSPS notifications to customers were available in 16 additional languages (Sixteen additional languages are: Khmer, Armenian, Farsi, Arabic, Japanese, Russian, Punjabi, Thai, Hmong, Portuguese, Hindi, French, German, Mixteco, Zapoteco, and Purapecha).

In 2021, SCE changed the cadence of notifications to customers on the monitored circuit list to factor in data from two consecutive weather reports. This adjustment allows SCE to use more accurate weather data to reduce false positive notifications.

In addition, SCE began sending de-energization notifications as soon as a de-energization decision has been made instead of waiting for confirmation that circuit or circuit segments have been de-energized. This change should help reduce missed and delayed notifications.

PSPS Event Notifications to Non-SCE Account Holders:

SCE has enhanced its PSPS event notification processes to provide the option for those who are not SCE account holders or customers of record to receive outage notifications. To do this, SCE uses address-level alert notifications and social media channels to communicate with people who may be visiting the area, are transient, are living in a sub-metered housing unit, or do not have other means to access notifications.

In 2019, SCE began participating in the Nextdoor platform, a neighborhood online forum to exchange helpful information, goods, and services. Nextdoor currently has 2.5 to 3.0 million verified users in SCE's service area that can be targeted by region, county, city, or neighborhood. Nextdoor is also used as a channel to reach populations who may not have access to other channels or forms of communications. In 2021, SCE enhanced its Nextdoor communications to further refine our targeting capabilities and enable PSPS notifications to deliver directly to the customers served by a specific circuit segment affected by a PSPS event.

As part of its PSPS Action Plan, SCE removed customers from ZIP code alerts if they were also enrolled in premise-level account alerts for a premise in the same ZIP code. The change will reduce duplicate and potentially conflicting notifications to customers previously enrolled in both alert types. SCE will continue the Nextdoor engagement in 2022 and continue to explore additional refinements.

SCE Website (SCE.com):

SCE has also improved its website to make wildfire and PSPS information readily available in multiple languages. In alignment with Commission direction, SCE's website, which contains three wildfire pages and four PSPS pages, now provides information in all prevalent languages beyond English.[230] SCE

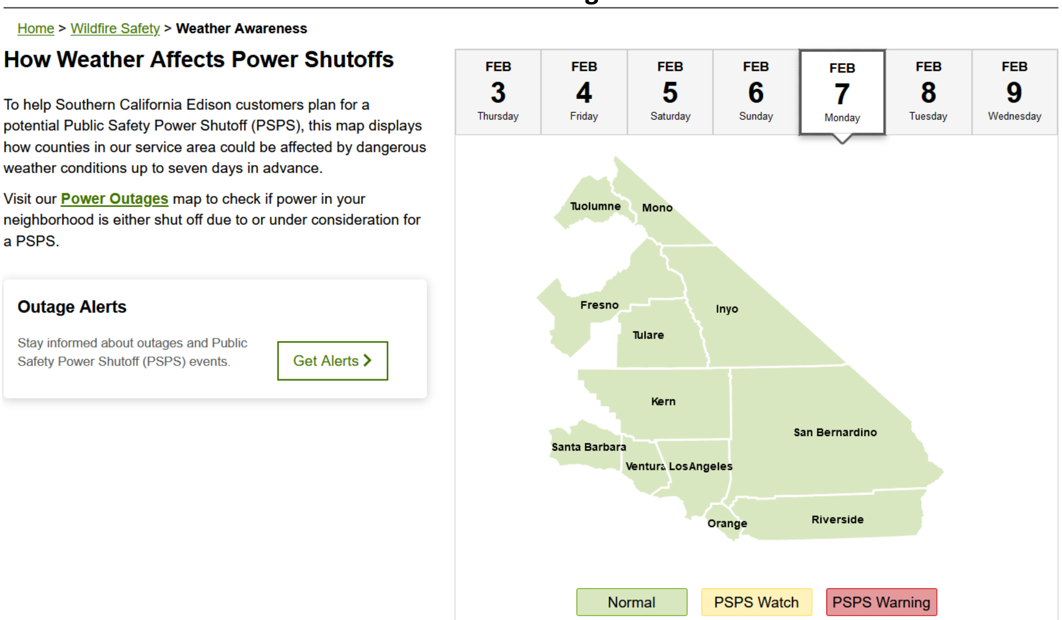
[230] Described in Section 8.4.2

implemented these changes in November 2020. SCE is also clearly articulating to customers the benefits and considerations to signing up for premise-level outage alerts. In addition, PSPS information will separately now be available to all customers on the website at the same time as it is provided to Public Safety Partners through the Portal.

SCE launched the Weather Awareness Map in November 2021 to help customers plan for potential PSPS events that may affect their electrical service. The map shows a seven-day forecast on how counties in SCE territory might be affected by weather conditions. This complies with D.21-06-034, Section H.1 [E33] of the appendix, which requires the presentation of a forecast. Figure SCE 8-2 provides a view of the Weather Awareness page.[231]

Figure SCE 8-2

Weather Awareness Page on SCE.com



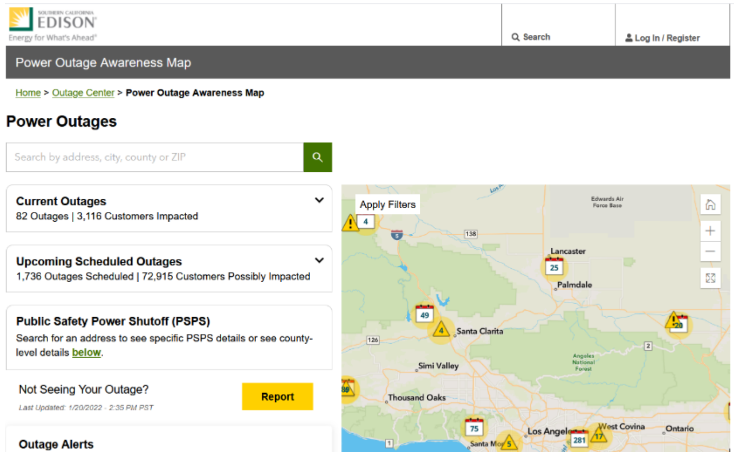
In 2021, a "Wildfire Communications Center" on SCE.com was launched to provide a repository of all the latest information customers may be interested in. For example, the latest HFRA newsletter in all languages described in Section 8.4.2 are available.

SCE has improved the outage look-up features on SCE.com to make it easier for customers to find the status of any type of event that may impact their electrical service. This addressed the previous inconvenience when customers had to check up to three different website pages (PSPS Events, Maintenance/Repair Outages, and CAISO Rotating Outages) to determine the cause and expected duration of an outage during PSPS events that coincide with other service interruptions.

[231] https://www.sce.com/wildfire/weather-awareness accessed on February 3, 2022.

Figure SCE 8-3

SCE.com Outage Center[232]



With the enhancements to the website, customers are able to enter an SCE service address and the website will display the status of any current or planned interruptions to their electrical service including an estimate for the end time for the Period of Concern and an estimated restoration time. This simple search-based service interruption look-up tool was launched at the beginning of the 2021 fire season. Phase 2 of the outage map improvements launched in January 2022 and expanded the capability and scope to consolidate the various map-based displays of service interruptions into a single solution to improve the experience for website visitors who need or prefer to see the information in a visual, area-wide format. Additional detail was added into the map-based display to improve customer understanding of active PSPS event conditions, EV charging locations and the ability to search CRC locations. Lastly, the website aims to better reflect realistic expected restoration times for each event.

Priority Notifications:

Per the PSPS Guidelines, certain entities are entitled to receive priority notifications (72 to 48 hours prior to de-energization) whenever feasible. The following critical facility and infrastructure entities receive priority notifications related to PSPS events:

Table SCE 8-8

List of Critical Facilities and Infrastructure

Critical Facilities/Infrastructure	
Government Facilities	***Chemical Sector***
Gov't agencies essential to national defense	Chemical Plants
Jails and Prisons	Chemical Distribution Centers

[232] https://www.sce.com/outage-center/check-outage-status

Schools	Chemical Storage Facilities
Communications Sector (Public Safety Partner)	***Paratransit***
Cellular Sites, Cellular Switches, Routers	Airports
Central Offices, Head end	CalTrans Operations Centers*
Radio and Television broadcasting stations	Mass Transit Stations
Remote Switches	Transportation Management Centers
Healthcare and Public Health Sector	***Emergency Services Sector***
Blood Banks	Emergency Dispatch Centers (per county request)
Dialysis Centers	Emergency Operations Centers
Hospice Facilities	Fire Stations (Federal/State/Local)
Hospitals	Food Banks
Nursing Homes	Police Stations (Federal/State/Local)
Public Health Departments	***Water and Wastewater Systems Sector (Public SafetyPartner)***
Skilled Nursing Facilities	Wastewater Treatment Plants, Pumping Stations,
Energy Sector	Lift Stations, Flood Control Gates, Well Sites,
Electric Cooperatives	
Inter-connected Publicly Owned Utilities	
Public and Private Utility Facilities	

8.1.5 Protocols for mitigating the public safety impacts

Protocols for mitigating the public safety impacts of these protocols, including impacts on first responders, health care facilities, operators of telecommunications infrastructure, and water utilities/agencies.

SCE fosters strong relationships with Emergency Management at the local and State level to effectively coordinate and manage emergency events, including PSPS events. Sections 7.1 and 7.2. discuss near and long-term strategy for emergency planning and preparedness, including improvements for response and information sharing. To continue to strengthen these relationships, SCE is working to improve engagement, help ensure timely and accurate data sharing, proactively and quickly address issues, and simplify information shared with local and State Emergency Management, first responders and Public Safety Partners during PSPS events. SCE is also establishing engagement metrics, performing surveys and in-person (or virtual) after-action reviews after PSPS events and sharing the results of these surveys with partners and the Commission to measure improvement.

Currently, local and tribal government officials, Public Safety Partners, and critical infrastructure managers can access outage and Period of Concern boundaries for HFRA circuits in SCE service area for planning purposes through SCE's Representational State Transfer (REST) Service.

Public Safety Partner Portal

SCE launched its new Public Safety Partner Portal in June 2021 to improve situational awareness during PSPS events for first responders and operators of critical facilities and communications systems. A new and refreshed site was published in December 2021 with additional functionality.

The portal is accessible to Public Safety Partners as defined by the CPUC. It features near real-time PSPS information not publicly available on sce.com. Data on the Portal is also fed through SCE's PSPS REST service, and feeds SCE.com. Subject to appropriate confidentiality measures, expanded information to enable better coordination of event response between SCE and Public Safety Partners is also provided. To gain access to the Portal, partners register, review a user agreement, and set up multi-factor authentication. The Portal is a single destination to find PSPS information for planning (pre-event), active PSPS event information during PSPS events, and access to an archive of event data published on the Portal post-PSPS events. SCE conducted a benchmarking review with PG&E to understand its experiences with a similar portal and leveraged these learnings to develop our requirements for the Portal. The Portal does not replace the existing PSPS REST service at this time.

Subscribers are able to access the following information on the Public Safety Partner Portal:

- Planning Information (Pre-Event): information for planning purposes when there is no active PSPS event. The information available will include:
  - PSPS planning interactive map (GIS layers, KMZ, Shapefile, PDF, File Geodatabase, GeoJSON)
    - Includes outage areas and impacted circuits
  - Planning Files
    - Outage areas and impacted circuits in various downloadable formats and API to allow integration with third-party systems
  - Planning Reports
    - Summary of potentially impacted customers
    - Critical facilities and identified MBL and critical care customers
    - Also available in various downloadable formats and API
  - PSPS Policies & Procedures
  - PSPS Sample Notifications
- Circuit to zip code mapping files
- Critical infrastructure partner contact information
- Event Information: information used to get active PSPS event information and certain archived PSPS event information. The information available will include:
  - PSPS event interactive map
    - Includes outage areas, impacted circuits with estimated restoration times, CRCs and CCVs
  - Event-specific files

    - Outage areas and impacted circuits in various downloadable formats and API to allow integration with third-party systems
  - Event-specific reports
    - Summary of impacted customers
    - Critical facilities and identified MBL and critical care customers
- Also available in various downloadable formats and API
  - Reports including situational awareness and data
  - Archive of certain information from inactive past events

SCE continues to assess additional functionalities for the Public Safety Partner Portal, including those suggested by partners. Updated functionality is communicated to partners through updates to the website, office hour meetings, and direct briefings with partners.

Backup Power

Because PSPS may disrupt electric services to critical electrical loads and essential customers, SCE may deploy temporary mobile generators for critical facilities to assist maintaining electric service for essential life safety and public services emergencies. These case-by-case decisions are made by the IMT in coordination with county emergency management offices, based on the unique circumstances associated with each event. SCE's supply chain organization performed a competitive solicitation for regional vendors who could support mobile generator deployment and keep a list of generator vendors assigned to different regions. SCE begins to assess emergency generator deployment once the PSPS IMT is activated and emergent public safety needs are identified.

8.2 DIRECTIONAL VISION FOR NECESSITY OF PSPS

Describe any lessons learned from PSPS since the last WMP submission and describe expectations for how the utility's PSPS program will evolve over the coming 1, 3, and 10 years. Be specific by including a description of the utility's protocols and thresholds for PSPS implementation. Include a quantitative description of the projected evolution over time of the circuits and numbers of customers that the utility expects will be impacted by any necessary PSPS events. The description of protocols must be sufficiently detailed and clear to enable a skilled operator to follow the same protocols.

When calculating anticipated PSPS, consider recent weather extremes, including peak weather conditions over the past 10 years as well as recent weather years, and how the utility's current PSPS protocols would have been applied to those years.

SCE has developed a robust infrastructure program aimed at hardening the grid to reduce wildfire risks associated with its electrical infrastructure and enhancing system resiliency. However, under extreme weather and fuel conditions, proactive de-energizations are necessary as a last resort to protect public safety. Decisions for PSPS events are based on a complex set of factors including weather, fuel conditions, electrical asset conditions, circuit configurations, and de-energization impacts to customers and communities. SCE initiates such de-energizations after the weather data, confirmed by SCE crews in the field when possible, shows that there is an imminent danger of fire. For example, SCE may initiate a de-energization in an area with abundant dry fuel due and high wind conditions because tree limbs, palm fronds or other objects blowing into power lines can cause sparks or ignitions.

As discussed in Sections 7.3.3 and Section 7.3.6, and the sections below, SCE has dedicated efforts to reduce the need for PSPS, manage PSPS events more effectively, and mitigate the impact of PSPS on our customers.

Once the proposed expedited grid hardening and circuit segment exception measures are implemented, the communities historically most impacted by PSPS events experience a reduction in the number of events, the duration of events, and the number of customers that experience these events.

8.2.1 Describe any lessons learned from PSPS since the utility's last WMP submission

As described above, SCE implemented numerous activities in 2021 as part of its Action Plan. As of January 2022, SCE has completed 131 of the 132 Action Plan activities and intends to complete the remaining item, to deploy a behind the meter energy storage system, enabling a microgrid at an elementary school, by March 31, 2022. In 2021, SCE provided bi-weekly updates on our progress to implement the PSPS Action Plan, followed by bi-weekly meetings with CPUC and Energy Safety staff where SCE provided an overview of the updates and key upcoming activities related to the PSPS Action Plan.

Figure SCE 8-4 below details SCE's progress towards completing the activities included in its Action Plan.

Figure SCE 8-4

PSPS Action Plan Categories & Status of Completion

	REDUCE THE NEED FOR PSPS	EXECUTE PSPS EFFECTIVELY	MITIGATE PSPS IMPACTS	INFORM PARTNERS & CUSTOMERS	IMPROVE POST-EVENT REPORTING
COMPLETE AS OF 1/31/22	**7 OF 7 ACTIVITIES**	**60 OF 60 ACTIVITIES**	**10 OF 11 ACTIVITIES**	**49 OF 49 ACTIVITIES**	**5 OF 5 ACTIVITIES**
	We installed **covered conductor, switching devices and weather stations** to accelerate **grid hardening** and improve the **resilience** of circuits most frequently impacted by PSPS, including equipment upgrades. These efforts in grid hardening resulted in reducing the scope, frequency and duration of PSPS.*		We expanded important customer programs like our **Critical Care Backup Battery** program to help customers through PSPS events. We made it easier for customers to enroll in our **Medical Baseline (MBL)** program and developed a webpage to provide resource information for our customers with **Access and Functional Needs (AFN).**	We launched our **Public Safety Partner Portal** and expanded our marketing efforts to promote our customer programs and services, as well as our Medical Baseline program. We hosted **over 100 virtual community meetings, Power Talks, and discussions,** events, and workshops to help communities prepare for PSPS.	We partnered with PG&E, SDG&E and the CPUC to **align on a common reporting format** to **improve the clarity and consistency** of PSPS post-event reporting. In addition, the PSPS OIR Phase 3 Decision helped inform the structure and content of the post-event reports.

In addition, following the PSPS events initiated in 2021, SCE continued to revise its processes and protocols to incorporate lessons learned during previous de-energizations and re-energization activities. SCE also conducted several table-top simulation exercises, and incorporated learnings from these activities into our PSPS processes. Table SCE 8-9 below provides key lessons learned and resulting actions taken from 2021 events:

Table SCE 8-9

Lessons Learned Following 2021 PSPS Events

Issue	Lesson Learned	Resulting Actions
Notification and Stakeholder Engagement	1. The large Thanksgiving event escalated rapidly and the focus on de-energizing partial circuits when possible added complexity. A new automation system to handle the complexity was not yet implemented across all workstreams. This complexity led to some delayed and missed customer and public safety partners notifications, and inconsistent reporting to state agencies. 2. Rapid increase in wind speed intensity during active events introduced notification challenges for circuits that were not initially forecast to reach de-energization thresholds, but ultimately needed to be de-energized.	1. SCE's expected adoption of fully integrated automated tools (Foundry system) across workstreams. Four of 12 use case have been completed as of January 2022. 2. In 2022, SCE will continue to refine its weather forecasting capabilities, developing approximately 500 additional ML technology (Artificial Intelligence) weather models to help improve estimations of wind speeds at specific locations where PSPS has occurred most frequently in prior wildfire seasons
Restoration Planning	After the Thanksgiving event, the Period of Concern for most circuits ended Thursday evening, but most restoration was not completed until Friday, including 9 circuits not approved for re-energization until completion of air operations.	We are examining and training on air operations protocols for timely inspections and reporting and will analyze whether some circuits could be patrolled sooner using foot patrols. We aim to have any enhancements in place before peak wildfire season 2022
Resource Availability	CRC and CCV deployment is designed based on the forecast. When an event scales quickly the number and location of CRCs and CCVs may need to be changed in event. The forecast volatility led to some logistical supply shortages at CRCs during the Thanksgiving event.	We are examining staff augmentation solutions and addressing gaps in logistics process for CRC/CCV supplies. We aim to have any enhancements in place before peak wildfire season 2022
Customer Engagement	1. There were anecdotal complaints about wait times on 211 referral service lines. 2. SCE's automated customer contact center Interactive Voice Response (IVR) messaging seemed to incorrectly suggest the call center was closed for during the Thanksgiving holiday event. 3. Notification language describing 3- to 8-hour "typical restoration time" did not account for slower overnight restoration or need for daylight patrols on certain hard-to-reach circuits	We reviewed average wait times across 211 networks and most were in the acceptable range. We will engage in further discussion with providers in 2022. SCE changed messaging protocol for IVR messages over holidays to clarify that the contact center is open 24/7 for outages and emergencies, including PSPS. SCE is evaluating how to provide customers more specific and accurate restoration times. We aim

Issue	Lesson Learned	Resulting Actions
		to have enhancements in place before peak wildfire season 2022.
Communication Cadence	Throughout 2021, we received feedback from stakeholders about the cadence of communications. We also recognize the need to continue to improve communication messaging, cadence and delivery methods.	We will be doing customer research with customers who experienced PSPS in 2021 to further refine content, if required. The automated processes we will be using in 2022 should improve the timeliness of notifications
Non-Notifications	To minimize potentially notifying customers who were not likely to be de-energized, SCE did not send pre-event notifications for covered conductor circuits unless the forecast was expected to meet or exceed the de-energization threshold. This process minimizes unnecessarily notifying customers who will not be de-energized if their circuits do not meet de-energization criteria. However, those customers could potentially need to be de-energized with no prior notification if actual wind speed conditions in the field rapidly exceed forecasted values.	We continue to assess options for striking the right balance between providing sufficient notice for customers to prepare for potential de-energizations with not unnecessarily notifying customers who are unlikely to be de-energized. These options include potentially adding a buffer to help account for forecast bias and minimize the need to de-energize customers with short or no notice.
Cell Phone Notification Access	In 2021, SCE shared that there are locations with poor cell phone access during PSPS events with telecommunication service providers to make them aware of our communication challenges.	SCE and the telecommunication partners continue to share information through PSPS working group meetings and the telecommunication service providers are assessing the information. SCE has committed to continue to share customer feedback with the telecommunication service providers if/when customers raise concerns. SCE is working with telecommunications providers to support their mandated resiliency efforts in cases of unplanned electrical service disruption.
Data Access	Access to situational awareness data was delayed during some 2021 events, which in some cases resulted in inconsistent notifications and reporting to public safety partners during external briefings.	The automation of core PSPS processes through the Foundry platform will reduce processing time ahead of potential 2022 PSPS events.
Data Granularity	In early 2021, Los Angeles County officials requested that SCE specify how many customers are on the circuit by segment impacted instead of the entire circuit as SCE had	We continue to explore IT solutions to enhance our Portal to address this.

Issue	Lesson Learned	Resulting Actions
	previously communicated and as was reported on the Partner Portal.	
Service to MBL Customers	SCE partners with Community-Based Organizations (CBOs) during PSPS events to provide support for MBL customers (including Critical Care) who may be de-energized. This coordination is mainly during regular business hours, however, it was determined after-hours services may need to be provided.	SCE coordinated with external community partners to identify after-hour contacts for addressing escalated support requests during events. SCE plans to develop a protocol to intake and triage requests received after business hours into the response structure when the liaison role is not activated into a night shift.
Improving Forecasting Models to Improve Communications	Consistent with public/external weather forecasts, SCE's weather models forecasted FPI values below PSPS thresholds because relative humidity levels were expected to be higher than actual observed humidity levels in the AOC on some event days. This difference in forecasted and observed weather models lead to de-energizations with little or no prior notification during this event.	SCE continues to refine its weather models to better inform customers of the potential for de-energization ahead of time. However, even as we improve our weather modeling capabilities, there may still be instances where sudden onset of unexpected weather will occur.

8.2.2 PSPS Expectations

Expectations for how the utility's PSPS program will evolve over the coming 1, 3, and 10 years

SCE's PSPS-related activities will evolve in terms of (1) grid hardening measures that will over time reduce reliance on PSPS and reduce the scale and duration of PSPS events when they are necessary, (2) measures that will reduce the impact of a PSPS event on customers, including those customers who are most vulnerable to a power shutoff as well as those customers who provide vital services to society, and (3) operational protocols and stakeholder engagement before, during, and after events.

PSPS Expectations in the Coming Year

Refinements to Wind Speed Thresholds

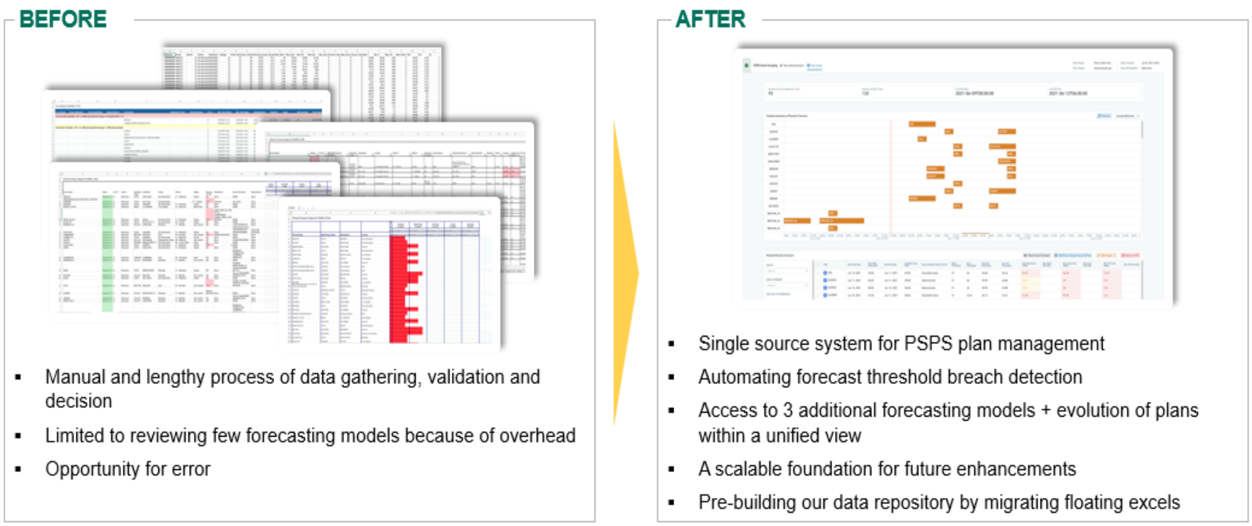
In 2022, SCE will continue to assess refinements to its current PSPS wind speed thresholds for covered conductor circuits to more directly account for how wind impacts the outage behavior of circuits subject to PSPS events, and its condition-based risk-informed model to establish thresholds. Specifically, we will integrate outage data to align wind speeds with outage behavior, and separately will improve fire spread modeling to improve scoping and de-scoping of PSPS circuits. Assuming final verification and successful side-by-side testing of the new methodology with SCE's current algorithm, SCE will gradually integrate this new data model into its PSPS decision-making process.

Improvements to Data Management and Customer Notifications

SCE is improving its data management processes by developing a PSPS Centralized Data Platform intended to enable data-driven decisions and optimized operational outcomes. Using the Foundry system by Palantir, SCE initiated a proof of concept in early May 2021. The proof of concept focused on two use cases in wildfire risk management that were selected to address critical needs for the fire season and evaluate Foundry's capabilities. Four use cases were initiated after the completion of the proof of concept to deliver a core set of capabilities for the PSPS Team in 2021. The first use case aimed to improve and automate PSPS capabilities for PSPS scoping and initial weather forecasting, allow incident management teams to collaborate more efficiently in a single tool, and increase accuracy, transparency, and ease of auditability of activities. The single platform and developed workflow automation creates a sustainable process that is scalable to event size and be enhanced quickly through the addition of forecast models to improve accuracy over time.

Figure SCE 8-5

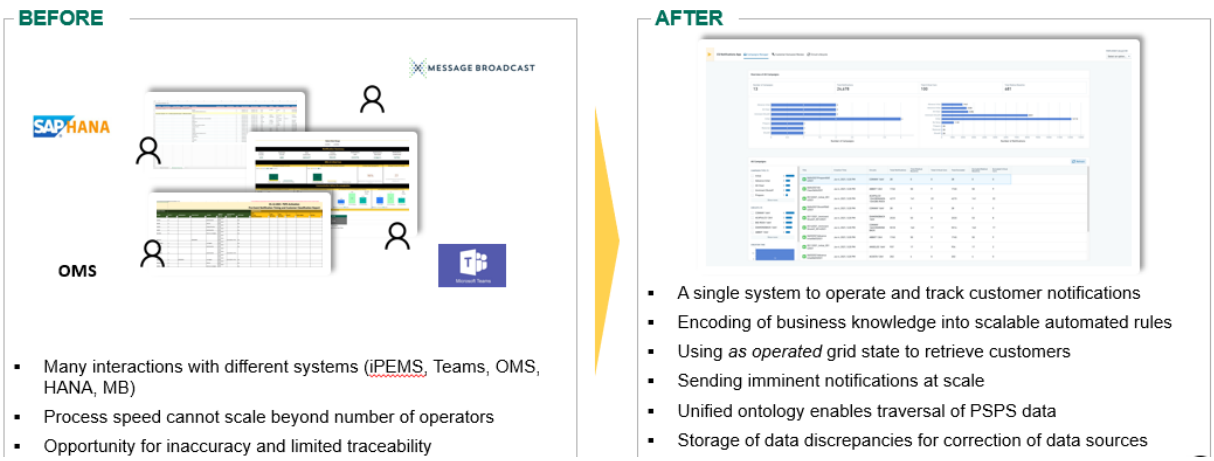
Use Case 1: Integrated PSPS Plan Management



The second use case is a customer notification application that was designed to replace the existing notification workflow. This new application enables automated and assisted creation of notifications campaigns to our customers during PSPS operations. This includes pre-event notifications to critical infrastructure customers and all other customers and in-event notifications such as imminent, de-energization and re-energization notifications. Automated notification was enabled through the creation of several system-to-system integrations including Integrated PSPS Event Management System (IPEMS) and OMS. This application also includes features to manage our customer notification escalation process designed to ensure that our most critical customers (Medical Baseline, Critical Care, and Self-Certified Sensitive) receive notifications throughout PSPS events. This application also includes features to actively retains communication records for post event analysis and reporting.

Figure SCE 8-6

Use Case 2: Improving Customer Notifications



The third use case was a notification application for Liaison Officers, who communicate directly with state agencies and city/county government offices during PSPS events. This new application enables automated and assisted creation of notification campaigns to our public safety partners and local city/county governments during PSPS operations. This includes pre-event notifications delivered twice daily and in-event notifications such as imminent de-energization and re-energization notifications. Automated notification was enabled through the creation of several system-to-system integrations including IPEMS, OMS, and Everbridge. This application also includes features to manage these notifications throughout a PSPS event and actively retains communication records for post event analysis and reporting.

The fourth use case was the development of a data pipeline designed to meet the requirements for downstream systems such as IPEMS and SCE.com. This new pipeline eliminates the manual processing and transfer of information through developed system-to-system integration and automated file delivery. This use case assists creation of files and data elements required as inputs to display data such as circuit customer counts and profiles, summary city/county data, and assists in the rendering of outage polygons for the SCE.com outage maps that are updated during PSPS event as actions are completed.

The progress and improvements yielded by the new system will increase SCE's operational effectiveness across SCE's PSPS operations. SCE will continue to expand the use of the Palantir Foundry platform for PSPS in 2022, covering additional use cases for post-event reporting, In-Event PSPS Risk Comparison Tool, and event situational awareness, among other enhancements. This additional work in 2022 will enable an end-to-end design of PSPS event management and event data management using a single point and integrated platform for PSPS.

<u>**Improvements to PSPS Forecasting**</u>

Advancements in the granularity of PSPS forecasting will allow for greater utilization of SCE's targeted mitigations and isolatable segments, allowing for potentially smaller PSPS events. SCE will also make every effort to expedite restoration of de-energized circuits when it is safe to do so. As discussed below, SCE is adding new technology including additional computing capacity, by adding two new supercomputers in

2021, enabling new and increased ML models. These will improve and increase weather forecast resolution and add new weather modeling capabilities to enhance forecast precision and accuracy. These improvements contributed to the reduction of PSPS as described below. The Foundry system, discussed above, will increase refinement of our weather forecasting capabilities, developing approximately 500 additional ML technology (AI) weather models to help improve estimations of wind speeds at specific locations where PSPS has occurred most frequently in prior wildfire seasons.

Enhanced Customer Care and Outreach

In 2022, SCE is expanding our customer care portfolio to better support individuals with AFN by providing backup power, on loan, during a PSPS activation. SCE will supplement the current CCBB program offering with an in-event battery loan Pilot. This pilot will allow customers with AFN to escalate the need for backup power for use with a medical device or assistive technology for independence, health, or safety. Section 7.3.6.6.2 provides additional details about these activities.

In addition, SCE has significantly increased its marketing efforts to inform customers about SCE's customer care programs and resiliency options. Specifically, for the CCBB program, SCE utilizes direct mail, phone calls, email, door knocking, and digital channels (sce.com, social media, etc.) to increase awareness about the program. SCE is also working with CBOs and other agencies to continue to increase awareness about the program and will include CBOs as a stakeholder in the new in-event battery loan Pilot. Additionally, SCE will continue to identify newly eligible customers each month and will outreach to customers to enroll them into the program.

SCE is also re-evaluating our communication and customer/agency notifications processes to address specific concerns and feedback from local government partners, and are collaborating with frequently impacted communities for education, outreach, and critical infrastructure planning support to help other entities providing critical services be more resilient as well. The variance between customer notifications sent and actual number of customers de-energized reflects, in part, SCE's commitment to de-energize as few customers as possible while protecting public safety and adhering to notification requirements. SCE makes the final decision to de-energize based on real-time weather conditions, not forecasts, and after it takes all available mitigation steps such as switching load to other non-impacted circuits. However, SCE recognizes the importance of continuing to improve customer notifications, and we are working to refine the granularity of our weather forecasting to narrow the gap between notifications and de-energizations and improve the clarity and accuracy of our notification processes. SCE made significant changes in its notifications process as part of its PSPS Action Plan, including improved messages, revised notification cadence, and other process and technology improvements. These changes are discussed in Section 8.2.4.

PSPS Expectations in Next Three Years

Over the next three years, SCE will continue to make advancements in the granularity and flexibility of decision-making through additional grid sectionalization and automation, and improve circuit resiliency, primarily through expanding the network of overhead covered conductor, in addition to other grid hardening initiatives. As described in its response to the 2021 WMP Progress Report Item SCE-21-06 in Section 7.1.2.1, at the end of 2021, SCE underwent a comprehensive and granular risk analysis to better understand wildfire mitigation deployment going forward, including covered conductor, undergrounding, and REFCL. The analysis considered the potential consequence of an ignition at each circuit-segment within SCE's HFRA. SCE determined which initiatives and combinations of initiatives are potential viable mitigations for a segment, based on factors such as risk drivers, mitigation effectiveness and cost, and potential consequences. The analysis also considered circuits that have been frequently impacted by PSPS events and prioritized the work to help reduce the need for PSPS. SCE's implementation of the resulting integrated grid hardening strategy will significantly reduce PSPS events for communities as the HFRA segments of their circuits are upgraded fully with undergrounding, covered conductor, REFCL, and/or other measures.

PSPS Expectations in Next Ten Years

In ten years, the portfolio of SCE's planned PSPS mitigation work, including targeted undergrounding for highest risk areas, will likely be completed and the majority of PSPS events should be limited to cases of fire danger where wind speeds reach extreme levels and threaten infrastructure damage. Figure SCE 8-7, below, provides a glimpse of the potential order of magnitude for these kinds of events. Additionally, activities like circuit undergrounding can lower the risk profiles of certain HFRA circuits and/or communities enough so that they can be completely removed from PSPS scope. The main unknown in the medium- to long-term future of PSPS is the impact of climate change and its effects on local wind and vegetation conditions.

8.2.3 Description of the utility's protocols and thresholds for PSPS implementation

SCE utilizes pro-active de-energization as a measure of last resort when all other alternatives to de-energization have been exhausted. Typically, ahead of the period of concern when fire weather that could potentially impact the SCE service territory is forecasted, SCE performs mitigations to minimize customer impacts, including enacting operating restrictions,[233] implementing FC settings,[234] and performing switching operations where possible on circuits in scope for potential de-energization. SCE also pre-patrols circuits in scope and deploys field personnel to circuits at risk to monitor real-time weather and FPI data. Once in the period of concern, SCE employs PSPS as a last resort measure only when it is necessary to protect public safety and there are no other available alternatives to mitigate identified wildfire risk. SCE only de-energizes those circuits and/or circuit segments where event-specific thresholds and de-energization triggers are being exceeded after exhausting all other alternatives.

SCE's PSPS decisions are based on quantitative analyses while accounting for qualitative factors such as the impacts to emergency services. SCE uses preset thresholds for dangerous wind conditions that create increased fire potential (including wind speeds, humidity, fuel moisture levels and other factors as the basis for PSPS decision-making, as described in SCE's technical paper).[235] These thresholds are set for each of the circuits in SCE-designated HFRAs and are continuously reviewed to estimate the risk of significant events against the potential for harm to customers from the loss of power.

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[233] SCE's System Operating Bulletin No. 322 includes restrictions to limit the potential for a spark to occur or mitigate the risk of an ignition such as limits to circuit switching, recloser operations, and requirements for personnel to be physically present when operating equipment and circuits subject to hot work restrictions.

[234] FC settings reduce fault energy by increasing the speed with which a protective relay reacts to most fault currents. FC settings can reduce heating, arcing, and sparking for many faults compared to conventional protection equipment settings. More details are in SCE's 2021 Wildfire Mitigation Plan Update (Revised), WMP Activity SH-6.

[235] SCE's detailed technical paper, Quantitative and Qualitative Factors for PSPS Decision-Making, can be found at https://energized.edison.com/psps-decision-making

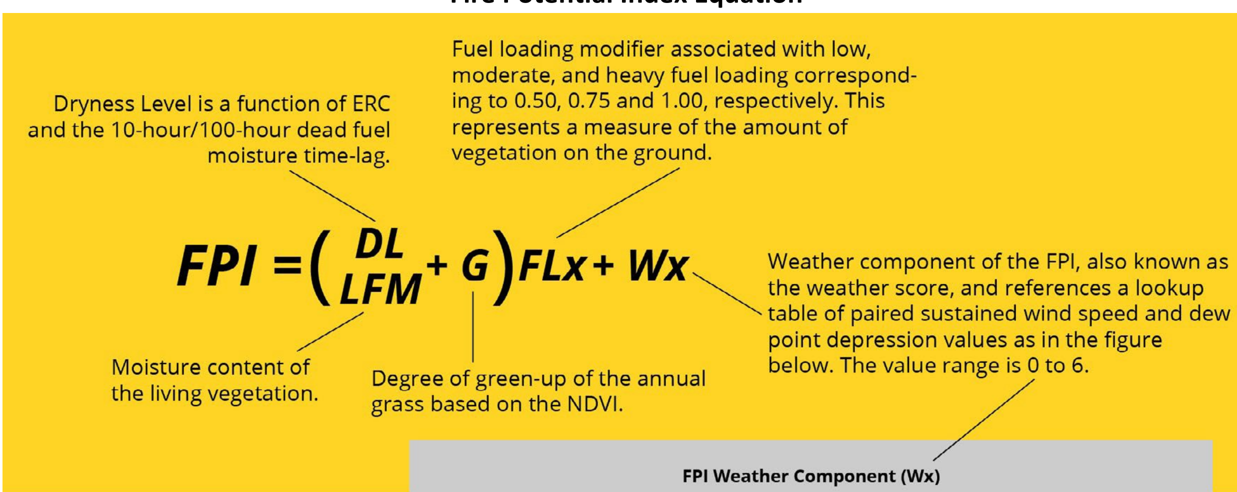
All circuits have an activation threshold, defined by the FPI and the wind speed at which they are considered at risk. Activation thresholds are computed for each circuit for the season.

FPI is calculated using the following inputs:

- Wind speed—Sustained wind velocity at six meters above ground level.
- Dew point depression—The dryness of the air as represented by the difference between air temperature and dew point temperature at two meters above ground level.
- Energy release component (ERC)—As defined by the U.S. Department of Agriculture: "The available energy (BTU) per unit area (square foot) within the flaming front at the head of a fire … reflects the contribution of all live and dead fuels to potential fire intensity."
- 10-hour dead fuel moisture—A measure of the amount of moisture in ¼-inch diameter dead fuels, such as small twigs and sticks.
- 100-hour dead fuel moisture—A measure of the amount of moisture in 1- to 3-inch diameter dead fuels, i.e., dead, woody material such as small branches.
- Live fuel moisture—A measure of the amount of moisture in living vegetation.
- Normalized Difference Vegetation Index (NDVI)— As defined by the U.S. Department of the Interior: "… used to quantify vegetation greenness and is useful in understanding vegetation density and assessing changes in plant health."

Figure SCE 8-7

Fire Potential Index Equation



FPI Weather Component (Wx)

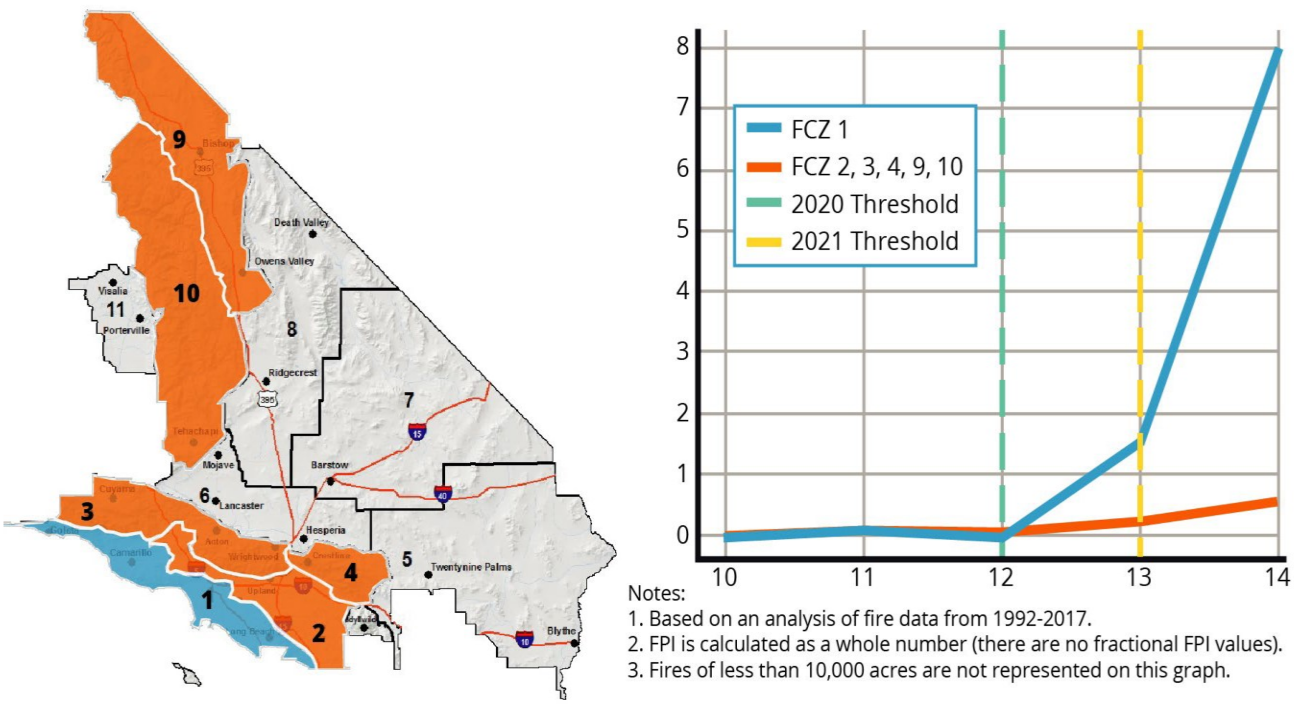
Dew Point Depression	Wind Speed (mph) <=5	6-10	11-16	17-22	23-28	>=29
>=50	2	3	3	4	5	6
40-49	2	2	3	3	4	5
30-39	1	2	2	3	3	4
20-29	1	1	2	2	3	3
10-19	0	0	1	1	1	1
<10	0	0	0	0	0	0

Previously, SCE set the activation threshold at the FPI of 12. Starting September 1, 2021, SCE changed the FPI to 13 for most areas and most events based on a risk analysis of historical fire data. Exceptions in which the FPI threshold will continue to be set at 12 include:

- FCZ1 (Coastal region) — The threshold for FCZ1 remains at 12 because probability calculations indicated a significantly higher ignition risk factor at an FPI threshold of 13 for this FCZ than for the other FCZs (2, 3, 4, 9, and 10).
- Geographic Area Coordination Center (GACC) preparedness level of 4 or 5 — The GACC coordinates multiple federal and state agencies to track and manage regional fire resources. It provides a daily fire preparedness level on a score of 1-5. A high score signals that there could be resource issues in responding to a fire.
- Circuits located in an active Fire Science Area of Concern (AOC) — AOCs are areas within FCZs that are at high risk for fire with significant community impact. This designation is based on factors that are common to FPI as well as egress, fire history, and fire consequence.

Figure SCE 8-8

Probability of Wind-Driven Fires at 10,000 Acres at FPI 12 and 13



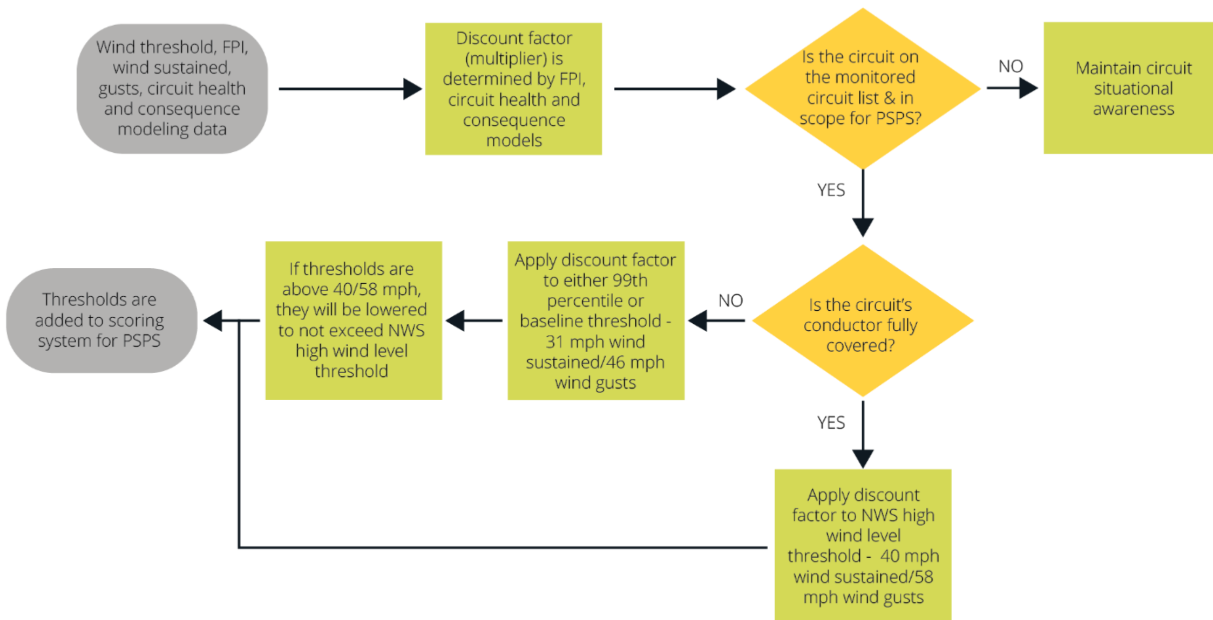
For each PSPS event, every circuit also has a de-energization threshold. De-energization thresholds are determined separately for each circuit to prioritize circuits for de-energization based on the specific risks of the event. This is particularly important for large events where many circuits must be evaluated simultaneously. There are a handful of circuits that have legacy thresholds below the NWS advisory level because they have a history of local circuit outages at lower wind speeds.

De-energization thresholds account for circuit health, including any issues identified through patrols, and are also informed by a consequence score for each specific HFRA. The consequence score estimates the impact of an ignition on communities. The higher the score, the greater the risk to a particular location from wildfires. The method for calculating this score is described in detail in Section 8.1.1.

SCE's process for determining de-energization thresholds is outlined below.

Figure SCE 8-9

PSPS Decision-Making Flowchart/Diagram



If actual conditions suggest more risk, or in large-scale events when many circuits are under consideration for shutoffs, the de-energization thresholds may be lowered (discounted), meaning power on a circuit will be turned off at lower wind speeds. This step prioritizes the circuits that represent the highest risk to be evaluated for de-energization before circuits at lower risk. Conversely, de-energization thresholds are raised for segments or circuits that have had covered conductor installed. The de-energization threshold for segments with covered conductor is 40 mph sustained/58 mph gusts, which aligns with the NWS HWW level for windspeeds at which infrastructure damage may occur.

Once SCE's in-house meteorologists confirm forecasts show an upcoming breach of FPI and circuit-specific wind speed thresholds, SCE activates its PSPS IMT and begins preparations for the upcoming event. Whether remotely due to the COVID-19 pandemic, or in-person at SCE's Emergency Operation Center, the IMT begins notifying affected parties. Notifications are sent to First Responders, Public Safety Partners, local governments, tribal governments and critical infrastructure providers approximately 72 hours prior to de-energization, followed by notifications to all other customers approximately 48 hours prior to de-energization. We continue to provide additional notifications as well as notifications of imminent de-energization as information becomes available during the PSPS events (discussed in Section 8.2.4), develop event- and circuit-specific de-energization triggers and direct resources to perform pre-patrols of all circuits in scope.

SCE also takes proactive measures to reduce the likelihood and impact of the pre-emptive de-energization of a transmission line. Due to the unique operating characteristics, transmission line outages have the potential to cause significant impacts to public safety and electric system reliability. To address these factors, SCE implemented PSPS protocols for transmission lines that traverse HFRAs. These operating protocols have been created to gauge the reliability risks associated with the pre-emptive de-energization of transmission lines including, analyzing forecasted fireweather conditions, identification of hazardous field conditions, application of risk evaluation models to analyze various operational scenarios, and the development of mitigation plans to address such events.

The protocols are designed to prevent testing of transmission lines when live field monitoring is taking place on a distribution line that is within one mile of a transmission line. When a distribution line is being monitored in the field due to extreme weather conditions, SCE performs a geospatial analysis to determine if there are transmission lines that run parallel to or cross over the distribution line being monitored. When a transmission line is within the one-mile boundary of the monitored distribution line, the transmission line has operating restrictions placed into effect to prevent a test if the transmission line was to relay. If the transmission line relayed, it would require a patrol of the HFRA to ensure the line is safe, prior to being re-energized.

8.2.4 Customers Impacted by PSPS

Quantitative description of how the circuits and numbers of customers SCE expects will be impacted by any necessary PSPS events is expected to evolve over time.

As submitted in the 2021 WMP update, SCE expected to yield significant reduction to the scope, frequency, and duration, assuming the same weather and fuels as 2020.

Table SCE 8-10

2021 Anticipated PSPS Reductions

Scope	Frequency	Duration
↓ 30%+	↓ 25%+	↓ 50%+

This forecast was assembled using a bottoms-up estimation of the 2020 outages that would be avoided or shortened had the mitigation been in place. An analysis of completed mitigations in 2021 confirms that SCE did in fact execute PSPS mitigations equivalent to or exceeding its projections made in 2020.

SCE’s 2021 PSPS season, which ran from April to November, necessitated far fewer customer and circuit de-energizations, partially due to targeted PSPS mitigations and partially due to differences in weather and fuels. This yielded a drastic reduction in the overall CMI.

Table SCE 8-11

2021 PSPS Season Impacts Compared to 2020 Season[236]

Scope (Customers De-energized)	Frequency (Customers De-energized)	Duration (CMI)
↓ 76%	↓ 75%	↓ 73%

Much of this reduction was driven by SCE’s proactive PSPS mitigations. Principal among these mitigations was the expedited grid hardening performed on 72 of SCE’s FICs. This work included the installation of about 685 miles of covered conductor, 25 new automated switches, including 17 automation devices and eight isolation devices, approving 96 circuit exceptions to raise PSPS thresholds or eliminate them altogether, and providing mobile generators to keep the power on at some locations during PSPS events. SCE also raised FPI thresholds from 12 to 13 in all of its Fire Climate Zones except one.

SCE recognizes the impacts of PSPS on customers and is committed to programmatic improvements targeted at reducing the need for de-energizations. In 2022, SCE anticipates the following PSPS reductions, assuming the average weather and fuels conditions from the 2019 to 2021 period.

Table SCE 8-12

2022 Anticipated PSPS Reductions

Scope	Frequency	Duration
↓ 25%	↓ 14%	↓ 17%

These anticipated benefits are driven by targeted grid hardening plans for 2022. SCE plans to scope or accelerate more than 150 miles of covered conductor scope, along with numerous other prescriptive mitigations (e.g., circuit exceptions, RCSs, weather stations) for 42 targeted circuits that have yet to undergo accelerated hardening. In parallel, SCE will continue to refine its PSPS risk modeling capabilities and understanding of local weather and asset conditions to potentially modify certain FPI and wind speed thresholds, where appropriate and safe to do so. To the extent higher thresholds are adopted, we would expect further reductions to PSPS impacts beyond those forecast above.

Despite the progress made to date and additional progress to be completed this year, PSPS will have to remain available as a tool of last resort to protect the safety of our customers and communities. Extreme wind speeds, paired with fuels that are susceptible to fire propagation, may continue to necessitate proactive de-energization of certain isolatable circuit segments to help ensure public safety.

Table 8-1 provides SCE's estimates about the use of PSPS protocols and specific impacts to the public over the coming decade. Forecasts in this table will be affected by any changes to Tier 2 and Tier 3 HFRA

[236] SCE's January 2021 PSPS event is considered to be a part of the 2020 season as it was driven by 2020 weather and fuels and managed with 2020 tools and capabilities

boundaries, population and load growth, the effects of climate change on fire weather in SCE's service area, and other emergent factors that could occur over this time period.

Anticipated characteristics of PSPS use over next 10 years

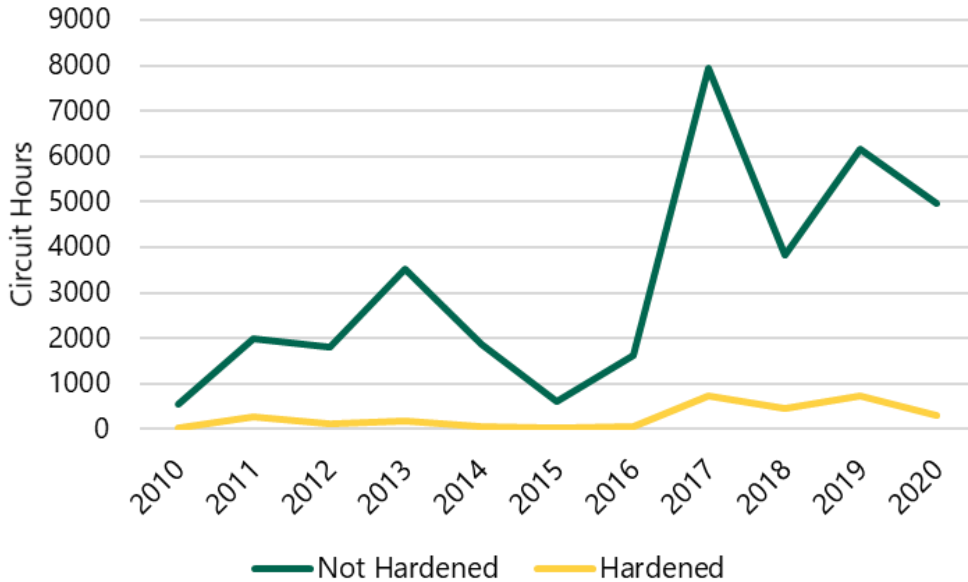
Rank order, from highest (1 – greatest anticipated change in reliability or impact on ignition probability or estimated wildfire consequence over the next 10 years) to lowest (9 - minimal change or impact, next 10 years), the characteristics of PSPS events (e.g., numbers of customers affected, frequency, scope, and duration), regardless of if the change is an increase or a decrease. To the right of the ranked magnitude of impact, indicate whether the impact would be a significant increase in reliability, a moderate increase in reliability, limited or no impact, a moderate decrease in reliability, or a significant decrease in reliability. For each characteristic, include comments describing the expected change and expected impact, using quantitative estimates wherever possible.

Figure SCE 8-10 demonstrates the potential of extensive grid hardening to increase PSPS de-energization thresholds, via an HFRA backcast analysis from 2010 - 2020. SCE has calculated the average annual exceedance of several control points as shown below. The green line represents non-hardened control point thresholds, which are typically set around 31 mph sustained winds or 46 mph gusts for bare conductor circuits and 12 FPI without risk modeling improvements. By comparison, hardened thresholds are set much higher, typically around 40 mph sustained winds or 58 mph gusts for full covered conductor circuits and 13 FPI where risk modeling improvements are warranted. These changes are ongoing, and circuits with these raised thresholds are expected to breach far less frequently, as seen in yellow.

The average windspeed exceedance for a fully hardened grid (i.e., circuits with full installation of covered conductor and 40/58 mph thresholds) is less than 10% that of bare conductor average thresholds. Notwithstanding the potential impacts of climate change and extreme weather events (such as the extreme wind events from the 2021 Thanksgiving event, which saw wind gusts as high as 89 mph) on future PSPS de-energizations, these data provide convincing support that grid hardening can have significant PSPS benefits. SCE considers those benefits as it plans to further harden the grid pursuant to the strategy laid out in Section 7.1.2.1.

Figure SCE 8-10

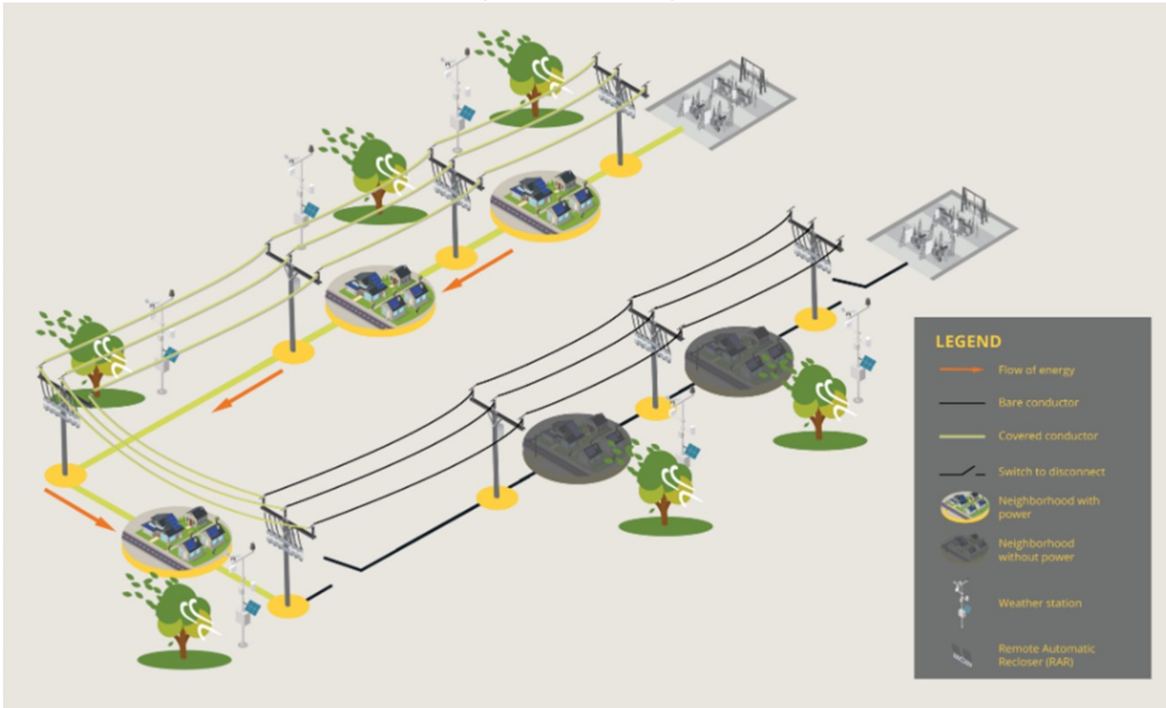
Annual Circuit Hours Exceeding Control Points by Circuit Condition



In 2021, SCE operationalized circuit segment level de-energization triggers where covered conductor was fully installed on an isolatable portion of a circuit (an "isolatable segment"), even if other segments of a circuit still contained bare overhead conductor. As shown in Figure SCE 8-11, below, areas with covered conductor can be allowed to remain powered during high winds, and areas with bare conductor could be isolated for de-energization. This approach demonstrates a more granular operational capability and allows for higher windspeed thresholds for those isolatable segments, meaning that these segments would be de-energized later into a PSPS event, if at all.

Figure SCE 8-11

Benefit of Grid Hardening and Circuit Segment Isolation



As a result of the activities described above, Table 8-1, below, provides the anticipated characteristics of PSPS over the next 10 years, rank-ordered from highest anticipated changes. SCE has leveraged its 2022 PSPS forecast reductions to inform this table.

Table 8-1

Anticipated characteristics of PSPS use over next 10 years

Rank order 1-9	PSPS Characteristics	Significantly increase;increase; no change; decrease; significantly decrease[237]	Comments
2	Number of customers affected by PSPS events (total)	Significantly Decrease	SCE's grid hardening efforts (e.g., covered conductor, targeted undergrounding and sectionalization devices) will allow for higher thresholds and shorter and fewer de-energizations, where possible

[237] Assuming an average PSPS year using 2019-2021.

Rank order 1-9	PSPS Characteristics	Significantly increase;increase; no change; decrease; significantly decrease[237]	Comments
1	Number of customers affected by PSPS events (normalized by fire weather, e.g., Red Flag Warning line mile days)	Significantly Decrease	Higher reductions expected than the metric above when normalized.
4	Frequency of PSPS events in number of instances where utility operating protocol requires de-energization of a circuit or portion thereof to reduce ignition probability (total)	Significantly Decrease	10 years of grid hardening will raise thresholds on the majority of PSPS circuits, meaning de-energization will be necessary less often
3	Frequency of PSPS events in number of instances where utility operating protocol requires de-energization of a circuit or portion thereof to reduce ignition probability (normalized by fire weather, e.g., Red Flag Warning line mile days)	Significantly Decrease	Higher reductions expected than Metric 4 when normalized.
8	Scope of PSPS events in circuit-events, measured in number of events multiplied by number of circuits targeted for de-energization (total)	Significantly Decrease	While extreme weather still puts fully covered conductor circuits in scope for PSPS, their higher thresholds should make this less frequent
7	Scope of PSPS events in circuit-events, measured in number of events multiplied by number of circuits targeted for de-energization (normalized by fire weather, e.g., Red Flag Warning line mile days)	Significantly Decrease	Higher reductions expected than metric #8 above when normalized.
6	Duration of PSPS events in customer hours (total)	Significantly Decrease	As SCE continues to harden the grid, PSPS events should become less frequent and shorter on average.
5	Duration of PSPS events in customer hours (normalized by	Significantly Decrease	Higher reductions expected thanmetric

Rank order 1-9	PSPS Characteristics	Significantly increase;increase; no change; decrease; significantly decrease[237]	Comments
	fire weather, e.g., Red Flag Warning line mile days)		#6 above when normalized.
9	Other (Describe) – Rank as 9 and leave other columns blank if no other characteristics associated with PSPS		

8.3 PROJECTED CHANGES TO PSPS IMPACT

Describe utility-wide plan to reduce scale, scope and frequency of PSPS for each of the following time periods, highlighting changes since the prior WMP report and including key program targets used to track progress over time,

1. By June 1 of current year
2. By September 1 of current year
3. By next WMP submission

For a more detailed description of SCE's commitment to reductions in the scale, scope, and frequency of PSPS events in 2022, please see Section 8.2.2 above. Based on current program projections, SCE plans to take the following actions in the noted timeframes to achieve the expected reduction in the scale, scope and frequency of PSPS events.

1. By June 1 of current year

During the first half of 2022, SCE will have completed the assessment of existing circuit plans to identify any improvements that can be made based on 2021 experiences, including the significant PSPS event that was initiated in late November 2021. Circuit mitigation plans identify ways to avoid de-energization of a specific circuit or isolatable circuit-segment by evaluating all relevant mitigations (e.g., covered conductor, sectionalizing devices, backup power) and accelerating those mitigations that provide the most potential PSPS reduction, wherepossible.

SCE will also develop and deliver appropriate training and facilitate exercises for dedicated and pooled IMT positions so that all new and existing protocols can be reviewed. Details on IMT training are discussed in Section 7.3.9.1

2. By September 1 of current year

As circuit mitigation plans are being executed, SCE expects to complete its risk modeling assessments of PSPS thresholds. SCE will evaluate historical outage and wildfire data to determine if wind speed and FPI threshold increases are appropriate.

As described in Section 8.2.2, SCE plans to perform analysis and validation to continue automating the PSPS event forecasting tools. Assuming final verification and successful side-by-side testing of the new model against SCE's current algorithm, SCE will integrate this new data model into its Foundry situational awareness tool.

3. By next WMP Submission

In the longer term, SCE plans to continue enhancing its forecasting and modeling for PSPS events. This includes robust ensemble forecasting, additional ML models, and improved FPI inputs. Upgrading the forecasting and modeling will help SCE be more precise on executing a PSPS event. SCE is also continuing to evaluate recent PSPS events and new methodologies to identify areas for additional grid hardening to further reduce the scope, scale and frequency of PSPS going forward.

Though not directly related to reducing PSPS scope, scale or frequency, SCE has undertaken additional activities for community engagement. SCE will also conduct its annual stakeholder and community engagement meetings, providing PSPS and wildfire mitigation updates. Some of these meetings will takeplace with specific communities and elected officials, offering detailed plans for FICs in their areas. These meetings will help inform the IMT's communications redesign to address concerns with counties, conduct end-to-end process mapping and further improve/automate notifications protocols.

SCE will evaluate its portfolio of customer care options and will consider changes based on customer feedback. Additional details on customer care programs are described in Section 7.3.6.6.2.

Finally, SCE will continue to evaluate ways to further reduce the impacts of PSPS to our customers through continued development of its Integrated Grid Hardening Strategy, as discussed in Section 7.1.2.1.

8.4 ENGAGING VULNERABLE COMMUNITIES

Report on the following:

1. Describe protocols for PSPS that are intended to mitigate the public safety impacts of PSPS on vulnerable, marginalized and/or at-risk communities. Describe how the utility is identifying these communities.

2. List all languages which are "prevalent" in utility's territory. A language is prevalent if it is spoken by 1,000 or more persons in the utility's territory or if it is spoken by 5% or more of the population within a "public safety answering point" in the utility territory[238] *(D.20-03-004).*[E36]

3. List all languages for which public outreach material is available, in written or oral form.

4. Detail the community outreach efforts for PSPS and wildfire-related outreach. Include efforts to reach all languages prevalent in utility territory.

8.4.1 Vulnerable Communities

Describe protocols for PSPS that are intended to mitigate the public safety impacts of PSPS on vulnerable, marginalized and/or at-risk communities. Describe how the utility is identifying these communities.

As part of its PSPS Action Plan, SCE discussed several specific areas of focus in 2022 to help ensure that its customers with AFN[239] are prepared for PSPS events and enroll in programs intended to support them during such events. These areas of focus include expanded outreach and marketing for its programs, increased research on populations with AFN, and an enhanced online AFN customer experience.

Outreach and Education:

To mitigate the impacts of PSPS events on individuals with AFN, SCE has developed a comprehensive communications strategy focusing onoutreach, education and awareness in advance of emergencies. Communications are designed to emphasize the importance of building personal resilience so that customers, including individuals with AFN, are prepared and remain safe when any power outage or other emergency occurs. Messaging focuses on communicating what to do during emergencies, what to expect, and the resources available following emergencies. SCE's messaging is developed for all types of emergencies, including PSPS de-energizations and other types of power outages.

SCE's plan includes outreach and education through various channels, including direct mail, social media, digital awareness, dedicated web pages and trained resources that provide direct support to customers, which helps to address the diverse needs of its customers. Additionally, SCE partners with CBOs and trusted agency partners to help amplify education and awareness about these important topics for our

[238] See Cal. Government Code § 53112

[239] The Commission has defined AFN populations as: "individuals who have developmental or intellectual disabilities, physical disabilities, chronic conditions, injuries, limited English proficiency, or who are non-English speaking, older adults, children, people living in institutionalized settings, or those who are low income, homeless, or transportation disadvantaged, including, but not limited to, those who are dependent on public transit or those who are pregnant." D.19-05-042, pp. A6-A7.[E35]

customers. These strategies are discussed in greater detail in Section 7.3.10 and can also be found in SCE's AFN Plan, which was submitted on January 31, 2022.[240]

As part of its PSPS Action Plan, SCE has increased its marketing, education, and outreach to enroll qualifying customers into appropriate programs and services, such as SCE's MBL program. The increased marketing includes advertisements in English and other languages using a variety of channels, including digital banners, digital video, connected TV, social media, digital audio and broadcast radio. In addition to this overall marketing campaign, SCE is working to promote meaningful and relevant programs that offer benefits, incentives, and services to its customers with AFN. SCE will promote these programs throughout the year using campaigns dedicated to individual programs. Communications that include highlights about available programs are sent to customers to raise awareness and direct them to channels, such as sce.com and SCE's customer contact center, where they can learn more about the programs. In 2021, SCE is more than tripling the dedicated marketing budget to increase MBL program enrollments.

SCE launched its expanded marketing and outreach for the MBL program in March 2021 and delivered an email campaign to approximately 420,000 customers with the highest likelihood of eligibility and need for the MBL program. In April 2021, SCE promoted the MBL program to 1,600 community-based organizations through SCE's CBO newsletter. In addition, SCE rolled out digital banner ads in English as well as in Spanish, Chinese, Korean, Vietnamese, and Tagalog in April 2021. SCE also created and deployed new ads promoting MBL through digital banners and print ads.

SCE has launched a dedicated web page where customers can self-certify as sensitive,[241] enroll in customer programs, and update their contact information.

SCE also delivered an emailable PDF with MBL information and links for the three IOUs in eleven languages, which the Department of Social Services' IHSS division placed on its website and distributed to 74 of its contacts across 58 counties for use with their customers. An SCE MBL article was placed in July in a Hospital Association of So Cal (HASC) newsletter distributed to 8,500 medical, staff and administrators.

PSPS Notifications and Alerts

SCE's overall PSPS notification and alert strategy is described above in Section 8.1.4. In addition, SCE employs a number of different channels to alert and notify specific at-risk customer groups about PSPS events. Since 2020, SCE has a dedicated position in its PSPS IMT that is responsible for effectively supporting the needs of customers with AFN during PSPS events. SCE ensures advanced PSPS notifications are sent to community partners such as CBOs, 211 and other trusted agencies statewide as PSPS events unfold. Community partners are engaged before, during and following events in the development and execution of customer care plans that help address the needs ofcustomers with AFN impacted by the events. SCE's IMT facilitates requests made through Public Safety Partners or other agencies seeking support for customers with AFN.

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[240] See Southern California Edison's AFN 2022 Plan for Public Safety Power Shutoff Pursuant to Commission Decision in Phase Two of R.18-12-005: Go to www.sce.com/regulatory/CPUC-Open-Proceedings; Click "View and Search all CPUC Documents"; Click "Proceeding #" column header; Click "Filter By", type "R.18-12- 005" into the Search box, and "Apply".

[241] Households with one or more individuals who have self-certified that they have a serious illness or condition that could become life threatening if their electric or gas service is disconnected for nonpayment receive an in-person visit.

In 2021, SCE began engaging CBOs during activations to brief them on PSPS activities and coordinate discrete customer issues. For example, there were approximately 10 escalations where customers required additional support during events; in these instances, SCE worked with CBOs to fulfill those customer needs (e.g., medical devices or food needs).

To better support customers with AFN during PSPS events, SCE works closely with other agencies and partners to raise awareness, share information and support resource planning to aid these populations. For example, when possible SCE provides three-day advanced notification to its Public Safety Partners, including county/tribal governments and first responders, upon activation of its IMT. Advanced notification helps these agencies prepare to respond to potential de-energization and community needs and begin contacting constituents. Upon request during PSPS events, SCE shares information about customers enrolled in the MBL program who may be affected by the PSPS event with representatives from county offices of emergency management to aid them in executing their own plans to assist customers with AFN.

Community Resources During De-Energization

Section 7.3.6.6.2.1 describes SCE's use of CRCs and CCVs to serve people affected by PSPS events.

Although CRCs and CCVs are intended to serve all customers, not just communities with AFN customers, SCE considers individuals with AFN when contracting CRCs and enhancing capabilities. All contracted CRCs must meet Americans with Disabilities Act requirements. Six of SCE's CRCs are located at ILCs, which are facilities specifically serving the needs of individuals with AFN. This partnership enables SCE to leverage the expertise and pre-established relationships that these ILCs have with the communities in addressing diverse AFN needs. CRCs and CCVs also serve individuals with AFN by enabling charging of medical devices and providing insulated thermal bags for medication that needs refrigeration. Some CRCs have refrigeration available for temporary storage of medication. Moreover, to serve customers for whom spoken English is not their primary language, SCE also offers real-time translation service for over 120 languages including American Sign Language. Customers may also update their contact information and enroll in SCE programs, including income-qualified programs, MBL program and outage alerts at CRCs and CCVs. In response to the COVID-19 pandemic, some features may not always be available as SCE tailors its CRCs to comply with state and local social distancing requirements.

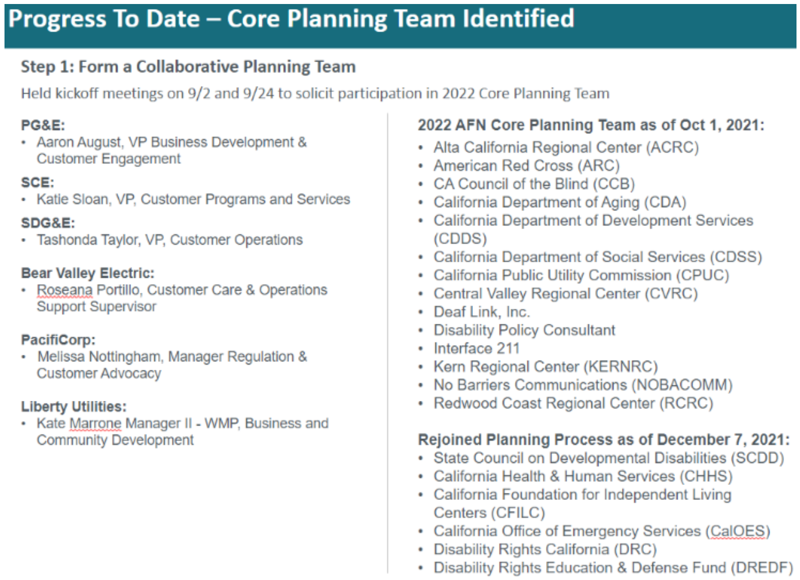
AFN Advisory Council

SCE co-launched the California statewide AFN Advisory Council with other IOUs in 2020 to raise greater awareness of the needs of our AFN populations and to collaborate on initiatives that will advance communications, resources and support for these populations, all aimed at PSPS impact mitigation. The AFN Council is comprised of more than 40 statewide agencies representing various AFN communities and stakeholders such as the Cal OES Director of AFN, members of the CPUC, and advocacy groups to advance new concepts and initiatives to support our vulnerable populations.

In 2021, SCE offered the opportunity for these groups to participate in our 2022 planning process. The following was presented on December 10, 2021, to provide the CPUC an update as to the parties and stakeholders involved in the planning process.

Figure SCE 8-12

December 10, 2021 Core Planning Team



SCE remains committed to building upon the expertise within the AFN Advisory Council and further opportunities to serve its AFN populations. In the Joint IOU Statewide AFN Advisory Council held in April 2021, the Council discussed how SCE, PG&E, and 211 can work together to create a statewide 211 service, building further on the 211 engagement that SDG&E initiated earlier in 2020. The IOUs are also working with the Department of Social Services to develop a communications plan to promote program communications with IHSS, which serves approximately 600,000 clients. Additionally, the IOUs are collaborating with IHSS, Regional Centers and Medicare. Collectively, we collected aggregated data at a ZIP code level of constituents that rely on electricity. The IOUs also captures MBL recipient's information which was aggregated by ZIP code to better understand the geographic representation of customers with AFN at the ZIP code level. SCE looks forward to welcoming new participants to the process in 2022.

Process Improvements

SCE developed the capability for MBL applicants to use DocuSign for physician e-signatures required for MBL application enrollment, building off of the form being available online in 2020. Allowing for DocuSign should reduce barriers for customer enrollment.

In 2021, SCE expanded some of its customer care programs targeted toward customers with AFN. For example, SCE expanded the eligibility requirements for the CCBB program to all customers enrolled in SCE's MBL who are also enrolled in CARE/FERA and reside in HFRA. The expansion of this program increased eligibility from 2,641 to over 13,000 customers. To further assist AFN customers that utilize a medical device or assistive technology for independence, health, or safety, in 2022, SCE will supplement the CCBB offering with a pilot to provide in-event support to customers that escalate a need for SCE to accommodate the provision of temporary power for a medical device or assistive technology during a PSPS event. Customers eligible to participate in the Pilot are those who would not otherwise be eligible to receive a free portable backup battery through the CCBB program. Through this pilot, the CCBB will loan, on a temporary basis, a portable backup battery to customers that reside in SCE's HFRA. The customers must provide proof of a medical device or assistive technology that supports independence, health, or safety, and are notified of the potential for de-energization as part of a PSPS event. Dedicated battery deployment contractors will deploy a portable back up battery to qualifying customers prior to a PSPS de-energization, will provide the customer with an overview of the safe operation of the portable backup battery, and will arrange to retrieve the battery from the customer once the PSPS event concludes. Further information can be found in Section 7.3.6.6.2. We also expanded the portable generator $500 rebate to include eligibility of MBL enrolled customers and removed electric well pump dependency for water supply as a requirement in 2021.

AFN Research

In 2021, SCE completed a qualitative AFN Research study that included both SCE customers and CBOs that serve AFN communities to gain a deeper understanding of their needs to help us identify the right solutions and support efforts necessary to serve this diverse and vulnerable population during PSPS events. The core research question was, "How can SCE enhance their services to better service and support AFN customers before, during, and after PSPS events?"

The completed research will influence customer care plans and future programs to address any gaps in resiliency capabilities for AFN customers so that as PSPS events unfold, this population will have emergency plans in place that enable them to remain resilient. This research will provide for greater integration between the vulnerable populations and our customer programs designed to meet their needs.

In July 2021, SCE conducted customer research via in-depth interviews with identified 20 AFN customers as well as 11 CBO representatives (i.e., 211s, ILCs and Area Agency of Aging (AAA)) to:

- Understand which AFN customers need to be as prepared as possible in the event of a PSPS outage.
- Determine AFN customer expectations of SCE before, during, and after a PSPS outage.
- Understand how SCE might collaborate with AFN CBOs to better serve AFN customers during PSPS events

Insights gleaned from these interviews include:

- Though AFN customers are adaptable and resilient in the face of power shutoffs, PSPS events can be costly and disruptive. While PSPS knowledge and planning varies widely, those customers who have been previously de-energized and customers who use electrically powered medical devices are typically most prepared for emergencies.
- Across all AFN interviews, a lack of education and resources creates gaps in PSPS preparation and general emergency readiness. Overall, customers have learned to get by during PSPS de-energizations using their own preparedness plans and using SCE communications for updates.
- However, AFN customers are largely unaware of SCE's other support programs and CBOs that could provide them assistance.
- The goal of CBOs during emergencies is to support the needs of their AFN constituents, both with internal resources and in collaboration with other organizations. A main area of future collaborative interest revolves around information sharing—while CBOs are successful at meeting the needs of AFN individuals already in their database, they

recognize that there are customers likely falling through the cracks. Because of this, CBOs are open to strengthened communication and collaboration with SCE to identify and fill support gaps through information sharing and other measures.

This research identified gaps and opportunities for SCE in 2022, including:

- Education: Knowledge gaps exist among AFN customers around why PSPS events occur, how they should better prepare for PSPS events, and what support measures exist.
- Resourcing: Providing AFN customers with backup power and replacement food supplies emerged as a critical need. Additionally, informing AFN customers about the various programs and services that are available and relevant to them (e.g., SCE programs and services, CBO support, SCE's recent 211 partnership) will provide them with the necessary tools to withstand PSPS events.
- Communication: Timely and relevant communications is key for AFN customers surrounding PSPS.
- Collaboration: Increased collaboration with trusted sources (e.g., CBOs and fire departments) will be instrumental in better preparing AFN customers for PSPS events.

SCE incorporated these findings and recommendations in its SCE's 2022 AFN plan filing on January 31, 2022.

Identification of Vulnerable Populations

To identify vulnerable populations, SCE leverages internal customer enrollment data from customer programs and services, in addition to demographic designations SCE has on record that match an AFN definition, such as income qualified programs (CARE or FERA), MBL, including life-support (Critical Care), customers who receive their utility bill in an alternate format (e.g., Braille; large font), customers who have identified their preferred language as a language other than English, older adults, and those that self-certify as having a medical condition that could become life-threatening if service is disconnected.

SCE also leverages external data through Acxiom, to account for AFN designations that are not represented in SCE's systems.

SCE performed an analysis to identify the percentage of the SCE customer base that meets the definition of AFN in D.19-05-042. Based on data gathered from SCE's internal systems and programs, and through external research with Acxiom, SCE estimates that approximately 80% of its customer accounts would identify with at least one AFN category. SCE actively identifies customers as AFN that directly interface with SCE's customer programs and services.[242] For the remainder, SCE enlists the help of a third-party vendor to obtain information about population characteristics in order to help refine its outreach and engagement to AFN populations.

Using data on customer characteristics, such as current customer program participation, energy usage, demographic, psychographic information, and operational data, SCE developed a model to estimate MBL propensity scores to each SCE service account based on predicted probability of enrollment for over 1 million residential customers. SCE targeted communications to the customers with the highest probability of enrollment.

[242] More information about how SCE tracks AFN populations may be found in the Calculation of Key Metrics, Chapter 4.4 under AFN Population.

SCE will use this data in 2022 to increase our campaigns to identify and assist MBL customers.

SCE also delivered an emailable PDF with MBL information and links for the three IOUs in eleven languages, which the Department of Social Services' IHSS division placed on its website and distributed to 74 of its contacts across 58 counties for use with their customers. An SCE MBL article was placed in July in a Hospital Association of So Cal (HASC) newsletter distributed to 8,500 medical, staff and administrators.

8.4.2 Prevalent Languages

List all languages which are "prevalent" in utility's territory. A language is prevalent if it is spoken by 1,000or more persons in the utility's territory or if it is spoken by 5% or more of the population within a "public safety answering point" in the utility territory (D.20-03-004).

SCE continues to be compliant with this requirement. Advice Letter 4215-E was filed on May 15, 2020 identifies the following "prevalent" and indigenous languages (in addition to English) prevalent in its service area:

Prevalent Languages:

1. Arabic
2. Armenian
3. Cantonese[243]
4. Farsi
5. French
6. German
7. Japanese
8. Khmer
9. Korean
10. Mandarin
11. Punjabi
12. Russian
13. Spanish
14. Tagalog
15. Vietnamese

A subsequent ALJ Ruling issued in August 2020 ordered SCE to also treat four additional languages as "prevalent" within our service area:[244]

16. Portuguese
17. Hindi
18. Hmong

[243] Cantonese and Mandarin refer to dialects of the spoken word. SCE uses Traditional Chinese for these speakers thus has 18 written "prevalent" languages.

[244] *See* August 21, 2020 Administrative Law Judge's Ruling Regarding Compliance Filings Submitted In Response to Decision 20-03-004[E29] Related to In-Language Outreach Before, During And After a Wildfire And Surveys Of Effectiveness of Outreach, OP 1, p. 6.

19. Thai

While not considered "prevalent" languages, D.20-03-004[E29] ordered electrical utilities to also conduct community awareness and public outreach in languages spoken by indigenous communities that have significant roles in California's agricultural economy regardless of prevalence. SCE has identified three Indigenous (Spoken) Languages within our service area:[245]

1. Mixteco
2. Zapoteco
3. Purepecha

8.4.3 Languages for Public Outreach Material

List all languages for which public outreach material is available, in written or oral form.

SCE conducted wildfire-related community awareness and public outreach in all languages prevalent in our service area along with the three indigenous languages. In 2021, SCE continued to promote wildfire and resiliency awareness in the prevalent languages through several channels, including direct mail, web-based messaging, community meetings, digital media, and radio. SCE also worked to reach and administer pre- and post-wildfire season surveys in the preferred language of the survey participants.

SCE conducted digital and radio campaigns targeting customers in its HFRA and in languages that are prevalent, to the extent available. To conduct customer outreach and community awareness in the prevalent languages, SCE launched its Wildfire Communications Center (referred to in the 2021 AFN Plan as "Multicultural Communications Resource Library"), which serves as a centralized hub for customers to find wildfire-related outreach in all prevalent languages. Most notably, SCE's Wildfire Communications Center provides non-English speaking customers access to all versions of radio, website, social media, digital ads, print collateral, email, direct mail, call center, notification texts, recorded messages, and emergency alerts created in all languages (beyond English) that are prevalent in its service area. SCE enlisted a third-party vendor to integrate its translation technology and AI capability into SCE's website, sce.com, so that the applicable webpages are accessible to customers in the prevalent languages.[246]

In 2021, SCE continued a mass media campaign to educate customers about emergency preparedness, urging them to sign up for outage alerts and provide information about the critical wildfire mitigation work that SCE is undertaking, as well as programs and services offered to vulnerable customers (e.g., MBL) and customers impacted by wildfire. These ads took place in the following media/languages:

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[245] D.20-03-004[E29], OP 1, p. 37.

[246] SCE's wildfire and PSPS related webpages that are available in all prevalent languages include: Wildfire Safety primary landing page (sce.com/wildfire), Wildfire Mitigation Efforts page (sce.com/mitigation), PSPS page (sce.com/psps), PSPS Alerts page (sce.com/pspsalerts) Fire Weather page (sce.com/fireweather), Community Meetings page, (sce.com/wildfiresafetymeetings), and Customer Resources and Support page (sce.com/customerresources).

Table SCE 8-13

List of SCE Channels and Associated Languages

CHANNEL	LANGUAGES
Radio[247]	English, Spanish, Mandarin, Cantonese, Korean, Vietnamese
Digital Banners	All prevalent languages and English
Social Media[248]	English, Spanish
Digital Videos	English, Korean, Chinese, Spanish, Tagalog, and Vietnamese
Newspaper	English, Spanish, Chinese, Korean, Vietnamese, Tagalog
Direct Mail (PSPS Newsletter)	English and a list of SCE customer service contact numbers and PSPS website (in-language versions, where available) was provided in Spanish, Chinese, Korean, Vietnamese, Cambodian, Tagalog, Arabic, Armenian, Farsi, French, German, Japanese, Punjabi and Russian

In collaboration with the other IOUs, SCE designed a questionnaire, also known as the In-Language Wildfire Mitigation Communications Effectiveness Surveys, to measure the communications and outreach effectiveness prior to and coincident with the wildfire seasons by prevalent language. The questionnaire was administered in two phases: a pre-wildfire season survey in August / September 2020, and a post-wildfire season survey in November / December 2020.[249] In mid-August 2020 when the pre-surveys were launched, SCE initially included the 15 "prevalent" languages – Arabic, Armenian, Cantonese, Mandarin, Farsi, French, German, Japanese, Khmer, Korean, Punjabi, Russian, Spanish, Tagalog, and Vietnamese – plus English for a total of 16 languages. Given the August 21, 2020 ALJ Ruling, SCE expanded the survey to include five additional languages (Hindi, Hmong, Portuguese, Thai, and Urdu) for a total of 21 languages– and subsequently added five more variations of Hindi (Bengali, Gujarati, Tamil, Telugu, and Pashto) for a total of 26 languages. Survey invitations were delivered to Residential and Business customers via email in all 26 languages (with a link to a self-administered web survey in the language of the respondent's choice) and phone (to an interviewer-administered telephone survey). For phone surveys, the Computer-Assisted Telephone Interview phone center has staff capable of administering the questionnaire inall

[247] There are no radio stations in Southern California that transmit in the remaining prevalent languages. SCE does not implement radio ads in many of these languages as these ads are dependent on availability of a resource in SCE's Corporate Communications organization with the ability to speak that language and reply in real-time.

[248] SCE does not implement social media in many of these languages as social media is a two-way communication channel that is dependent on availability of a resource in SCE's Corporate Communications organization with the ability to speak that language and reply in real-time. SCE is limited in how it communicates on social media in manyof these prevalent languages.

[249] See SCE's December 31, 2020 compliance filing entitled Southern California Edison Company's 2020 Survey Results Pursuant To Public Utilities Code Section 8386(c)(18)(B), As Required By Decision 20-03-004[E29], And Response to August 21, 2020 Administrative Law Judge's Ruling that includes the pre- and post-survey questions and detailedreports on the 2020 Survey results.

languages, although not all interviewers / languages were available at all times. Upon encountering a language barrier with a potential survey respondent, the interviewer attempted to identify the language and stored the customer record for re-contact at a later date. If the language could not be identified, a surname-based, pre-coded flag was used to assign the record for re-contact at a later time.

All Residential and Business pre-wildfire season surveys were completed between July 7 and August 3, 2021 (2+ months earlier than in 2020) -- and again administered on a large scale to the general public (both Residential and Business customers) systemwide and in HFRA. Post-surveys were fielded between November 24 and December 23, 2021. The post-surveys were also conducted with Residential and Business customers area-wide and in HFRA -- and the combined pre-/post- final report was released at the end of January 2022.

Results for both 2020 and 2021 indicate clearly that only a small minority of residential customers chose to take the survey in a non-English language (6.4% of all surveys – or 608 of a total 9,522 – across 15 of the available languages). When asked directly in the survey to choose their preferred language for wildfire communications from SCE, less than 1 in 10 (9.25% – or 881 of 9,522) indicated a preference for a language other than English. To further investigate this issue of language dependency, an additional question was asked of these respondents who prefer a non-English language option about receiving communications from SCE in English only:

- 3.1% of all Residential customers report they cannot understand English and need wildfire communications in some other language.
- Most of these (2.1% or 68% of the group) require a Spanish language option
- The balance (1%) require communications in a language other than English or Spanish.

Thus, after two survey years it appears that language dependency for residential customers is a relatively minor need across SCE's territory (and even less so in the HFRAs) in reaching customers with wildfire-related communications.

SCE intends to follow the same pattern of surveys in 2022, conducting two major surveys in prevalent languages plus English: Pre- (before wildfire season: to assess general SCE wildfire safety and preparedness communications) and Post- (after wildfire season: measuring the before, during, and after PSPS event experiences, as well as general communications).

8.4.4 Community Outreach for PSPS

Detail the community outreach efforts for PSPS and wildfire-related outreach. Include efforts to reach all languages prevalent in utility territory.

In 2020, SCE increased the number of prevalent languages pursuant to OP 3 of D.20-03-004[E29] in its service area when conducting community outreach to increase public awareness of emergency planning and preparedness. SCE's community outreach efforts for PSPS and wildfire-related activities are described in detail in Section 7.3.10, but SCE offers below some additional context around those efforts to reach communities in all languages prevalent in SCE's service area.

SCE's community meetings in 2021 continued to be conducted online via livestream meetings to communicate our wildfire mitigation and grid hardening efforts, PSPS protocols, customer programs, resources and emergency preparedness. The online platform allowed participants to receive translations through closed captioning. SCE recorded the community meetings and added closed captioning to the recorded videos,[250] which enables closed captioning in multiple languages on YouTube. SCE's other community outreach activities related to wildfire and PSPS were conducted in English, including local and tribal government meetings, PowerTalks, resiliency workshops, PSPS Working Group and PSPS Advisory Board meetings.

SCE issued an RFP to CBOs to aid with conducting outreach and communications to the customer segments previously mentioned and in the prevalent languages required by D.20-03-004. SCE selected 50 CBOs through the RFP selection process to partner with SCE to help educate their constituents around wildfire and how to be prepared in the event of a disaster or a PSPS. The 50 selected CBOs support prevalent languages (including English) mandated by D.20-03-004[E29] and the subsequent ALJ Ruling. SCE will continue to explore options to expand in-language engagement through partnerships and collaboration with CBOs and other organizations.

SCE's wildfire risk reduction and PSPS outreach prior to the start of the 2021 fire season provided in-language information in all prevalent languages to direct customers to contact our Customer Contact Center. SCE's Customer Contact Center currently communicates in English, Spanish, Mandarin, Cantonese, Korean, Vietnamese, Tagalog, and Cambodian. SCE's customer service representatives also use a translations service vendor that supports more than 150 languages for customer inbound inquires, to ensure all prevalent languages are available to customers.

When power outages occur, SCE customers who have enrolled will receive digital outage notifications in English and translated notifications in Spanish, Tagalog, Vietnamese, Chinese (Mandarin and Cantonese), and Korean. In addition, the sce.com/outage-center website provides customers with access to information on the status of the outage affecting them. Non-English-speaking customers are directed to contact the Customer Contact Center where they can speak to an SCE representative or in conjunction with SCE's translation vendor to help ensure communications occur in-language. SCE is working toward providing outage notifications in all required prevalent languages and plans to implement these additional languages in 2021.

After an emergency, SCE conducts outreach to impacted customers to raise awareness about its consumer protections via on-bill messaging, direct mail (when appropriate), email, CBO engagement, targeted social media, web-based content, and direct phone calls (in certain cases when emergency events impact a smaller population of customers). The purpose of these communications is to inform customers of important protections such as billing adjustments, deposit waivers, extended payment plans, suspension of disconnection and nonpayment fines, and access to utility representatives.

After a wildfire, SCE will provide in-language information in all prevalent languages that directs customers to contact our Customer Contact Center where they can speak to an SCE representative and third-party interpreter, if needed, for in-language communications.

SCE will continue using SCE's customer-facing Energized by Edison website to complement our outreach activities. Through this website we share content that aids customers in understanding PSPS and

[250] Recorded community meetings are available for viewing on SCE's website at sce.com/wildfiresafetymeetings.

encourages customer participation in rebates and other customer programs. SCE recently published the following articles on its website:

- Protecting Communities in Sierra Nevada on March 2, 2021
- Drone Usage for Beyond-Visual-Line-of-Sight Inspections on March 5, 2021
- Expediting grid hardening to reduce PSPS on May 4, 2021

SCE's ongoing marketing campaign, which includes radio, digital, social media, newspaper and search ads and direct customer mailings, seeks to educate customers and the public on PSPS, including the conditions that trigger a PSPS, how to prepare for a PSPS, what SCE has done and continues to do to mitigate the risk of wildfires, and how to prepare for emergencies, including signing up for PSPS alerts. In 2021, SCE created new digital ads and print materials to expand the campaign for increasing customer awareness of and participation in customer programs and services. Print ads promoting the MBL program, signing up for outage alerts, and preparedness for emergencies and PSPS were published in 40 ethnic (African American, Chinese, Filipino, Korean, Spanish and Vietnamese) newspapers in April and June 2021.

SCE continued to track impressions as well as measuring click-through rates for these ads. The 2021 campaign generated 832 million impressions.

Using feedback from the CPUC and customers, SCE continues to develop plans for enhanced notifications ahead of the 2022 season.

8.5 PSPS-SPECIFIC METRICS

PSPS data reported quarterly. Placeholder tables below to be filled in based on quarterly data.

Instructions for PSPS table of Attachment 3:

In the attached spreadsheet document, report performance on the following PSPS metrics within the utility's service area over the past seven years as needed to correct previously reported data. Where the utility does not collect its own data on a given metric, the utility is required to work with the relevant state agencies to collect the relevant information for its service area, and clearly identify the owner and dataset used to provide the response in the "Comments" column.

8.5.1 Response to SCE Action Statement, 2021 WMP Additional Issue to Address in 2022 WMP

The following is one of the Additional Issues as provided by OEIS in the Final Action Statement on SCE's 2021 WMP.

> *Issue: The discussion in section 8.2.4 appears to provide a narrow plan for how SCE plans to achieve reductions and appears to report only on mitigated circuits and resulting PSPS scope, frequency, and duration reductions without seeming to explain this in the full context of broader impacts to all customers, for instance, those on non-mitigated circuits (previously de-energized or not).*
> *Energy Safety is not convinced on whether these targets apply to all customers or only those benefitting from circuits mitigated during 2021. It is unclear what the plan is for remaining circuits outside the 72 circuits targeted for mitigation, discussed in Section 8.2.4 or what customers dependent on those circuits may experience. For next year, Energy Safety expects the discussion*

of "8.2.4 Customers Impacted by PSPS" to describe the broader plan of all circuits at risk for PSPS, including non-mitigated circuits, and resulting impacts.
Remedy: SCE must in its 2022 WMP Update:

1. *Describe its narrative and PSPS planning strategy and metrics in the context of all circuits, rather than focusing solely on historically de-energized circuits prioritized for mitigations in 2021. The narrative should relate directly to the metrics provided in Table 11.*
2. *Describe in detail, how calculations were made for Table 11. Explain how the risk model was employed, if at all, in achieving PSPS reductions.*
3. *Describe whether it met targets of the 2021 PSPS Action Plan and describe if/how expedited /enhanced mitigation measures reduced PSPS. If PSPS reduction targets were not met identify lessons learned and corrective actions for next year.*

1. **SCE's response to this Issue/Remedy is described below:**SCE describes its planning strategies throughout Chapter 8, which is conducted in the context of all circuits. Section 8.2 provides information on SCE's PSPS protocols, including risk-informed decision making, strategies for safe re-energization, customer communication, and support for customers during PSPS events. All statistics provided, unless otherwise noted (i.e., 8.2), are also provided for all circuits.
2. The section below describes how the calculations were made for Table 11. SCE's use of risk modeling for PSPS is described in Section 8.2.1.
3. Section 8.2.1 includes information on SCE's progress towards completion of its 2021 PSPS Action Plan. As of January 2022, SCE has completed 131 of the 132 Action Plan activities and intends to complete the remaining item, by March 31, 2022. Section 8.2.4 describes customers affected by PSPS in 2021, including that SCE met or exceeded its anticipated PSPS reductions.

Table 11: Recent use of PSPS and other PSPS Metrics

Table 11 provides a seven-year history (2015-2021), where applicable, of recent use of PSPS and other PSPS metrics as defined by the 2022 WMP Guidelines, as well as projections for 2022. As of Q2 2021, SCE is currently unable to provide planned outage data metrics due to recent IT system implementation issues. SCE is actively investigating this issue and is targeting the Q1 2022 QDR to resume providing these metrics. This affects rows 2a., 2c., 2d., 2e., and 2f. The comment section for each metric in the table provides details of the source and data that was used or explanations for why certain data was corrected or is not available.

Table 11 represents the frequency, scope, and duration of PSPS events in total. A combination of data from SCE's OMS and data recorded by documentation specialists during actual PSPS events was used for the historical information including data through Q4 2021.

Please see Table 11 for updates to SCE's use of PSPS protocols and other related metrics.

For individual metric projections requested in Table 11, a baseline was established for each quarter in 2022 by averaging values for that quarter from the previous 2 to 3 years—depending on data availability for the relevant metric. This matches SCE's baseline expectation for PSPS reduction, which utilizes the average outcomes from 2019-2021. Expected reductions in PSPS frequency, scope, and duration (as forecast in Section 8.1.4) were then applied to the quarterly 2022 baseline values. The analysis resulted in expected reductions of 14% in frequency, 25% in scope, and 17% in duration of PSPS events in 2022.

8.6 Identification of Frequently De-Energized Circuits

Senate Bill 533 (2021) added an additional requirement to the WMPs. Pub. Util. Code Section 8386(c)(8) requires the "Identification of circuits that have frequently been de-energized pursuant to a de-energization event to mitigate the risk of wildfire and the measures taken, or planned to be taken, by the electrical corporation to reduce the need for, and impact of, future de-energization of those circuits, including, but not limited to, the estimated annual decline in circuit de-energization and de-energization impact on customers, and replacing, hardening, or undergrounding any portion of the circuit or of upstream transmission or distribution lines." To comply with this statutory addition, utilities are required to populate Table 8-2 and provide a map showing the listed frequently de-energized circuits.

Pursuant to SB 533,[251] this section was added to the 2022 WMP update to identify circuits with frequent wildfire mitigation related de-energizations and the measures to be taken to reduce the need for and impact of such de-energizations.

Table 8-2 below describes events from 2019 to now. It should be noted that SCE presents the list of circuits that meet the defined criteria, but this does not represent the entirety of circuits on which SCE has accelerated prescriptive PSPS mitigations and includes circuits with three or more event per calendar year.

Table 8-2

Frequently De-energized Circuits

Circuit name with >2 Incidents per Calendar year	County	Dates of Outages	# of Customers Affected	Measures taken, or planned to be taken, to reduce the need for, and impact of, future PSPS of circuit
ACOSTA	SAN BERNARDINO COUNTY	10/26/2020	788	Completed: • Automate 1 existing switch and • Implement operational protocol to raise PSPS windspeed thresholds
		11/26/2020	5	
		12/2/2020	5	
		10/10/2019	5	
		10/24/2019	1243	
		10/28/2019	1244	
		10/30/2019	1243	
AMETHYST	SAN BERNARDINO COUNTY	10/26/2020	630	Completed: • Replace 1.4 miles of existing overhead wire with new insulated wire
		11/26/2020	630	
		12/2/2020	629	
		12/7/2020	629	

[251] SB 533 (2021) text: https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id =202120220SB533 (accessed Oct. 15, 2021

Circuit name with >2 Incidents per Calendar year	County	Dates of Outages	# of Customers Affected	Measures taken, or planned to be taken, to reduce the need for, and impact of, future PSPS of circuit
				• Install an additional weather station to improve situational awareness
ANTON	VENTURA COUNTY	11/25/2021	298	Planned Work: • Replace 25.2 miles of existing overhead wire with new insulated wire • Install an additional weather station • Install 1 automated switch and implement additional segmentation • Implement operational protocol to raise PSPS windspeed thresholds
		1/15/2021	139	
		1/17/2021	139	
		1/19/2021	277	
		9/9/2020	117	
		10/16/2020	47	
		10/26/2020	137	
		11/26/2020	117	
		12/2/2020	118	
		12/3/2020	152	
		12/7/2020	138	
		12/19/2020	139	
		12/23/2020	49	
		10/10/2019	49	
		10/24/2019	287	
		10/28/2019	341	
		10/30/2019	286	
		11/17/2019	49	
ARLENE	LOS ANGELES COUNTY	11/26/2020	1668	Completed: • Replace all 7.12 miles of existing overhead wire with new insulated wire • Updated switching protocols
		12/3/2020	703	
		12/7/2020	703	
		12/23/2020	712	
ATENTO	ORANGE COUNTY	10/26/2020	901	Completed: • New insulated wire has already been installed in various places on the circuit. • Plan involves replacing an additional 25.4 miles of bare overhead wire with new insulated wire, to fully cover the circuit outside of the operational protocol area. • Implement operational protocols to raise PSPS windspeed thresholds
		11/26/2020	2680	
		12/2/2020	801	
		12/23/2020	801	
BALCOM	VENTURA COUNTY	12/2/2020	359	Completed:
		12/7/2020	359	

Circuit name with >2 Incidents per Calendar year	County	Dates of Outages	# of Customers Affected	Measures taken, or planned to be taken, to reduce the need for, and impact of, future PSPS of circuit
		12/23/2020	359	• Replace 2.6 miles of existing overhead wire with new insulated wire • Implement switching protocols to transfer load to a less affected circuit
		10/10/2019	2849	
		10/24/2019	1536	
		10/28/2019	1535	
		10/30/2019	1539	
BIG ROCK	LOS ANGELES COUNTY	1/14/2021	119	Completed: • Replace 10.2 miles of existing overhead wire with new insulated wire • Install 2 automated switches • Install an additional weather station • Implement operational and switching protocols to transfer load to a less affected circuit
		1/15/2021	2473	
		1/19/2021	119	
		10/26/2020	2839	
		11/26/2020	2841	
		11/27/2020	86	
		12/2/2020	2841	
		12/3/2020	87	
		12/7/2020	2928	
		12/23/2020	119	
BLUE CUT	SAN BERNARDINO COUNTY	10/26/2020	300	Planned Work: • Replace 43.2 miles of existing overhead wire with new insulated wire
		11/26/2020	25	
		12/2/2020	25	
BOOTLEGGER	LOS ANGELES COUNTY	9/9/2020	61	Completed: • Insulated Wires: Replace 27.8 miles of existing overhead wire with new insulated wire • Implement switching protocol to remove some customers and critical businesses from PSPS
		10/26/2020	1579	
		11/26/2020	1576	
		12/3/2020	1502	
		12/7/2020	62	
		12/23/2020	62	
BOUQUET	LOS ANGELES COUNTY	10/10/2019	91	Planned Work: • Replace 28.9 miles of existing overhead wire with new insulated wire • Add temporary generator to serve approx. 250 customers during a PSPS event with minimal outages
		10/24/2019	734	
		10/30/2019	733	
CALGROVE	LOS ANGELES COUNTY	1/15/2021	24	Under Engineering Review
		1/16/2021	24	
		1/19/2021	24	
CALSTATE	SAN BERNARDINO COUNTY	10/26/2020	605	Completed:
		11/27/2020	614	
		12/3/2020	616	

Circuit name with >2 Incidents per Calendar year	County	Dates of Outages	# of Customers Affected	Measures taken, or planned to be taken, to reduce the need for, and impact of, future PSPS of circuit
		12/8/2020	9	• Replace 3.0 miles of existing overhead wire with new insulated wire
		12/23/2020	10	
		10/10/2019	10	
		10/20/2019	10	
		10/28/2019	617	
		10/24/2019	10	
		10/30/2019	617	
CAMP BALDY	LOS ANGELES COUNTY, SAN BERNARDINO COUNTY	10/26/2020	154	Planned Work: • Install insulated wire
		11/26/2020	154	
		12/7/2020	152	
CASMALIA	SAN BERNARDINO COUNTY	10/10/2019	665	Completed: • All existing overhead in HFRA was previously switched to the Impala 12kV
		10/24/2019	2023	
		10/28/2019	2021	
		10/30/2019	1988	
CASTRO	VENTURA COUNTY	12/2/2020	21	Completed: • Add a new switch to improve segmentation and reduce customer impacts
		12/7/2020	224	
		12/24/2020	20	
		10/10/2019	2379	
		10/23/2019	2395	
		10/28/2019	2298	
		10/30/2019	2291	
COBRA	LOS ANGELES COUNTY	12/2/2020	1705	Completed: • Replace 0.2 miles of existing overhead wire with new insulated wire • Automate 2 existing switches • Install an additional weather station
		12/7/2020	1705	
		12/23/2020	1711	
CONDOR	KERN COUNTY	11/27/2020	1464	Completed: • New insulated wire has already been installed on nearly all existing overhead portions of the circuit • Replace an additional 1.7 miles of existing overhead wire with new insulated wire near the substation
		12/2/2020	1466	
		12/7/2020	1466	
		12/8/2020	34	
		12/23/2020	1463	
		10/10/2019	1463	
		10/24/2019	1464	
		10/29/2019	1464	
CUDDEBACK	KERN COUNTY	10/10/2019	325	Completed:
		10/24/2019	325	

Circuit name with >2 Incidents per Calendar year	County	Dates of Outages	# of Customers Affected	Measures taken, or planned to be taken, to reduce the need for, and impact of, future PSPS of circuit
		10/28/2019	326	• Replace 7.53 miles of existing overhead wire with new insulated wire
		10/30/2019	326	
CUTHBERT	LOS ANGELES COUNTY	11/21/2021	1129	Completed: • Replace 0.8 miles of existing overhead wire with new insulated wire • Implement operational protocols to raise PSPS windspeed thresholds, and transfer load to a less affected circuit • Install 1 automated switch
		11/24/2021	2384	
		1/14/2021	2439	
		1/15/2021	498	
		1/19/2021	76	
DAVENPORT	LOS ANGELES COUNTY	10/26/2020	762	Completed: • Replace 17.07 miles of existing overhead wire with new insulated wire
		11/26/2020	452	
		12/2/2020	765	
		12/7/2020	1468	
		10/10/2019	2678	
		10/24/2019	1393	
		10/30/2019	1461	
		10/28/2019	1458	
DE MILLE	LOS ANGELES COUNTY	10/26/2020	243	Completed: • Replace 6.0 miles of existing overhead wire with new insulated wire • Circuit will be cutover to Lopez 16kV which will have higher PSPS thresholds
		12/3/2020	243	
		12/7/2020	243	
DUKE	RIVERSIDE COUNTY	12/2/2020	1140	Completed: • New insulated wire on most overhead portions of the circuit within HFRA • Replace 0.4 miles of remaining bare overhead wire within HFRA with new insulated wire
		12/3/2020	1118	
		12/7/2020	23	
		12/23/2020	23	
DYSART	RIVERSIDE COUNTY	12/2/2020	4	Completed: • Replace 12.9 miles of overhead bare wire with new insulated wire
		12/7/2020	75	
		12/23/2020	75	
ECHO	SAN BERNARDINO COUNTY	10/26/2020	117	Completed: • Replace 2.2 miles of existing overhead wire with new insulated wire
		12/7/2020	1775	
		12/18/2020	117	

Circuit name with >2 Incidents per Calendar year	County	Dates of Outages	# of Customers Affected	Measures taken, or planned to be taken, to reduce the need for, and impact of, future PSPS of circuit
ENERGY	Los ANGELES COUNTY, VENTURA COUNTY	10/11/2021	37	Completed: • Replace 14.9 miles of existing overhead wire with new insulated wire • Install 3 automated switches and implement additional segmentation • Add temporary generator to serve approx. 120 customers during a PSPS event with minimal outages
		10/15/2021	74	
		11/21/2021	37	
		11/24/2021	1702	
		1/14/2021	2495	
		1/18/2021	900	
		10/16/2020	37	
		10/26/2020	849	
		11/26/2020	1861	
		12/2/2020	2664	
		12/7/2020	1857	
		12/19/2020	870	
		12/23/2020	46	
		10/10/2019	625	
		10/24/2019	1809	
		10/30/2019	1811	
		10/28/2019	1808	
		11/25/2019	36	
ESTABAN	VENTURA COUNTY	12/2/2020	156	Completed: • Replace 13.8 miles of existing overhead wire with new insulated wire
		12/3/2020	93	
		12/7/2020	249	
		12/23/2020	312	
		10/10/2019	2128	
		10/24/2019	2133	
		10/30/2019	1628	
FERRARA	LOS ANGELES COUNTY	10/26/2020	242	Planned Work: • Replace existing overhead wire with new insulated wire
		11/26/2020	242	
		12/7/2020	242	
FINGAL	RIVERSIDE COUNTY	12/2/2020	230	Completed: • Replace approximately 35.1 miles of existing overhead wire with new insulated wire
		12/7/2020	1426	
		12/23/2020	232	
FROZEN	KERN COUNTY	1/18/2021	1	Completed: • Replace <0.1 miles of existing overhead wire with new insulated wire
		11/16/2020	1	
		12/2/2020	1	
		12/23/2020	1	
GNATCATCHER	KERN COUNTY	11/27/2020	1446	Completed: • New insulated wire has already been installed on nearly all
		12/2/2020	1445	
		12/7/2020	1450	

Circuit name with >2 Incidents per Calendar year	County	Dates of Outages	# of Customers Affected	Measures taken, or planned to be taken, to reduce the need for, and impact of, future PSPS of circuit
		12/23/2020	1451	existing overhead portions of the circuit • Replace an additional 3.53 miles of existing overhead wire with new insulated wire at various locations
		10/10/2019	1447	
		10/24/2019	1448	
		10/29/2019	1446	
GUITAR	LOS ANGELES COUNTY, VENTURA COUNTY	10/26/2020	42	Planned Work: • Replace 10.0 miles of existing overhead wire with new insulated wire
		11/27/2020	42	
		12/3/2020	42	
		12/23/2020	42	
		10/10/2019	197	
		10/24/2019	43	
		10/28/2019	255	
		10/30/2019	255	
HILLFIELD	LOS ANGELES COUNTY	10/26/2020	2373	Completed: • Replace 3.6 miles of existing overhead wire with new insulated wire • Automate 3 switches • Update switching protocols • Implement operational protocol for portions of the circuit
		12/7/2020	2373	
		12/23/2020	2057	
HUCKLEBERRY	LOS ANGELES COUNTY	10/10/2019	4	Planned Work: • Replace 17.8 miles of existing overhead wire with new insulated wire and Implement protocols to transfer load to a less affected circuit
		10/24/2019	173	
		10/27/2019	174	
		10/30/2019	174	
ICE HOUSE	SAN BERNARDINO COUNTY	10/26/2020	12	Planned Work: • Replace existing overhead wire with new insulated wire
		11/26/2020	12	
		12/7/2020	12	
IMPALA	SAN BERNARDINO COUNTY	11/21/2021	463	Completed: • Replace 25.8 miles of existing overhead wire with new insulated wire • Existing overhead in HFRA will be fully covered with insulated wire
		11/24/2021	463	
		11/25/2021	361	
		1/19/2021	776	
		10/26/2020	751	
		11/27/2020	760	
		12/3/2020	764	
		12/7/2020	763	
LOPEZ		10/26/2020	168	Completed:

Circuit name with >2 Incidents per Calendar year	County	Dates of Outages	# of Customers Affected	Measures taken, or planned to be taken, to reduce the need for, and impact of, future PSPS of circuit
	LOS ANGELES COUNTY	12/2/2020	49	• Replace 22.4 miles of existing overhead wire with new insulated wire, and Install a new automated switch
		12/3/2020	96	
		12/7/2020	145	
LOUCKS	LOS ANGELES COUNTY	9/9/2020	14	Completed: • Replace 3.2 miles of existing overhead wire with new insulated wire
		10/26/2020	55	
		11/26/2020	55	
		12/7/2020	55	
		10/10/2019	56	
		10/24/2019	56	
		10/30/2019	56	
		10/28/2019	52	
MCKEVETT	VENTURA COUNTY	10/10/2019	289	Completed: • Implement operational protocol to raise PSPS windspeed thresholds
		10/23/2019	578	
		10/28/2019	289	
		10/30/2019	289	
METTLER	KERN COUNTY	11/16/2020	8	Completed: • Replace 38.0 miles of existing overhead wire with new insulated wire
		12/2/2020	527	
		12/7/2020	527	
		10/10/2019	514	
		10/24/2019	514	
		10/28/2019	516	
		10/30/2019	516	
NAPOLEON	RIVERSIDE COUNTY	12/2/2020	45	Completed: • Replace 5.8 miles of existing overhead wire with new insulated wire
		12/3/2020	1028	
		12/7/2020	45	
		12/8/2020	527	
		12/23/2020	45	
NORTHPARK	SAN BERNARDINO COUNTY	11/26/2020	552	Completed: • Replace 18.6 miles of existing overhead wire with new insulated wire • Implement switching protocols to transfer load to a less affected circuit • Automate 2 existing sectionalizing devices
		12/2/2020	550	
		12/18/2020	1101	
		12/23/2020	623	
PETIT	VENTURA COUNTY	10/24/2019	22	Completed:
		10/25/2019	11	

Circuit name with >2 Incidents per Calendar year	County	Dates of Outages	# of Customers Affected	Measures taken, or planned to be taken, to reduce the need for, and impact of, future PSPS of circuit
		10/28/2019	1076	• Implement operational protocols to raise PSPS windspeed thresholds
		10/29/2019	42	
		10/30/2019	1074	
		10/31/2019	42	
PHEASANT	RIVERSIDE COUNTY	12/2/2020	178	Completed: • Replace 9.3 miles of existing overhead wire with new insulated wire
		12/7/2020	178	
		12/23/2020	178	
RACER	LOS ANGELES COUNTY	12/3/2020	722	Completed: • Replace 0.6 miles of existing overhead wire with new insulated wire • Implement operational protocol for portions of the circuit
		12/7/2020	723	
		12/23/2020	723	
RAINBOW	VENTURA COUNTY	12/2/2020	180	Completed: • Replace 15 miles of existing overhead wire with new insulated wire
		12/7/2020	180	
		12/23/2020	179	
		10/24/2019	19	
		10/28/2019	343	
		10/30/2019	399	
		10/31/2019	399	
RED BOX	LOS ANGELES COUNTY	1/19/2021	30	Completed: • Install an additional weather station • Adjustments to switching plans and weather station assignments in order to leverage better situational awareness and reduce PSPS use
		9/9/2020	20	
		10/26/2020	20	
		12/2/2020	30	
		12/7/2020	30	
		10/24/2019	29	
		10/30/2019	28	
		10/27/2019	29	
RUSTIC	ORANGE COUNTY	10/26/2020	367	Under Engineering Review
		11/26/2020	41	
		12/3/2020	41	
SADDLEBACK	RIVERSIDE COUNTY	12/2/2020	79	Planned Work: • Replace 4.8 miles of existing bare overhead wire with new insulated wire • Add new weather station near end of the circuit to improve situational awareness
		12/7/2020	8	
		12/23/2020	4	
SAND CANYON		9/30/2021	9	Planned Work:

Circuit name with >2 Incidents per Calendar year	County	Dates of Outages	# of Customers Affected	Measures taken, or planned to be taken, to reduce the need for, and impact of, future PSPS of circuit
	LOS ANGELES COUNTY	10/15/2021	9	• Replace 22.8 miles of existing overhead wire with new insulated wire • Update switching protocols • Implement operational protocol for portions of the circuit
		11/21/2021	9	
		11/24/2021	290	
		1/14/2021	9	
		1/18/2021	9	
		1/19/2021	697	
		9/9/2020	9	
		10/26/2020	144	
		11/17/2020	9	
		11/26/2020	142	
		12/2/2020	9	
		12/3/2020	133	
		12/7/2020	2200	
		12/18/2020	9	
		12/23/2020	61	
		10/10/2019	8	
		10/24/2019	2205	
		10/28/2019	2204	
		10/30/2019	987	
SHOVEL	LOS ANGELES COUNTY	9/9/2020	31	Completed: • Replace 30.5 miles of existing overhead wire with new insulated wire and Implement to transfer load to a less affected circuit
		10/26/2020	52	
		11/17/2020	165	
		11/26/2020	197	
		12/2/2020	525	
		12/7/2020	719	
		10/10/2019	775	
		10/20/2019	165	
		10/24/2019	416	
		10/26/2019	9	
		10/27/2019	9	
		10/29/2019	9	
		10/30/2019	770	
STEEL	RIVERSIDE COUNTY	10/15/2021	37	Completed: • Update switching protocols to reassign the boundary point between PSPS Segment 1 and Segment 2
		11/21/2021	37	
		11/25/2021	37	
		1/19/2021	37	
		12/2/2020	36	

Circuit name with >2 Incidents per Calendar year	County	Dates of Outages	# of Customers Affected	Measures taken, or planned to be taken, to reduce the need for, and impact of, future PSPS of circuit
		12/7/2020	36	
		12/23/2020	2	
		10/10/2019	34	
		10/24/2019	35	
		10/28/2019	34	
		10/30/2019	34	
SUTT	SAN BERNARDINO COUNTY	10/26/2020	1839	Planned Work: • Implement operational protocol for portions of the circuit
		12/7/2020	27	
		12/18/2020	81	
SWEETWATER	SAN BERNARDINO COUNTY	1/15/2021	2533	Completed: • Replace 4.9 miles of existing overhead wire with new insulated wire
		1/19/2021	1266	
		1/20/2021	1265	
		10/26/2020	3432	
		12/23/2020	3431	
TAHQUITZ	RIVERSIDE COUNTY	10/10/2019	134	Completed: • Add new weather station near in the Mountain Center area to improve situational awareness
		10/24/2019	133	
		10/28/2019	133	
		10/30/2019	133	
TANAGER	KERN COUNTY	11/27/2020	1598	Completed: • Replace 28.6 miles of existing overhead wire with new insulated wire • Install 1 new automated switch
		12/2/2020	1597	
		12/7/2020	1597	
		10/10/2019	1532	
		10/24/2019	1541	
		10/30/2019	1543	
TAPO	VENTURA COUNTY	10/26/2020	57	Completed: • Replace 11.7 miles of existing overhead wire with new insulated wire • Implement operational protocol to raise PSPS windspeed thresholds
		11/26/2020	57	
		12/3/2020	518	
		12/7/2020	1370	
TUBA	LOS ANGELES COUNTY	10/24/2019	25	Planned Work: • Add temporary generator to serve approx. 306 customers during a PSPS event with minimal outages • Other: Adjustments to switching plans and weather station assignments in order to leverage
		10/30/2019	25	
		11/25/2019	25	

Circuit name with >2 Incidents per Calendar year	County	Dates of Outages	# of Customers Affected	Measures taken, or planned to be taken, to reduce the need for, and impact of, future PSPS of circuit
				better situational awareness and reduce PSPS use
TWIN LAKES	VENTURA COUNTY	10/26/2020	840	Completed: • Implement operational protocol to raise PSPS windspeed thresholds • Implement switching protocols to isolate overhead portions and transfer customers to adjacent circuits
		11/26/2020	840	
		12/2/2020	840	
		12/7/2020	3644	
		12/23/2020	467	
VARGAS	SAN BERNARDINO COUNTY	10/26/2020	391	Completed: • Replace 0.2 miles of existing overhead wire with new insulated wire • Install 1 new automated switch • Implement operational protocol to raise PSPS windspeed thresholds
		11/27/2020	391	
		12/3/2020	391	
		12/7/2020	394	
		12/23/2020	393	
VERA CRUZ	ORANGE COUNTY	10/26/2020	27	Completed: • Replace 3.2 miles of existing overhead wire with new insulated wire • Implement switching protocols to update boundary between PSPS segment 1 and segment 2
		12/2/2020	5	
		12/7/2020	5	
		12/23/2020	5	
ZONE	VENTURA COUNTY	12/2/2020	56	Planned Work: • Replace 23.7 miles of existing overhead wire with new insulated wire • Implement operational protocols to raise PSPS windspeed thresholds near substation • Implement switching protocols to transfer load to a less affected circuit • Install an additional weather station
		12/3/2020	890	
		12/7/2020	946	
		10/10/2019	56	
		10/24/2019	1237	
		10/28/2019	1229	
		10/30/2019	1230	

9 APPENDIX

9.1 DEFINITIONS OF INITIATIVE ACTIVITIES BY CATEGORY

Category	Initiative activity	Definition
A. Risk mapping and simulation	*A summarized risk map that shows theoverall ignition probability and estimated wildfire consequence along the electric lines and equipment*	*Development and use of tools and processes to develop and update risk map and simulations and to estimate riskreduction potential of initiatives for a given portion of the grid (or more granularly, e.g., circuit, span, or asset). May include verification efforts, independent assessment by experts, and updates.*
	Climate-driven riskmap and modeling based on various relevant weather scenarios	*Development and use of tools and processes demonstratingmedium and long-term climate trends based on the best available climate models demonstrating the most wildfire- relevant impacts (e.g., warming trends, fuel moisture trends, soil moisture trends, vegetation distribution trends).Describe how these trends are being incorporated into risk modeling or other risk-informed analyses.*
	Ignition probability mapping showing the probability of ignition along the electric lines and equipment	*Development and use of tools and processes to assess therisk of ignition across regions of the grid (or more granularly, e.g., circuits, spans, or assets).*
	Initiative mapping and estimation of wildfire and PSPS risk- reduction impact	*Development of a tool to estimate the risk reduction efficacy (for both wildfire and PSPS risk) and risk-spend efficiency of various initiatives.*
	Match drop simulations showing the potential wildfire consequence of ignitions that occur along the electric lines and equipment	*Development and use of tools and processes to assess the impact of potential ignition and risk to communities (e.g., in terms of potential fatalities, structures burned, monetary damages, area burned, impact on air quality andgreenhouse gas, or GHG, reduction goals, etc.).*
B. Situational awareness and forecasting	*Advanced weather monitoring and weather stations*	*Purchase, installation, maintenance, and operation of weather stations. Collection, recording, and analysis of weather data from weather stations and from external sources.*
	Continuous monitoring sensors	*Installation, maintenance, and monitoring of sensors and sensorized equipment used to monitor the condition of electric lines and equipment.*
	Fault indicators for detecting faults onelectric lines and equipment	*Installation and maintenance of fault indicators.*

Category	*Initiative activity*	*Definition*
	Forecast of a fire riskindex, FPI, or similar	*Index that uses a combination of weather parameters (such as wind speed, humidity, and temperature), vegetation and/or fuel conditions, and other factors to judge current fire risk and to create a forecast indicative of fire risk. A sufficiently granular index is required to inform operational decision-making.*
	Personnel monitoring areas of electric lines and equipment in elevated fire risk conditions	*Personnel position within utility service territory to monitorsystem conditions and weather on site. Field observations is required to inform operational decisions.*
	Weather forecasting and estimating impacts on electric lines and equipment	*Development methodology for forecast of weather conditions relevant to utility operations, forecasting weather conditions and conducting analysis to incorporateinto utility decision making, learning and updates to reduce false positives and false negatives of forecast PSPS conditions.*
C. Grid design and system hardening	*Capacitor maintenance and replacement program*	*Remediation, adjustments, or installations of new equipment to improve or replace existing capacitor equipment.*
	CB maintenance and installation to de-energize lines upon detecting a fault	*Remediation, adjustments, or installations of new equipment to improve or replace existing fast switching CB equipment to improve the ability to protectelectrical circuits from damage caused by overload of electricity or short circuit.*
	Covered conductor installation	*Installation of covered or insulated conductors to replace standard bare or unprotected conductors (defined in accordance with GO 95 as supply conductors, including butnot limited to lead wires, not enclosed in a grounded metal pole or not covered by: a "suitable protective covering" (in accordance with Rule 22.8), grounded metal conduit, or grounded metal sheath or shield). In accordance with GO 95, conductor is defined as a material suitable for: (1) carrying electric current, usually in the form of a wire, cable or bus bar, or (2) transmitting light in the case of fiber optics; insulated conductors as those which are surrounded by an insulating material (in accordance with Rule 21.6), the dielectric strength of which is sufficient to withstand the maximum difference of potential at normaloperating voltages of the circuit without breakdown or puncture; and suitable protective covering as a covering ofwood or other non-conductive material having the electrical insulating efficiency (12kV/in. dry) and impact strength (20ft.-lbs) of 1.5 inches of redwood or other material meeting the requirements of Rule 22.8-A, 22.8-B, 22.8-C or 22.8-D.*

Category	*Initiative activity*	*Definition*
	Covered conductor maintenance	*Remediation and adjustments to installed covered or insulated conductors. In accordance with GO 95, conductoris defined as a material suitable for: (1) carrying electric current, usually in the form of a wire, cable or bus bar, or* *(2) transmitting light in the case of fiber optics; insulated conductors as those which are surrounded by an insulatingmaterial (in accordance with Rule 21.6), the dielectric strength of which is sufficient to withstand the maximum difference of potential at normal operating voltages of thecircuit without breakdown or puncture; and suitable protective covering as a covering of wood or other non- conductive material having the electrical insulating efficiency (12kV/in. dry) and impact strength (20ft.lbs) of* *1.5 inches of redwood or other material meeting the requirements of Rule 22.8-A, 22.8-B, 22.8-C or 22.8-D.*
	Crossarm maintenance, repair,and replacement	*Remediation, adjustments, or installations of new equipment to improve or replace existing crossarms,defined as horizontal support attached to poles or structures generally at right angles to the conductor supported in accordance with GO 95.*
	Distribution pole replacement and reinforcement, including with composite poles	*Remediation, adjustments, or installations of new equipment to improve or replace existing distribution poles(i.e., those supporting lines under 65kV), including with equipment such as composite poles manufactured with materials reduce ignition probability by increasing pole lifespan and resilience against failure from object contact and other events.*
	Expulsion fuse replacement	*Installations of new and CAL FIRE-approved power fuses to replace existing expulsion fuse equipment.*
	Grid topology improvements to mitigate or reduce PSPS events	*Plan to support and actions taken to mitigate or reduce PSPS events in terms of geographic scope and number of customers affected, such as installation and operation ofelectrical equipment to sectionalize or island portions of the grid, microgrids, or local generation.*
	Installation of system automation equipment	*Installation of electric equipment that increases the abilityof the utility to automate system operation and monitoring, including equipment that can be adjusted remotely such as automatic reclosers (switching devices designed to detect and interrupt momentary faults that can reclose automatically and detect if a fault remains, remaining open if so).*

Category	Initiative activity	Definition
	Maintenance, repair,and replacement of connectors, including hotline clamps	*Remediation, adjustments, or installations of new equipment to improve or replace existing connectorequipment, such as hotline clamps.*
	Mitigation of impacton customers and other residents affected during PSPS event	*Actions taken to improve access to electricity for customersand other residents during PSPS events, such as installationand operation of local generation equipment (at the community, household, or other level).*
D. Asset management and inspections	*Other corrective action*	*Other maintenance, repair, or replacement of utility equipment and structures so that they function properly and safely, including remediation activities (such as insulator washing) of other electric equipment deficiencies that may increase ignition probability due to potential equipment failure or other drivers.*
	Pole loading infrastructure hardening and replacement programbased on pole loading assessment program	*Actions taken to remediate, adjust, or install replacement equipment for poles that the utility has identified as failingto meet safety factor requirements in accordance with GO95 or additional utility standards in the utility's pole loading assessment program.*
	Transformers maintenance and replacement	*Remediation, adjustments, or installations of new equipment to improve or replace existing transformer equipment.*
	Transmission tower maintenance and replacement	*Remediation, adjustments, or installations of new equipment to improve or replace existing transmissiontowers (e.g., structures such as lattice steel towers or tubular steel poles that support lines at or above 65kV).*
	Undergrounding of electric lines and/or equipment	*Actions taken to convert overhead electric lines and/or equipment to underground electric lines and/or equipment (i.e., located underground and in accordance with GO 128).*
	Updates to grid topology to minimizerisk of ignition in HFTDs	*Changes in the plan, installation, construction, removal, and/or undergrounding to minimize the risk of ignition dueto the design, location, or configuration of utility electric equipment in HFTDs.*
	Detailed inspections of distribution electric lines and equipment	*In accordance with GO 165, careful visual inspections of overhead electric distribution lines and equipment where individual pieces of equipment and structures are carefullyexamined, visually and through use of routine diagnostic test, as appropriate, and (if practical and if useful information can be so gathered) opened, and the condition of each rated and recorded.*

Category	*Initiative activity*	*Definition*
	Detailed inspections of transmission electric lines and equipment	*Careful visual inspections of overhead electric transmissionlines and equipment where individual pieces of equipment and structures are carefully examined, visually and throughuse of routine diagnostic test, as appropriate, and (if practical and if useful information can be so gathered) opened, and the condition of each rated and recorded.*
	Improvement of inspections	*Identifying and addressing deficiencies in inspections protocols and implementation by improving training and the evaluation of inspectors.*
	Infrared inspections of distribution electric lines and equipment	*Inspections of overhead electric distribution lines, equipment, and right-of-way using infrared (heat-sensing)technology and cameras that can identify "hot spots", or conditions that indicate deterioration or potential equipment failures, of electrical equipment.*
	Infrared inspections of transmission electric lines and equipment	*Inspections of overhead electric transmission lines, equipment, and right-of-way using infrared (heat-sensing)technology and cameras that can identify "hot spots", or conditions that indicate deterioration or potential equipment failures, of electrical equipment.*
	Intrusive pole inspections	*In accordance with GO 165, intrusive inspections involvemovement of soil, taking samples for analysis, and/or using more sophisticated diagnostic tools beyond visual inspections or instrument reading.*
	LiDAR inspections of distribution electric lines and equipment	*Inspections of overhead electric distribution lines, equipment, and right-of-way using LiDAR (Light Detectionand Ranging, a remote sensing method that uses light in the form of a pulsed laser to measure variable distances).*
	LiDAR inspections of transmission electric lines and equipment	*Inspections of overhead electric transmission lines, equipment, and right-of-way using LiDAR (Light Detectionand Ranging, a remote sensing method that uses light in the form of a pulsed laser to measure variable distances).*
	Other discretionary inspection of distribution electric lines and equipment, beyond inspections mandated by rules and regulations	*Inspections of overhead electric distribution lines, equipment, and right-of-way that exceed or otherwise go beyond those mandated by rules and regulations, including GO 165, in terms of frequency, inspection checklist requirements or detail, analysis of and response to problems identified, or other aspects of inspection or records kept.*

Category	*Initiative activity*	*Definition*
	Other discretionary inspection of transmission electric lines and equipment, beyond inspections mandatedby rules and regulations	*Inspections of overhead electric transmission lines, equipment, and right-of-way that exceed or otherwise go beyond those mandated by rules and regulations, includingGO 165, in terms of frequency, inspection checklist requirements or detail, analysis of and response to problems identified, or other aspects of inspection or records kept.*
	Patrol inspections of distribution electric lines and equipment	*In accordance with GO 165, simple visual inspections of overhead electric distribution lines and equipment that isdesigned to identify obvious structural problems and hazards. Patrol inspections may be carried out in the course of other company business.*
	Patrol inspections of transmission electric lines and equipment	*Simple visual inspections of overhead electric transmission lines and equipment that is designed to identify obvious structural problems and hazards. Patrol inspections may be carried out in the course of other company business.*
	Pole loading assessment program to determine safety factor	*Calculations to determine whether a pole meets pole loading safety factor requirements of GO 95, including planning and information collection needed to support saidcalculations. Calculations must consider many factors including the size, location, and type of pole; types of attachments; length of conductors attached; and number and design of supporting guys, per D.15-11-021.*
	Quality assurance / quality control of inspections	*Establishment and function of audit process to manage and confirm work completed by employees or contractors, including packaging QA/QC information forinput to decision-making and related integrated workforce management processes.*
	Substation inspections	*In accordance with GO 175, inspection of substations performed by qualified persons and according to the frequency established by the utility, including record- keeping.*
E. Vegetation management and inspections	*Additional efforts to manage community and environmental impacts*	*Plan and execution of strategy to mitigate negative impactsfrom utility vegetation management to local communities and the environment, such as coordination with communities, local governments, and agencies to plan and execute vegetation management work.*
	Detailed inspections and management practices for vegetation clearances around distribution electrical lines and equipment	*Careful visual inspections and maintenance of vegetationaround the distribution right-of-way, where individual trees are carefully examined, visually, and the condition of each rated and recorded. Describe the frequency of inspection and maintenance programs.*

Category	Initiative activity	Definition
	Detailed inspections and management practices for vegetation clearances around transmission electrical lines and equipment	Careful visual inspections and maintenance of vegetation around the transmission right-of- way, where individual treesare carefully examined, visually, and the condition of each rated and recorded. Describe the frequency of inspection andmaintenance programs.
	Emergency response vegetation management due to red flag warning or other urgent weather conditions	Plan and execution of vegetation management activities, such as trimming or removal, executed based upon and inadvance of forecast weather conditions that indicate highfire threat in terms of ignition probability and wildfire consequence.
	Fuel management and, management of all wood and “slash” from vegetation management activities	Plan and execution of fuel management activities in proximity to potential sources of ignition. This includes pole clearing per PRC 4292 and reduction or adjustment oflive fuel (based on species or otherwise) and of dead fuel, including all downed wood and “slash” generated from vegetation management activities.
	Improvement of inspections	Identifying and addressing deficiencies in inspections protocols and implementation by improving training and the evaluation of inspectors.
	Remote sensing inspections of vegetation around distribution electric lines and equipment	Inspections of right-of-way using remote sensing methods such as LiDAR, satellite imagery, and UAV.
	Other discretionary inspections of vegetation around distribution electric lines and equipment	Inspections of rights-of-way and adjacent vegetation that may be hazardous, which exceeds or otherwise go beyond those mandated by rules and regulations, in terms of frequency, inspection checklist requirements or detail, analysis of and response to problems identified, or other aspects of inspection or records kept.
	Other discretionary inspections of vegetation around transmission electriclines and equipment	Inspections of rights-of-way and adjacent vegetation thatmay be hazardous, which exceeds or otherwise go beyondthose mandated by rules and regulations, in terms of frequency, inspection checklist requirements or detail, analysis of and response to problems identified, or other aspects of inspection or records kept.
	Patrol inspections of vegetation around distribution electric lines and equipment	Visual inspections of vegetation along rights-of-way that isdesigned to identify obvious hazards. Patrol inspections may be carried out in the course of other company business.

Category	Initiative activity	Definition
	Patrol inspections of vegetation around transmission electric lines and equipment	*Visual inspections of vegetation along rights-of-way that isdesigned to identify obvious hazards. Patrol inspections may be carried out in the course of other company business.*
	Quality assurance / quality control of vegetation management	*Establishment and function of audit process to manage and oversee the work completed by employees or contractors, including packaging QA/QC information forinput to decision-making and workforce management processes. This includes identification of the percentage of vegetation inspections that are audited annually, as aprogram target in Table 5.3-1.*
	Recruiting and training of vegetationmanagement personnel	*Programs to ensure that the utility is able to identify andhire qualified vegetation management personnel and to ensure that both full-time employees and contractors tasked with vegetation management responsibilities are adequately trained to perform vegetation management work, according to the utility's wildfire mitigation plan, in addition to rules and regulations for safety.*
	Identification and remediation of "at-risk species"	*Specific actions, not otherwise described in other WMP initiatives, taken to reduce the ignition probability and wildfire consequence attributable to"at-risk species", such as trimming, removal, and replacement.*
	Removal and remediation of trees with strike potential toelectric lines and equipment	*Actions taken to identify, remove, or otherwise remediatetrees that pose a high risk of failure or fracture that couldpotentially strike electrical equipment.*
	Substation inspection	*Inspection of vegetation surrounding substations, performed by qualified persons and according to thefrequency established by the utility, including record-keeping.*
	Substation vegetation management	*Based on location and risk to substation equipment only, actions taken to reduce the ignition probability and wildfireconsequence attributable to contact from vegetation to substation equipment.*
	Vegetation management enterprise system	*Inputs, operation, and support for a centralized vegetation management enterprise system updated based upon inspection results and management activities such as trimming and removal of vegetation.*
	Vegetation management to achieve clearances around electric lines and equipment	*Actions taken to ensure that vegetation does not encroach upon the minimum clearances set forth in Table 1 of GO 95, measured between line conductors and vegetation, such as trimming adjacent or overhanging tree limbs.*

Category	*Initiative activity*	*Definition*
	Vegetation management activities post-fire	*Vegetation management activities during post-fire service restoration including, but not limited to: activities or protocols that differentiate post-fire vegetation management from programs described in other WMP initiatives; supporting documentation for the tool and/or standard the utility uses to assesses the risk presented by vegetation post-fire;and how the utility includes fire-specific damage attributesinto its assessment tool/standard.*
F. Grid operations and protocols	*Automatic recloser operations*	*Designing and executing protocols to deactivate automatic reclosers based on local conditions for ignition probabilityand wildfire consequence.*
	Protective equipment and device settings	*The utility's procedures for adjusting the sensitivity of grid elements to reduce wildfire risk, other than automatic reclosers (such as CBs, switches, etc.). For example, PG&E's Fast Trip Settings.*
	Crew-accompanying ignition prevention and suppression resources and services	*Those firefighting staff and equipment (such as fire suppression engines and trailers, firefighting hose, valves,and water) that are deployed with construction crews andother electric workers to provide site-specific fire prevention and ignition mitigation during on-site work.*
	Personnel work procedures and training in conditions of elevated fire risk	*Work activity guidelines that designate what type of work can be performed during operating conditions of different levels of wildfire risk. Training for personnel on these guidelines and the procedures they prescribe, from normaloperating procedures to increased mitigation measures to constraints on work performed.*
	Protocols for PSPS reenergization	*Designing and executing procedures that accelerate the restoration of electric service in areas that are de- energized, while maintaining safety and reliability standards.*
	PSPS events and mitigation of PSPS impacts	*Designing, executing, and improving upon protocols to conduct PSPS events, including development of advancedmethodologies to determine when to use PSPS, and to mitigate the impact of PSPS events on affected customers and local residents.*
	Stationed and on-call ignition prevention and suppression resources and services	*Firefighting staff and equipment (such as fire suppression engines and trailers, firefighting hose, valves, firefighting foam, chemical extinguishing agent, and water) stationed at utility facilities and/or standing by to respond to calls for fire suppression assistance.*
G. Data governance	*Centralized repository for data*	*Designing, maintaining, hosting, and upgrading a platform that supports storage, processing, and utilization of all utility proprietary data and data compiled by the utility from other sources.*
	Collaborative research on utility ignition and/or wildfire	*Developing and executing research work on utility ignitionand/or wildfire topics in collaboration with other non- utility partners, such as academic institutions and research groups, to include data-sharing and funding as applicable.*

Category	Initiative activity	Definition
	Documentation and disclosure of wildfire-related data and algorithms	Design and execution of processes to document and disclose wildfire-related data and algorithms to accord with rules and regulations, including use of scenarios for forecasting and stress testing.
	Tracking and analysis of near miss data	Tools and procedures to monitor, record, and conductanalysis of data on near miss events.
H. Resource allocation methodology	Allocation methodology development and application	Development of prioritization methodology for human andfinancial resources, including application of said methodology to utility decision-making.
	Risk reduction scenario development and analysis	Development of modeling capabilities for different risk reduction scenarios based on wildfire mitigation initiative implementation; analysis and application to utility decision making.
	Risk spend efficiency (RSE) analysis	Tools, procedures, and expertise to support analysis of wildfire mitigation initiative risk-spend efficiency, in terms of MAVF and/ or MARS methodologies.
I. Emergency planning and preparedness	Adequate and trained workforce for service restoration	Actions taken to identify, hire, retain, and train qualifiedworkforce to conduct service restoration in response to emergencies, including short-term contracting strategy and implementation.
	Community outreach, public awareness, and communications efforts	Actions to identify and contact key community stakeholders; increase public awareness of emergency planning and preparedness information; and design, translate, distribute, and evaluate effectiveness of communications taken before, during, and after a wildfire,including AFN populations and Limited English Proficiency populations in particular.
	Customer support in emergencies	Resources dedicated to customer support during emergencies, such as website pages and other digital resources, dedicated phone lines, etc.
	Disaster and emergency preparedness plan	Development of plan to deploy resources according to prioritization methodology for disaster and emergency preparedness of utility and within utility service territory (such as considerations for critical facilities and infrastructure), including strategy for collaboration with Public Safety Partners and communities.
	Preparedness and planning for service restoration	Development of plans to prepare the utility to restore service after emergencies, such as developing employeeand staff trainings, and to conduct inspections and remediation necessary to re-energize lines and restore service to customers.
	Protocols in place to learn from wildfire events	Tools and procedures to monitor effectiveness of strategyand actions taken to prepare for emergencies and of strategy and actions taken during and after emergencies,including based on an accounting of the outcomes of wildfire events.

Category	*Initiative activity*	*Definition*
J. Stakeholder cooperation and community engagement	*Community engagement*	*Strategy and actions taken to identify and contact key community stakeholders; increase public awareness and support of utility wildfire mitigation activity; and design, translate, distribute, and evaluate effectiveness of relatedcommunications. Includes specific strategies and actions taken to address concerns and serve needs of AFN populations and Limited English Proficiency populations in particular.*
	Cooperation and best practice sharing with agencies outside CA	*Strategy and actions taken to engage with agencies outside of California to exchange best practices both for utility wildfire mitigation and for stakeholder cooperation to mitigate and respond to wildfires.*
	Cooperation with suppression agencies	*Coordination with CAL FIRE, federal fire authorities, countyfire authorities, and local fire authorities to support planning and operations, including support of aerial and ground firefighting in real-time, including information-sharing, dispatch of resources, and dedicated staff.*
	Forest service and fuel reduction cooperationand joint roadmap	*Strategy and actions taken to engage with local, state, andfederal entities responsible for or participating in forest management and fuel reduction activities; and design utility cooperation strategy and joint stakeholder roadmap(plan for coordinating stakeholder efforts for forest management and fuel reduction activities).*

9.2 CITATIONS FOR RELEVANT STATUTES, COMMISSION DIRECTIVES, PROCEEDINGS AND ORDERS

Throughout the WMP, cite relevant state and federal statutes, Commission directives, orders, and proceedings. Place the title or tracking number of the statute in parentheses next to comment, or in the appropriate column if noted in a table. Provide in this section a brief description or summary of the relevant portion of the statute. Track citations as end-notes and order (1, 2, 3…) across sections (e.g., if section 1 has 4 citations, section 2 begins numbering at 5).

Table 9-1

Citations For Relevant Statutes, Commission Directives, Proceedings and Orders

WMP Section / Category	State and Federal Statutes, Commission Directives, Orders and Proceedings	Description
4.1– Lessons Learned: How Tracking Metrics on The 2020 And 2021 Plans Has Informed The 2022 Plan Update	1. Cal. Pub. Res. Code § 4292	1. Vegetation management and accompanying requirements for responsible maintenance for fire protection
4.2- Understanding Major Trends Impacting Ignition Probability and Wildfire Consequence	2. D.17-12-024 3. CPUC GO 95,Rule 31.1, App.E; GO 165; GO 166, Rule 11 4. D.20-12-030; D.19-05-038	2. Decision in Rulemaking 15-05-006 adopting regulations to enhance fire safety in the HFTD. Modified in D.20-12-030 to allow SCE to modify boundaries of HFTD within and near its service territory. 3(a). GO 95: • Rule 18: Reporting and resolution of safety hazardsdiscovered by utilities • Rule 31.1: known local condition monitoring by utility; Rule 35: Radial clearance of bare line conductors fromtree branches or foliage; Rule 38: Minimum clearances of wires from other wires • Rule 80.1: Patrol and detailed inspections, intrusive inspections • Appendix E: recommended minimum clearances that should be established, at time of trimming, between the vegetation and the energized conductors 3(b). GO 165: Standards and cycles for inspections of electric distribution and transmission facilities; 3(c). GO 166: standards for emergency response plan; 3(d). Rule 11: electric utility tariff rule governing discontinuanceand restoration of service.

WMP Section / Category	State and Federal Statutes, Commission Directives, Orders and Proceedings	Description
		4. D.20-12-030: Decision modifying HFTD maps (using approach adopted during the 2019 WMP D.19-05-038)
4.4.1– Research proposals	5. CPUC GO 95, Rule 35, Appendix E 6. SB 1339	5. Various research areas by universities relating to effectiveness of enhanced vegetation clearances, vegetation regrowth, usage of real-time dataset for de-energization and re-energization, and creation of preventive infrastructure risk profiles. 6. Definition of microgrid & facilitation of the commercialization of microgrids for distribution customers oflarge electrical corporations, Pub. Util. Code §§8370 – 8372.
4.5.2– Calculations of key metrics	7. Government Code § 8593.3; D.20-08-046 8. Rulemaking 18-12-005 9. Rulemaking 18-10-007 10. 38 CFR 17.701 11. CPUC GO 165	7. Sub. (b), definition of AFN population and disadvantaged communities 8. D.19-05-042: vulnerable populations defined and identified 9. D.20-03-004: Guidance on calculating number of households with limited or no English proficiency 10. Definition of "highly rural" 11. Definition of "rural" & "urban"
5.4 – Planning for Workforce and Other Limited Resources	12. CPUC GO 95 13. CPUC GO 128	12. Requirements for overhead line design, construction, maintenance, and qualified workers 13. Rules for construction of underground electric supply and communication system
7.2– Wildfire Mitigation Plan Implementation	14. Public Utilities Code Section 8389(e)(7)	14. OEIS issues a safety certification to SCE if WMP implementation, among other requirements, is approved.
7.3.3– Grid Design & System Hardening	15.Rulemaking 19-09-009	15. Microgrid and resiliency strategies for areas that are prone to outages

WMP Section / Category	State and Federal Statutes, Commission Directives, Orders and Proceedings	Description
7.3.4– Asset Management & Inspections	16. CPUC GO 95 17. CPUC GO 165 18. CPUC GO 95, Rule 18	16. Provides guidance on overhead electrical construction standards 17. Provides guidance on the minimum timing for inspections and maintenance 18. Requirements for reporting and resolution of safety hazards discovered by utilities.
7.3.5 – Vegetation Managementand Inspections	19. CPUC General Order 95, Rule 35 Appendix E 20. Pub. Res.Code § 4291 21. Pub. Res.Code § 4292 22. Pub. Res.Code § 4293 23. CPUC GO 174. 24. 14 Cal. Code of Regs. §§ 1252-1255. 25. D.17-12-024	19. Recommended minimum clearances that should be established, at time of trimming, between the vegetation and the energized conductors and associated live parts where practicable. 20.Maintenance of distance clearance from high voltage facilities. 21.Requirement for firebreak clearance from pole or tower. 22. Clearance maintenance of distances between vegetation and conductors. 23. Inspection program for equipment inside substations. 24. Regulations on liquid and compressed supplies, fuels, tanks, and lines 25. Decision in Rulemaking 15-05-006 adopting regulations to enhance fire safety in the HFTD. Modified in D.20-12-030 to allow SCE to modify boundaries of HFTD within and near its service territory.
7.3.6 – Grid Operations &Protocols	26. SB 167 27. D.20-05-051	26. Cal. Pub. Util. Code § 8386: Authorizes deployment of backup electrical resources or financial to customers. 28. Decision in Rulemaking 18-12-005 Risk to be mitigated /problem to be addressed Phase 2 Guidelines for PSPS; and directing IOUs to include specific actions in WMP to reduce scale, scope, impact of PSPS events.
7.3.9 – Emergency Planning and Preparedness	28. D.20-05-051 29. D.20-03-004 30. D.21-05-019 31. D.21-10-020	28. Decision in Rulemaking 18-12-005 Risk to be mitigated /problem to be addressed Phase 2 Guidelines for PSPS; and directing IOUs to include specific actions in WMP to reduce scale, scope, impact of PSPS events.

WMP Section / Category	State and Federal Statutes, Commission Directives, Orders and Proceedings	Description
		29. Decision on community awareness and public outreach before, during and after a wildfire, and explaining next steps for other phase 2 issues 30. Decision addressing Phase II issues relating to emergency and disaster preparedness plans, modifying GO 166 (Standards for Operation, Reliability, and Safety During Emergencies and Disasters) 31. Notification requirements, post-disaster community engagement and IOU reporting requirements
7.3.10 – Stakeholder Cooperation and Community Engagement	32. D.20-05-051	32. D.20-05-051, OP 1-5: IOUs to lead PSPS Working Groups that convene at least quarterly to help better inform the electric IOUs regarding how to plan and execute de-energization protocols and (2) coordinate service area-wide Advisory Boards to provide valuable input into a utility's planning for de-energization events
8.1.4 - Company standards relative to customer communications	33. D.21-06-034 34. D.19-05-042; D.20-05-051	33. Decision adopting Phase 3 with additional guidelines and rules for PSPS of electric facilities and mitigation of wildfire risk 34. Customer self-certification as having a serious illness or condition that could become life-threatening if disconnection occurs, and requiring in-person notification prior to disconnection for non-payment
8.4.1 – Vulnerable Communities	35. D.19-05-042	35. Decision in Rulemaking 18-12-005 defining AFN Population Decision in Rulemaking 18-10-007 requiring IOUs to conduct community awareness and public outreach before, during, and after a wildfire in any language that is "prevalent" in its service territory or portions thereof.
8.4.4 - Community Outreach for PSPS	36. D.20-03-004	36. Decision in Rulemaking 18-10-007 increasing the number of prevalent languages.

WMP Section / Category	State and Federal Statutes, Commission Directives, Orders and Proceedings	Description
8.6 – Identification of frequently de-energized circuits	37. Cal. Pub. Util. Code Sec. 8386(c)(8); SB 533	37. SB 533 amended Section 8386 requiring updates to identify circuits with frequent wildfire mitigation related de-energizations and the measures to be taken to reduce the need for and impact of such de-energizations
9.4 – Undergrounding Implementation Report	38. GO 165 39. GO 128	38. Operation of underground system within its established ampacity and rating; maintenance of cable infrastructure; including inspection and maintenance per regulatory requirements 39. Rules for construction of underground electric supply and communication system

9.3 Covered Conductor Installation Reporting

In Section 7.3.2.3.3, Covered Conductor Installation, report on the following key information for covered conductor installation:

- *Methodology for installation and implementation (prioritization)*
- *Design and design considerations (such as selection of type of covered conductor, additional hardware needed for installation, pole strengthening or replacements, etc.)*
- *Implementation (including timeframes, prioritization, contractor and labor needs, etc.)*
- *Long-term operations and considerations (including maintenance, long-term effectiveness and feasibility, effectiveness monitoring, etc.)*
- *Key assumptions*
- *Cost effectiveness evaluations (including cost breakdown per circuit mile, comparison with alternatives, etc.)*
- *Any other activities relevant to the covered conductor installation*

This information must be derived from utility-specific programs and supplemented by the findings of the covered conductor working group.

SCE provides key information pertaining to the installation and implementation of covered conductor. This is largely based on SCE's Distribution Overhead Construction Standards (DOH), which governs the methods and practices of covered conductor installation for SCE.[252] SCE updates its DOH as needed as more information is learned through testing, benchmarking, installation, and inspections.

Methodology for installation and implementation

SCE installs covered conductor in open-crossarm configuration shown on the left image in Figure SCE 9-1, the same configuration used in SCE's bare wire systems. In this configuration, the conductor is self-supporting and attached to insulators on crossarms at the structure. An open-crossarm is different from a spacer cable system shown on the right image in Figure SCE 9-1, where the covered conductor is supported by a high strength messenger through diamond shaped spacers. While SCE is in the process of piloting the spacer cable system, none have been installed as part of the WCCP.

[252] Covered conductor specific pages from the DOH can be found on CC100-CC190.

Figure SCE 9-1

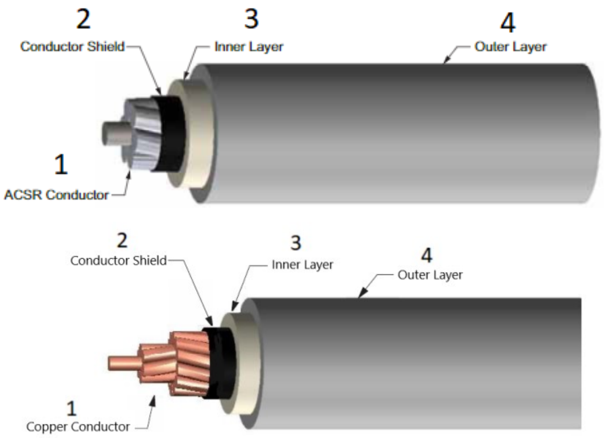
Covered Conductor in Open-Crossarm Configuration (Left) and Spacer Cable Configuration (Right)

Design and design considerations (such as selection of type of covered conductor, additional hardware needed for installation, pole strengthening or replacements, etc.)

The covered conductor SCE uses is a conductor that is protected by layers of insulating material. There are four components that comprise this type of covered conductor: the conductor, the conductor shield, the inner layer, and outer layer. This is illustrated in Figure SCE 9-2 below.

Figure SCE 9-2

Cross-section of ACSR Covered Conductor (left) and Copper Covered Conductor (right)



Descriptions of the four components are as follows:

1. Conductor: Either Aluminum Conductor Steel-Reinforced (ACSR) or Hard Drawn Copper (HDCU). Copper covered conductor is primarily for coastal applications due to copper being more resistant to corrosion than aluminum.

2. Conductor Shield: The conductor shield is a semi-conducting thermoset polymer that is designed to reduce electrical stress should any object make contact with the covered conductor, making the covered conductor more robust.

3. Inner Layer: The inner layer is Crosslinked Low Density Polyethylene (XL-LDPE), an insulating material that helps protect the conductor from phase-to-phase or phase-to-ground contact faults.

4. Outer Layer: The outer layer is Crosslinked High Density Polyethylene (XL-HDPE), which is also an insulating material, but because it is high density, it is a tougher layer that provides abrasion and impact resistance. Additional additives, such as UV resistance and track resistance, are included in the outer layer to prevent the degradation of the covering.

Design Considerations Regarding Voltage and Loading Characteristics:
SCE has two covered conductor designs that vary depending on system voltage requirements. These include 17 kV[253] and 35 kV covered conductor designs, the former of which SCE utilizes on its 2.4 kV, 4 kV, 12 kV and 16 kV distribution systems, and the latter of which SCE utilizes on its 25 kV and 33 kV distribution systems. The primary difference between these two designs is the thickness of the inner and outer layers (components 3 and 4 in Figure SCE 9-2). 35 kV covered conductor design has a thicker covering, allowing it to withstand intermittent contact at higher voltages. Additionally, SCE uses four ACSR conductor sizes (1/0 AWG,[254] 336.4 (18x1) AWG, 336.4 (30/7) AWG, and 653.9 AWG) and three copper conductor sizes (#2 AWG, 2/0 AWG, and 4/0 AWG). Circuit and customer loading requirements will determine the conductor size. SCE may also use higher strength conductors to resolve ground clearance issues in areas subject to ice.

Design Considerations for Structures and Equipment Supporting Covered Conductor:
SCE's covered conductor system also includes the installation of composite or fire-resistant wrapped poles (together known as fire-resistant poles (FRP)) (Figure SCE 9-3), composite crossarms (Figure SCE 9-4), wildlife covers (Figure SCE 9-5), surge arresters (Figure SCE 9-6), polymer insulators (Figure SCE 9-7), and vibration dampers (Figure SCE 9-8). These components are further described below.

FRPs: As part of SCE's WCCP, SCE uses FRPs when pole replacements are required to meet pole loading criteria. Composite poles are fiber-reinforced polymer utility structures. They are resistant to corrosion, chemicals, and rot. They are non-conductive and environmentally friendly. When compared to wood poles of the same class and size, composite poles are lighter in weight and have the capacity to carry more load under emergency conditions. The fire-resistant wrap is an intumescent (swelling up when heated) grid made of 23-gauge galvanized steel grid coated with a durable intumescent polymer. When exposed to elevated temperatures (greater than 300° F), either from direct flame contact or radiant heat, the wire mesh will expand via its intumescent

[253] The 17 kV accounts for 99% of the covered conductor installed thus far.
[254] American Wire Gauge is a U.S. standard set of conductor sizes.

properties and form a barrier that protects the wood pole. Once a direct flame is removed, the fire-resistant wrap will self-extinguish.

Figure SCE 9-3

Composite Pole (Left) and Fire-Resistant Wrapped Pole (Right)

Composite Crossarms: SCE’s present standards require covered conductor systems in HFRA be constructed with composite crossarms instead of traditional wood crossarms as it is possible for current to track on the wood crossarm. For instance, this can happen in areas near the coast and if the wood crossarm gets wet frequently, which could potentially lead to a pole top fire. Like composite poles, composite crossarms provide two benefits regarding ignition prevention: they can reduce pole top ignitions because they are less likely to conduct current than wood crossarms, and they are fire resistant and therefore less likely to ignite in the event of equipment failure or conductor contact.

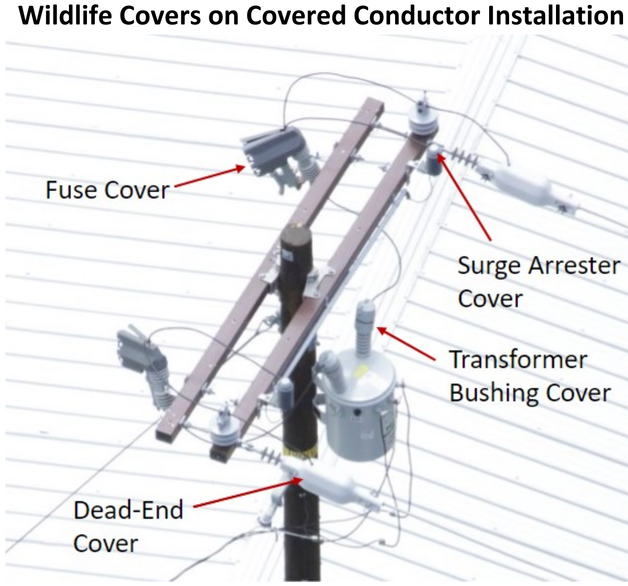
Figure SCE 9-4

Composite Crossarms

Wildlife Covers: SCE employs wildlife covers on covered conductor systems to mitigate contact risk at exposed connection points. Wildlife covers are installed on dead-ends, terminations, connectors, and equipment bushings. By covering other equipment, contact-from-object faults may be prevented not only with the conductor, but with other energized sources as well. Figure SCE 9-5 shows wildfire covers on a covered conductor system.

Figure SCE 9-5

Wildlife Covers on Covered Conductor Installation



Surge Arresters: Benchmarking and research indicated that burn downs are more likely to occur on covered conductor without additional surge protection. If an arc is generated on a covered conductor line due to an overvoltage event, such as lightning, the covering will not allow the arc to move. Therefore, an increased amount of surge arresters is used in covered conductor systems to provide efficient protection. Regardless of actual lightning density, SCE follows surge arrester installation guidelines for High Lightning Density areas in all covered conductor systems. Surge arresters will be installed at specific equipment installations and at overhead to underground transitions. These guidelines will help mitigate potential damage caused by overvoltage events.

Figure SCE 9-6

Surge Arrester

Polymer Insulators: Covered conductor installations require the use of polymer insulators. The use of non-polymer insulators, such as porcelain insulators, can cause damage to the outer layer of the covered conductor.

Figure SCE 9-7

Polymer Insulator

Vibration Dampers: In areas below 3,000 feet in elevation or high-tension installations, SCE requires the use of vibration dampers to mitigate conductor damage due to Aeolian vibration. Aeolian vibration may occur when 2 to 15 mile-per-hour winds flow across the conductor. Other factors, such as tension and terrain, can affect the likelihood of Aeolian vibration. Over time, Aeolian vibration can cause conductor failure due to conductor fatigue or abrasion.

Figure SCE 9-8

Types of Vibration Dampers: Stockbridge (left) and Spiral (right)

With respect to PSPS considerations, a circuit-segment that has covered conductor can offer PSPS reduction benefits in terms of wind threshold increases. However, these PSPS reduction benefits cannot meaningfully be realized unless SCE is able to electrically isolate that circuit-segment from its contiguous circuit-segments that still have bare conductor. Thus, SCE must install covered conductor to the next structure with an isolatable device, such as a RAR, which will allow for isolation of the covered portion of the circuit from the bare portion of the circuit. In order to achieve this PSPS benefit for an isolatable portion of a circuit, then, additional circuit miles may be required beyond those driven by POI risk. These circuit miles will be determined on a case-by-case basis during scoping and design based on the feasibility to operationalize this benefit.

Implementation (including timeframes, prioritization, contractor and labor needs, etc.)

Figure SCE 9-9 below shows an average timeline of covered conductor implementation and highlighted activities within each phase of work. Covered conductor has an estimated timeframe of 16 to 24+ months from initial scoping to in-field project completion. This estimate does not include the time between in-field project completion to work order close-out. SCE utilizes wildfire risk models to deploy covered conductor effectively and efficiently. In the **Initiate Phase**, scope is determined based on SCE's current risk model. SCE prioritizes the circuit-segments based on risk using its WRRM. Variables accounted for in the model include contact-from-object and equipment failure risk reduction. The modeling results, along with operational factors and constraints, determine the prioritization of covered conductor deployment, ensuring that areas with the highest risk of ignition are targeted. SCE has continuously improved its wildfire risk modeling since the inception of the WCCP. Improvements over the years include incorporating ML to predict the POI at specific locations, incorporating asset condition data points, and incorporating more advanced wildfire consequence data to refine risk results. Prior to the Plan Phase, the scope is reviewed for operational considerations, crosschecked with previously installed covered conductor circuit segments, and revised accordingly as needed. This phase usually takes two to three months to complete, assuming there are no competing resources for scoping.

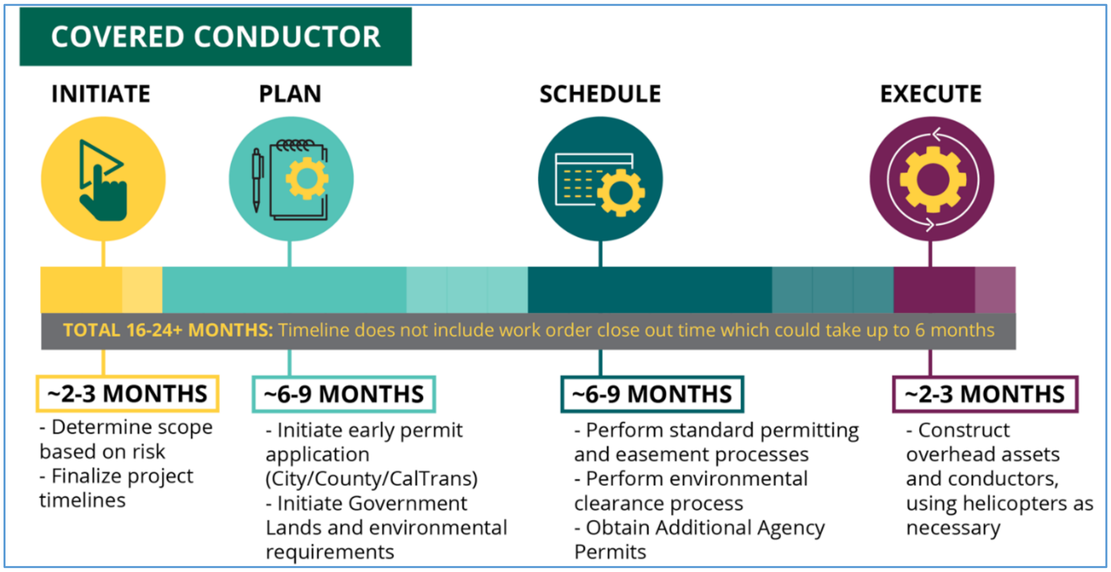
Once scoping is finalized, work is moved to the **Plan Phase**. During this phase, a project manager is assigned to oversee the work and design resources are assigned to initiate the work order, design the project, map the circuit miles, procure the materials, and initiate obtaining permits. On average, this process takes six to nine months assuming there are no completing resources for planning and no delays in environmental/agency approvals.

Once the covered conductor work is fully designed, permitted (including obtainment of easements), and cleared of environmental constraints, it gets authorization to proceed and is provided to SCE's regional districts for the **Schedule Phase**. Scheduling is where materials are acquired, permits are verified, work is scheduled, and circuit maps are revised if found inconsistent with what is shown in the database. Design resources and project management teams also collaborate with customers, local governments and state agencies to provide project details to obtain necessary easements prior to the start of construction. In general, SCE looks to first address those circuit-segments and circuits which present the greatest risk. However, SCE will often bundle work related to multiple and/or contiguous circuit-segments together to achieve operational efficiencies. For example, the risk associated with each circuit may not be uniform along its length. In other words, the risk can vary between a specific mile or segment within a circuit, especially if that circuit traverses various parts of HFRA and is exposed to different probabilities of ignition by contact-from-object, or varying topography and vegetation that can influence fire propagation and consequence. In some cases, it may be operationally efficient and prudent to remediate relatively lower risk segments of a circuit at the same time relatively higher risk segments of the same circuit are addressed, instead of sending multiple crews out at multiple different times, requiring the development of separate work scope packages. Bundling work can also reduce community and environmental impacts by working in a location once versus sending crews to the same area multiple times. Scheduling can take between six to nine months.

Once the project is ready to start, construction will proceed with necessary environmental monitoring if that is required during the **Execute Phase**. There are many factors that may affect the construction timeline including, for example, the size of the project, location of the project, terrain, environmental restrictions, weather (e.g., rain/snow, RFW days, etc.), resource availability and ensuring adherence to city requirements. Every project will have unique factors that impact project timelines. QEWs are required to perform the electrical construction work. SCE uses a combination of SCE and external contractor crews to perform this work. The determination of which to utilize is based on crew availability, work priorities, location, and other factors. Because there are numerous factors that can impact the Execute Phase, the average timeline in Figure 9-9, below, includes 2-3 months for the execution phase that assumes relatively good conditions, e.g., minimal agency requirements, no environmental restrictions, no RFW days, etc. Under challenging conditions, e.g., access issues, difficult terrain, environmental constraints, significant agency requirements, etc., the execution phase can take up to 6-12 months.

Figure SCE 9-9

Timeline of Covered Conductor Work



Long-term operations and considerations (including maintenance, long-term effectiveness and feasibility, effectiveness monitoring, etc.)

SCE performs regular inspections of its covered conductor installations through its Overhead Detail Inspection[255] and High Fire Risk-Informed Inspections (IN-1.1).[256] SCE will continue to monitor covered conductor installations and installation practices to identify any need for supplementary maintenance and inspection. Please see Section 7.3.3.4 for a discussion on Covered Conductor Maintenance.

In addition to regular inspections, SCE's T&D organization has a C&Q group that develops QC and QA processes to help ensure that mitigation activities are proceeding as planned. C&Q assesses wildfire and non-wildfire activities to measure conformance and drive continuous improvement throughout the organization.

The useful life of covered conductor is estimated to be 45 years with no degradation of performance within that time-period. SCE is actively monitoring the effectiveness of covered conductor installations. Although data is limited since covered conductor has only been used at SCE for a few years, preliminary analyses aimed at validating the effectiveness of covered conductor have shown promising results. Since 2018, SCE has documented known contact-related events with covered conductor. In one instance, a tree fell on covered conductor lines, making contact with all three phases. In another case, energized covered conductor lines fell into adjacent trees after a vehicle struck a pole. These did not result in faults, wires

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[255] SCE performs ODI to identify above-ground asset conditions that may lead to malfunction or failure, and to comply with GO 165 requirements.

[256] In HFRA, SCE conducts more frequent and ignition-focused risk inspections (beyond GO 165 requirements). These HFRI inspections take place from the ground and air (using drones and helicopters) to provide a 360-degree view of the assets.

down, or ignitions because covered conductor was deployed. A fault would have occurred if the conductor was bare wire, which could have resulted in an ignition, as experienced in previous events.

SCE has a new Vibration Damper Retrofit (SH-16) activity in this 2022 WMP Update to address instances of Aeolian Vibration[257] on covered conductor installations (see Section 7.3.3.3.3). SCE performed a study to determine the susceptibility of 2018 to 2020 covered conductor installations to Aeolian vibration. This study found that in those areas with high and medium susceptibility there was a potential reduction in useful life of the covered conductor. Therefore, SCE is adding vibration dampers to those locations deemed susceptible to Aeolian Vibration and has included vibration dampers as part of its construction standards, where applicable, for installations starting in 2021.

Key assumptions

SCE is closely monitoring the impacts of the COVID-19 pandemic and other emergent needs (e.g., storm conditions) on resource availability to perform the planned work for covered conductor installation for 2022. If challenges arise which greatly impact SCE's plans as communicated in this 2022 WMP Update, SCE will notify OEIS in a timely manner.

Cost effectiveness evaluations (including cost breakdown per circuit mile, comparison with alternatives, etc.)

SCE regularly performs a region-by-region cost analysis to track the performance of the unit capital cost (direct costs only) of completed covered conductor projects across its service area. In Table SCE 9-1 below, SCE is providing the unit cost breakdown for the covered conductor circuit miles completed in its nine regions (see Figure SCE 9-10). This analysis was calculated using closed work orders for the circuit miles installed in 2021.[258]

Table SCE 9-1

Capital Cost (Constant 2021$) per Circuit Mile of Covered Conductor Across SCE's Service Area by Region

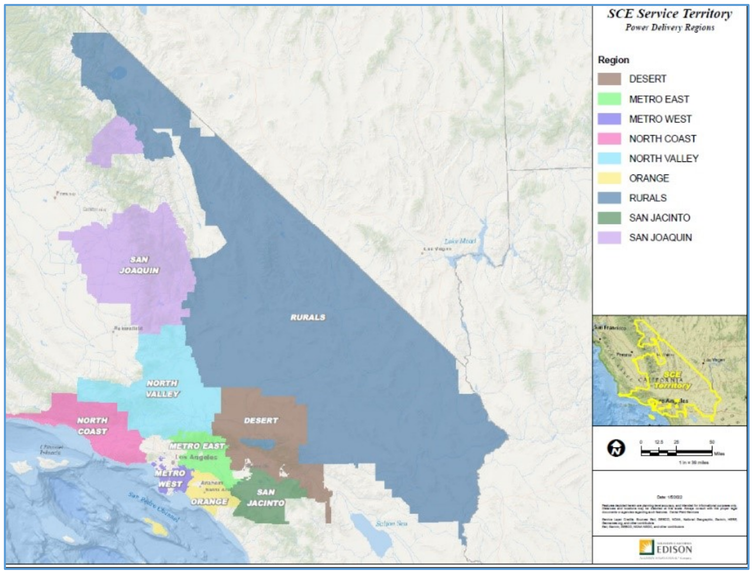
Region	Circuit Mile	Total Cost with Residuals	Cost per Mile
Desert	178	$ 90,192,264	$ 505,760
Metro East	17	$ 8,438,905	$ 496,698
North Coast	242	$ 139,700,896	$ 578,400
North Valley	355	$ 193,878,855	$ 546,467
Orange	38	$ 20,359,359	$ 529,502
Rurals	149	$ 114,050,895	$ 767,497
San Jacinto	354	$ 182,075,330	$ 513,971
San Joaquin	98	$ 46,715,039	$ 476,198
Grand Total	**1,431**	**$ 795,411,543**	**$ 555,828**

257 Aeolian vibration is wind-driven vibration that may lead to conductor abrasion or fatigue over time.

258 SCE added a 3% residual costs to these closed work orders to account for anticipated trailing costs in 2022. Examples of trailing costs may include the remaining costs of the committed purchase orders to the contractors and resulting overhead applied to those remaining costs.

Figure SCE 9-10

SCE's Service Area



Findings of Analysis:

Based on this analysis, the average direct capital cost per mile of covered conductor is approximately $556,000 which includes the cost of installing FRPs. The unit cost varies by region[259] due to, but not limited to, terrain type and contract crews that perform the work. In previous years, the North Coast region had the highest unit cost relative to other regions. However, in 2021, the Rurals region was the highest mainly due to having a higher cost contract crew performing work and an extended construction timeline due to the challenges working in this type of terrain.

Cost Evaluations of Other Alternatives:

REFCL: SCE has different system designs some of which are easier to covert to REFCL than others. The main drivers of complexity are how distribution transformers are connected, whether space exists in the substation for additional equipment, and size. The estimated costs to install REFCL at a substation vary from about $2 million to more than $100 million but current actual installs will all be on the low-end of that cost range. An installation will cover all circuitry out of a substation which at a small substation can be as little as 20 miles of circuitry or more than 500 miles at a large substation. The high-end of the cost range is from substations which feed mostly phase-to-neutral connected load which may require almost complete rebuilds of the circuits to make them compatible. The most expensive sites, i.e., large substation

[259] The North Coast region runs along various terrains such as steep coastal and mountainous plains. The Metro East region has a variety of hills, flats, and mountainous terrains. The Metro West region has a primarily coastal community. The San Joaquin region has foothills and forested terrains. The Orange region has a variety of terrains, from flat valleys to several hills and mountainous landscapes. The area also runs through a coastal community. The Rurals region runs along various terrains such as flat, highly mountainous, and forested terrains. The North Valley (Antelope Valley, Tehachapi, and Valencia) region's terrain combines desert and foothills. The Desert region has foothills and mountainous terrains. The San Jacinto region is primarily of flat and desert terrain.

rebuild projects, are unlikely to have a competitive RSE until techniques for replacement of phase-to-neutral connected transformers are improved. Also challenging are small substations which cannot fit the equipment and thus will require a new substation to be constructed at a different site. However, these substations might be good sites for the installation of isolation transformers targeting the high fire sections of circuitry because the phase-to-neutral connected transformers are often outside HFRA. All of SCE's active projects have an estimated cost of under $10 million. For comparison, the capital cost to install the Ground Fault Neutralizer at Neenach substation in 2021 was approximately $4.5 million at the time of energization and the project covered approximately 170 miles of circuitry.

Targeted Undergrounding: At the inception of the wildfire mitigation program in 2018, SCE utilized the costs associated with Rule 20A undergrounding projects as a proxy for future undergrounding projects in its HFRA. Based on that preliminary analysis, the average cost per mile to underground overhead distribution lines was approximately $3.8 million (2022 $).[260] SCE further performed a desktop undergrounding cost analysis on the top 100 riskiest circuits in its HFRA. The result of this analysis was consistent with the Rule 20A projects coming in at approximately $3.5 million per circuit mile. The study showed that the costs could vary from $1.5 million to $5.5+ million dollars depending on construction methodology including additional re-routing, locational and operational factors. Please refer to Appendix 9.4 below for more details.

Spacer Cable: In selected situations, SCE plans to use a spacer cable system in which covered conductor is attached to spacer hardware that is suspended from a supporting messenger line (See Figure SCE 9-1). The messenger line has high tensile strength, is attached to the pole via side-arm hardware and supports the weight of the covered conductor at the pole and along the span. The messenger line is specifically designed to withstand the weight of a falling tree branch. Anticipated use of the spacer cable system is primarily limited to heavily forested areas and certain circuit spans in areas of dense vegetation. In particular, the spacer cable system may be used for the replacement of SCE's existing tree attachments, discussed below. The direct capital costs associated with spacer cable installation are estimated to be approximately $1.0 million per circuit mile based on estimates from planning the pilot. Once the spacer cable pilot is complete, SCE will have a more refined cost estimate.

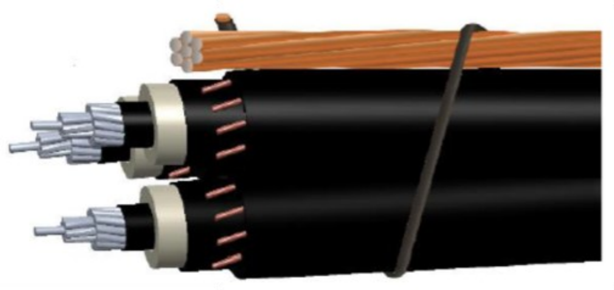
Aerial Bundled Cable: In the 2000s, SCE began using manufacturer-assembled or bundled cable, known as Aerial Bundled Cable (ABC). Deployment of legacy-designed covered conductor (tree wire) or ABC was guided mainly by potential reliability benefits, typically considered only in areas of dense vegetation where there are limitations on SCE's ability to trim trees. Depending on the application, SCE uses 1 conductor, 2 conductor, or 3 conductor ABC, which is an installation of underground cable on poles for the overhead distribution system (see Figure SCE 9-11). Direct capital costs associated with ABC

[260] While the costs for Rule 20A projects were a good estimation of future undergrounding projects, those costs did not account the following things: (1) additional miles may be needed when converting overhead circuit miles to an underground system. This re-routing factor could be as much as four times the overhead length as underground lines are routed through roads or to avoid obstacles; (2) reduced O&M activities over the life of undergrounding (e.g., reduced or eliminated the need for vegetation management, reduced asset inspection frequency, etc. In a robust study, we would sum up those benefits and calculate a net present value); (3) PSPS benefits; (4) longer term potential for cost reductions as industry and other utilities improve based on experience. Conversely, the Rule 20A analysis included costs associated with undergrounding telecom and secondaries, whereas targeted undergrounding would likely not include those.

installation are estimated to be approximately $1.4 million per circuit mile based on a small subset of completed tree attachment remediation and other work orders.

Figure SCE 9-11

Aerial Bundled Cable (3 Conductor)



Any other activities relevant to the covered conductor installation

SCE ensures that our inspection programs, as described in Section 7.3.4.9.1, address covered conductor by including specific covered conductor-related questions in the inspection survey, as shown below. For applicable areas, SCE installs vibration dampers as discussed above. Additionally, based on research, SCE still needs to perform vegetation management since prolonged contact-from-objects such as trees, i.e., longer than six months,[261] may cause the covered conductor to fail.

As noted above, below are covered conductor-related questions that are included in the Distribution Ground Inspection Survey:

What type(s) of primary conductors are installed? Select all that apply.
NOTE: Only select primary conductor sizes and NOT taps/jumpers. Covered is tree wire. Aerial cable is bundled cable.

- Covered/insulated
- Copper
- Aluminum
- Aerial cable

For covered conductor – select all applicable directions covered conductor is installed? Select all that apply or select "No primary covered conductors installed".

- North
- South
- East
- West
- No primary covered conductor installed

[261] Wareing, J.B, "Covered Conductor Systems for Distribution." EA Technology, December 2005.

For covered conductor – indicate if any of the following covered conductor covers are missing. Select all that apply or select “No missing covered conductor covers” or select “No primary covered conductor installed”.

- Dead-end cover (Notification Required)
- Bare Tap (Notification Required)
- Connector cover (Notification Required)
- Fuse cover (Notification Required)
- Lightning arrestor cover (Notification Required)
- Equipment bushing cover (Notification Required)
- Pothead cover (Notification Required)
- No primary covered conductor installed
- No missing covered conductor cover

If covered conductor is installed, are there visible signs of tracking or damage on the outer jacket?

- Yes (Notification Required)
- No
- No primary covered conductor installed

For covered conductor – Are lightning arresters installed on structures containing the following equipment: RAR, RSR, Capacitors, Voltage Regulators, PTs associated with RCSs and PE equipment, Transformers, BLFs, and UG Dips?[262]

- No (Notification Required)
- Yes
- No primary covered conductor installed
- No primary equipment present

For covered conductor – For line connections (excludes connections to equipment), what jumper is used?

- PGW (Notification Required)[263]
- Bare wire (If bare, will need to be covered with split tube) (Notification Required)
- Covered Conductor
- Wire with split tube
- No covered conductor installed

[262] RAR = Remote-Controlled Automatic Recloser, RSR = Remote Sectionalizing Recloser, PT= Potential Transformers, PE = Preferred Emergency, RCS= Remote Controlled Switch(es), BLF = Branch Line Fusing.

[263] PGW = Protected Ground Wire.

9.4 Undergrounding Implementation Reporting

In Section 7.3.3.16 Undergrounding of electric lines and/or equipment, report on the following key information for undergrounding implementation:

- *Methodology for installation and implementation*
- *Design and design considerations (such as permitting requirements, additional hardware needed for installation, etc.)*
- *Implementation (including timeframes, prioritization, contractor and labor needs, etc.)*
- *Long-term operations and considerations (including maintenance, long-term effectiveness and feasibility, effectiveness monitoring, etc.)*
- *Key assumptions*
- *Cost effectiveness evaluations (including cost breakdown per circuit mile, comparison with alternatives, etc.)*
- *Any other activities relevant to the undergrounding implementation*

This information must be derived from utility-specific programs.

SCE designs, constructs, and maintains its underground systems to ensure industry-best practices, specifications, and regulatory requirements are met, if not exceeded to ensure safety and reliability. Below, SCE outlines key information pertaining to the installation and implementation of underground structures for electrical facilities based on SCE's Underground Structures Standards (UGS). SCE describes design considerations, including pre-construction permitting requirements and long-term operation considerations including monitoring and maintenance. SCE also provides a cost-effectiveness analysis in comparison with alternatives such as covered conductor.

Methodology for installation and implementation

The most common undergrounding approach is by open trenching. This method entails saw cutting the existing asphalt or concrete street (if the trench is located in the street) and excavating a trench with a backhoe, trencher, or rock wheel. The most common equipment used for excavation is a backhoe as it can easily navigate around the existing utility infrastructure that cross the path of the trench being excavated. Backhoes, trenchers, or rock wheels are the primary methods used for open trenching, particularly if the conduit bank is to be encased in concrete.

Figure SCE 9-12

Encasement Being Poured on a Conduit Bank

The second method is Horizontal Directional Drilling (HDD), also known as Directional Boring. This method entails the use of a bore rig that bores a hole in the ground from one point to another for the installation of a conduit(s). HDD requires that all existing utilities be potholed[264] prior to the boring operation, and depending on the number of potholes required, the asphalt repair could be extensive due to some governing agencies preference of not having “numerous” potholes in their street and as a result they would require additional asphalt grinding and re-paving the length of the entire conduit run in these areas. There can be limitations to HDD due to the presence of rock, which impedes the HDD operation (e.g., in rocky terrain typically found in the foothills near mountains and in the mountains themselves). Conversely, HDD may be a required method of conduit installation due to site conditions or in environmentally sensitive areas, such as areas traversing an unlined wash near endangered species/habitat.

The trench size is approximately 24” wide and anywhere from 36” to 62“ deep depending on number of conduits required. Vaults and manholes will be required at regular intervals along this trench to accommodate cable pulling and electrical connections as well as any underground equipment being relocated from the overhead system. These structures vary in size from 7’x18’x8’ for the largest vaults to 5’x10’6”x7’ for the smallest standard manhole. For previous Targeted Undergrounding installations, SCE only addressed primary conductors and did not include any secondary conductor nor communications infrastructure. Going forward, SCE may include both primary and secondary conductors and may not be including any communications infrastructure in the program.

Design and design considerations (such as permitting requirements, additional hardware needed for installation, etc.)

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[264] Act of exposing existing marked sub-surface utility structures to verify their location and depth before trenching.

The operating voltage level for distribution underground cable in SCE's system is 4 kV to 33 kV. Our current underground cable system standard requires the installation of Crosslinked Polyethylene cable (XLPE) installed in PVC conduit,[265] which can be direct buried or encased in concrete with a two-sack slurry backfill, Class II Base, or native backfill for three conduits or more.[266]

Once potential undergrounding segments are identified using a risk-informed methodology, the next step is to perform a constructability review to determine whether the underground design can be safely constructed in the field per current standards. There are additional factors that determine whether a project receives approval to proceed by key stakeholders involved in the process. A constructability review is conducted by a team of SMEs who evaluate if the specific targeted locations can be converted from overhead to underground. Constructability is determined by assessing the terrain and topography to ensure the targeted locations are suitable to meet our current standards. For example, a particular circuit segment may appear reasonable for implementation given its risk ranking, however, the circuit segment may be located on a narrow two-lane highway in the mountains traversing a federal forest making it difficult to construct safely and economically. SCE's design considerations are carefully reviewed for potential underground projects before initiating them, as there can be many challenges that are unknown during initiation. For any given underground project, challenges such as easements, permitting, and ROW issues are determined as the scheduling or execution work begins. An important and necessary part of the design considerations is acquiring easements[267] and adhering to environmental permitting[268] requirements. The process to obtain these permits may be lengthy. For these reasons, SCE identifies, assesses, and initiates projects above planned yearly targets as contingency for these unknown constraints.

SCE continually looks to evaluate/update standards by considering the latest available technology and gathering benchmarking information from other utilities to implement best practices for design to reduce costs.

Implementation (including timeframes, prioritization, contractor and labor needs, etc.)

Figure SCE 9-13 below shows an average timeline of undergrounding implementation and highlighted activities within each phase of work. Undergrounding has an estimated timeframe of 25 – 48+ months from initial scoping to in-field project completion. This estimate does not include the time between in-field project completion to work order close-out. The activities within the phases of undergrounding are similar to what is described for covered conductor in Section 9.3 above (e.g., determine scope, initiate early permits, etc.). However, the length of time for the **Plan**, **Schedule**, and **Execute** phases are several months longer. Additionally, the average time range for the **Plan**, **Schedule**, and **Execute** phases is wider

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[265] If the location is a residential tract, then concrete encasement is not required regardless of the number of conduits in the trench.

[266] A slurry made using rock, sand, cement, water and sometimes fly ash is primarily used to cover utility lines. A Class II base is made from a mixture of different sizes of crushed rocks. A native backfill indicates a backfill comprised of material that is excavated from the project site.

[267] An easement is a right for a utility to use a portion of a real estate that they do not own for utility work. Permits must be obtained from various agencies such as city or county governments.

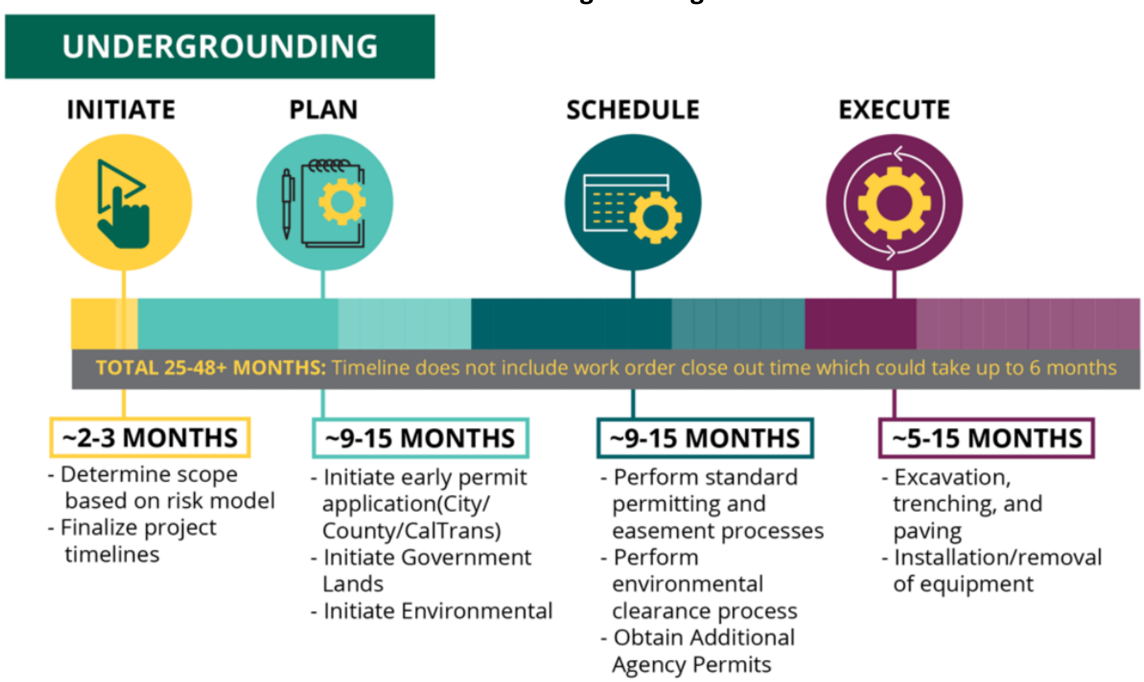
[268] Environmental permits must be obtained and any special execution requirements in order to protect the environment must be identified.

than covered conductor because 1) SCE has installed thousands of miles of covered conductor compared to its wildfire mitigation undergrounding miles and 2) undergrounding has more risk factors including, for example, agency requirements, land rights, rerouting and cultural discoveries. As SCE completes more wildfire mitigation undergrounding, these ranges should be reduced.

For the **Execute Phase** of undergrounding, depending on the scope and location of the project, community outreach may be required. There are also numerous other resources that act in support of project execution. Resources will work to schedule outages, when an outage is required to perform the undergrounding work and whether generation is necessary to support the existing customers on the circuit during an outage. Also, SCE resources develop and schedule alternate traffic plans as needed based on applicable laws of the city where work is taking place. Once the project is ready to start, construction will proceed with necessary monitoring to help ensure adherence to the design standards. Even after construction has started, delays can occur due to weather (e.g., rain/snow, RFW days, etc.), material delays, permit requirements, and environmental constraints (e.g., nesting birds). SCE estimates the average construction time to be from 5-15 months, which assumes no significant delays. To complete the construction, both civil crews and QEW electrical crews are required to perform the work. For the approximate six miles of undergrounding installed in 2021, most of the work was performed by SCE crews.Similar to covered conductor, there are many factors that may impact the total project lifecycle, including permitting and environmental requirements, easements, geography and terrain, construction resource availability, and other construction related factors.

Figure SCE 9-13

Timeline of Undergrounding Work



Long-term operations and considerations (including maintenance, long-term effectiveness and feasibility, effectiveness monitoring, etc.)

Undergrounding distribution circuits has some advantages when comparing to reconductoring overhead circuits with covered conductor. In addition to aesthetics benefits, undergrounding improves reliability by almost completely eliminating contact-from-object events, enhances safety by specifically minimizing car hit pole instances, more completely addresses risk drivers associated with ignitions, and provides egress risk mitigation in certain applications.

With respect to the O&M of SCE's underground systems, SCE has written standards and guidelines and utilizes leading edge software systems to house inspection and operating data to allow for effective monitoring and analysis of the undergrounding system. As an example, underground cable and conduit systems are designed and specified to meet rating and ampacity requirements to serve customer loads. The installed cable infrastructure is operated in real time based on established system planning criteria with monitoring using SCE's Supervisory Control and Data Acquisition (SCADA) system. The SCADA system provides system operators with a pulse of the system and if any issues arise such as an electrical fault, they can dispatch the appropriate crews to respond accordingly, whether to make the system safe or restore service. Underground inspections are more costly than overhead inspections but can be performed less frequently. Also, typically it takes longer to resolve underground faults compared to overhead faults.

Operating the underground system within its established ampacity and rating provides an indirect means to maintain the cable infrastructure by not exceeding its design limits and thus meet its asset expected life (45 years). In addition to this, however, is the established CPUC GO 165[E37] and GO 128[E38], that institutes the inspection and maintenance regulatory requirements that SCE complies with or exceeds.

Undergrounding may have some long-term benefits with respect to future avoided costs and PSPS considerations. For example, as more circuit miles are undergrounded in HFRA, the need to inspect/maintain structures and perform tree trimming could be reduced compared to overhead distribution lines resulting in potential cost savings. Additionally, undergrounding in HFRA will reduce the frequency of PSPS de-energizations.

Key assumptions

Prior to 2022, the process of scoping undergrounding deployment involved multiple steps. SCE's engineering planners identify a certain number of miles that are operationally feasible to deploy at a given time. SCE then reviews a list of all circuit segments in SCE's HFRA and eliminates the segments that are already in-flight or scoped for covered conductor. From that reduced list, SCE prioritizes the circuit segments based on risk using WRRM. SCE then applies the mitigation effectiveness of covered conductor and undergrounding and generates "mitigated risk" values for both options for each circuit segment. Each circuit-segment is then assessed to determine the highest delta of mitigated risk between both mitigation options of undergrounding versus covered conductor. Local districts and SCE's ERM are consulted to identify and incorporate locations with known egress issues. This methodology, as well as considerations of undergrounding constructability and potential risk of PSPS de-energization, helps SCE engineers evaluate all HFRA circuits to determine specific circuits that would benefit most from undergrounding.

Given the significant ignition and PSPS risk mitigation benefits and interest among external stakeholders to consider undergrounding, in 2021 SCE undertook an additional effort developing new tools to methodically identify qualitative risk factors to further expand its undergrounding scope. These factors include, but are not limited to, population egress, historical fire frequency, as well as those locations with extreme winds and/or dense tree cover to ultimately identify locations which may benefit from additional hardening such as targeted undergrounding. SCE intends to utilize these new tools and methods to identify locations for scoping enhanced hardening efforts, including undergrounding, as early as 2022. SCE anticipates this may result in potentially hundreds of miles of additional targeted undergrounding to sufficiently address wildfire and PSPS risks. Going forward SCE will use the process as described in SCE's Integrated Grid Hardening Strategy in Section 7.1.2.1.

Cost effectiveness evaluations (including cost breakdown per circuit mile, comparison with alternatives, etc.)

The cost per mile (or unit cost) for undergrounding distribution voltages can vary greatly due to factors such as population density, terrain, permitting and environmental clearances, and paving. In 2021, SCE conducted a high-level analysis on the unit cost to underground isolatable circuit segments that make up the top 100 riskiest circuits based on SCE's WRRM (see Table SCE 9-2).[269] The majority of the top 100 riskiest circuits is in the medium-cost range.

Table SCE 9-2

Unit Cost Ranges for Undergrounding for Top 100 Riskiest Circuits

Cost Range Per Circuit Mile	Characteristics of Isolatable Circuit Segments	% Top 100 Riskiest Circuits
Low-cost range ($1.5 million)	(1) radials with straight runs, minimal bends, limited structures (splice box); (2) zero to three transformers per mile; (3) limited need for re-paving post-installation (typically due to no curbs nor gutters); (4) typical setting such as flat and rural areas	13%
Medium-cost range ($3.5 million)	(1) moderate re-paving required; (2) includes both mainline and radial components; (3) eight to 12 transformers per mile; (4) typical setting: medium density in residential/rural areas	68%
High-cost range ($5.5+ million)	(1) extensive re-paving required and potential moratorium; (2) 20+ transformers per mile; (3) majority mainline with some radial; (4) high number of easements required;	19%

[269] The analysis includes rerouting multipliers based on Google Earth with equipment overlays (typical multiplier ranged between 10 to 100+% of additional circuitry). The analysis did not include existing covered conductor or undergrounding projects already planned. It also did not include secondaries, service drops, or panel conversions. The analysis also excluded isolatable segments that were not constructible. Note that this is a preliminary desktop analysis which is subject to change with a larger sample size.

	(5) typical setting: rocky, hilly terrain, and/or high re-routing, and/or high population density	

Please refer to Appendix 9.3 for estimated costs associated with other alternatives including covered conductor, REFCL, spacer cables, and aerial bundled cables.

Any other activities relevant to the undergrounding implementation

As mentioned above, in 2021 SCE developed a new framework to identify locations in which the wildfire risk to those locations is not fully captured by ignition simulations alone. This framework allows SCE to consider qualitative risk factors, such as population egress, historical fire frequency, canopy cover and/or density, the deployment of existing mitigations, as well as locations likely to exceed PSPS thresholds even if fully covered. This framework will be utilized for scoping as early as 2022. See Section 7.1.2.1 for more details.

9.5 WMP ACTIVITY MAP

The table below provides a mapping that documents the movement of activities included in the 2021 WMP and their disposition in the 2022 WMP Update.

Table SCE 9-3

Map of 2021 WMP Activities in 2022 WMP Update

2021 WMP Activities			2022 WMP Designation
WMP ID	**WMP Activity**	**Category**	**Notes**
SA-1	Weather Stations	Situational Awareness	2022 WMP Activity
SA-2	Fire Potential Index (FPI) Phase II		Incorporated in SA-8
SA-3	Weather and Fuels Modeling		2022 WMP Activity
SA-4	Fire Spread Modeling		Incorporated in SA-8
SA-5	Fuel Sampling Program		Incorporated in SA-8
SA-7	Remote Sensing / Satellite Fuel Moisture		Incorporated in SA-8
SA-8	Fire Science		2022 WMP Activity; renamed to “Fire Science”
SA-9	Distribution Fault Anticipation (DFA)		2022 WMP Activity
SA-10	High-Definition (HD) Cameras		New Activity in 2022 WMP
SH-1	Covered Conductor	Grid Design & System Hardening	2022 WMP Activity
SH-2	Undergrounding Overhead Conductor		2022 WMP Activity
SH-4	Branch Line Protection Strategy		2022 WMP Activity
SH-5	Installation of System Automation Equipment – RAR/RCS		2022 WMP Activity
SH-6	Circuit Breaker Relay Hardware for Fast Curve		2022 WMP Activity
SH-7	PSPS-Driven Grid Hardening Work		2022 WMP Activity
SH-8	Transmission Open Phase Detection		2022 WMP Activity
SH-10	Tree Attachment Remediation		2022 WMP Activity
SH-11	Legacy Facilities		2022 WMP Activity
SH-12	Microgrid Assessment		2022 WMP Activity
SH-13	C-Hooks		2022 WMP Activity
SH-14	Long Span Initiative (LSI)		2022 WMP Activity
SH-15	Vertical Switches		2022 WMP Activity
SH-16	Vibration Damper Retrofit		New Activity in 2022 WMP
SH-17	Rapid Earth Fault Current Limiters (REFCL)		New Activity in 2022 WMP
IN-1.1	Distribution High Fire Risk Informed Inspections in HFRA	Asset Management & Inspections	2022 WMP Activity
IN-1.2	Transmission High Fire Risk Informed Inspections in HFRA		2022 WMP Activity
IN-3	Infrared Inspection of energized overhead distribution facilities and equipment		2022 WMP Activity

2021 WMP Activities			2022 WMP Designation
WMP ID	**WMP Activity**	**Category**	**Notes**
IN-4	Infrared Inspection, Corona Scanning, and High Definition imagery of energized overhead Transmission facilities and equipment		2022 WMP Activity
IN-5	Generation High Fire Risk Informed Inspections in HFRA		2022 WMP Activity
IN-8	Inspection Work Management Tools		2022 WMP Activity
IN-9	Transmission Conductor & Splice Assessment		New Activity in 2022 WMP
VM-1	Hazard Tree Management Program	Vegetation Management	2022 WMP Activity
VM-2	Expanded Pole Brushing		2022 WMP Activity
VM-3	Expanded Clearances for Legacy Facilities		2022 WMP Activity
VM-4	Dead and Dying Tree Removal		2022 WMP Activity
VM-6	VM Work Management Tool (Arbora)		2022 WMP Activity
PSPS-2	Customer Care Programs	Grid Operations and Protocols	2022 WMP Activity
DEP-1.2	Customer Education and Engagement - Community Meetings	Emergency Preparedness and Planning	2022 WMP Activity
DEP-1.3	Customer Education and Engagement - Marketing Campaign		2022 WMP Activity
DEP-2	SCE Emergency Responder Training		2022 WMP Activity
DEP-4	Customer Research and Education		2022 WMP Activity
DEP-5	Aerial Suppression	Stakeholder Cooperation and Community Engagement	2022 WMP Activity
DG-1	Wildfire Safety Data Mart and Data Management (WiSDM / Ezy)	Data Governance	2022 WMP Activity

9.6 SCE EXTERNAL ENGAGEMENTS WITH AGENCIES OUTSIDE OF CALIFORNIA (1/1/2021–12/31/2021)

Table SCE 9-4

SCE External Engagements Outside of California

Meeting	Engagement / Forum	Purpose
1/12/21	Meeting with Filsinger Energy Partners and IOUs	Provided details about SCE's plans on undergrounding
1/19/21	AEIC Power Delivery Distributed Energy Resources Subcommittee Meeting	Utility professionals virtually gathered to discuss technical and operational challenges, best practices and solutions implemented that are related to the integration of Distributed Energy Resources. SCE presented its Re-imaging the Grid white paper and discussed in-progress microgrid and mobile battery energy storage pilots focused on mitigating customer impacts of PSPS.
2/1/21	Department of Energy Meeting	Provided the Department of Energy's Acting Assistant Secretary Patricia Hoffman an overview of SCE's Reimagining the Grid white paper
2/19/21	S&P Credit Agency Meeting	Provided an overview of state legislative and regulatory landscape on wildfire risk and SCE's wildfire mitigation plan and actions
4/1/21	California Foundation on the Environment and the Economy (CFEE) Site Visit	Provided a tour for participants to observe recently installed covered conductor and other devices in Tehachapi area
2/19/21	S&P Credit Rating Agency Meeting	Provided update on SCE's WMP
4/8/21-4/9/21	EUCI Online Conference: 2021 Wildfire Mitigation for Utilities – Western Region	Utility and industry professionals, wildfire experts, and thought leaders from across the West gathered to discuss the challenges of wildfires and share their best practices and lessons learned, as well as share cutting-edge technology that can help better manage these disasters. SCE presented on its WMP objectives, strategies, risk analysis and capabilities.
4/21/21	The Edison Electric Institute's (EEI) Electricity Subsector Coordinating Council (ESCC) Trade Associations: Wildfire – A Critical Challenge for Every Segment of the Industry	During the ESCC wildfire workshop and technology summit, SCE provided an overview of its wildfire risk modeling.

Meeting	Engagement / Forum	Purpose
5/7/21	Distributech CONNECT Virtual Summit	During the summit meeting that brought together decision makers and technical experts from organizations in the T&D industry from across North America, SCE participated in the “Next Practices in Fire Mitigation” panel.
5/4/21	2021 Wildfire Prevention Summit, hosted by Western Fire Chiefs Association (WFCA)	Participating speakers and panels representing federal and state organizations as well as utility leaders from the states of California and Arizona, provided a national perspective on wildfire prevention while discussing regional, statewide and local initiatives. SCE presented on its WMP, 2020 wildfire season and PSPS response, new technologies and aerial fire suppression resources.
5/12/21	The Western Electricity Coordinating Council (WECC) Wildfire Webinar	The webinar series for industry experts addressed wildfire risks to the bulk power system in the geographic area known as the Western Interconnection. SCE provided an overview of its WMP, wildfire risk modeling framework and analysis, and 2020 wildfire season and PSPS response.
5/20/21	Western Energy Institute Conference: Wildfire Planning & Mitigation Forum	During the conference, SCE provided an overview of its WMP, evolution of the regulatory environment, wildfire risk management, organization design and resource commitment, system protection and more.
6/3/21	Eugene Water & Electric Board (EWEB) Meeting	SCE met with leaders at EWEB, a utility in Eugene, Oregon, to share knowledge and best practices regarding SCE’s PSPS operations and communications. SCE provided an overview of its WMP as well as its PSPS response, operational collaboration, tools, communications, and community engagement.
6/30/21	White House Wildfire Preparation Dialogue	Pedro J. Pizarro, president and chief executive officer of Edison International, participated in a discussion with attendees including the U.S. President, Vice President, eight western governors, cabinet secretaries, and more. He addressed SCE’s wildfire mitigation efforts and how the government can continue to help support our efforts.
10/20/21	SCE Project Initiation Public Workshop	SCE held a public workshop for its EPIC portfolio inviting policymakers, city officials, vendors/technology providers, national labs and universities to hear about our Wildfire Prevention & Resilience Technologies

Meeting	Engagement / Forum	Purpose
		demonstration and the Beyond Lithium-ion Energy Storage demonstration.
10/27/21	Plug & Play's Tech for Extreme Weather Events	SCE participated in an event hosted by startup accelerator Plug & Play, which connects leading corporates and startups internationally. The event focused on innovations around wildfire and extreme weather events. SCE provided an overview of its WMP and the new technologies it's piloting and exploring.
11/9/21-11/10/21	EUCI's California Power Summit	SCE participated in the California Power Summit and covered SCE's grid modernization and integration efforts, including wildfire mitigation/PSPS topics.
12/15/21	California Energy Commission's Electric Program Investment Charge (EPIC) Symposium	SCE participated in the EPIC Symposium where multiple SCE speakers presented on energy innovation and grid modernization, including wildfire mitigation/PSPS topics.
Ongoing	EPRI 2021 Incubatenergy Labs Challenge	SCE participated in EPRI's Incubatenergy program which connects leading utilities with early stage companies to demonstrate and deploy innovative solutions in targeted areas, including wildfire.

9.7 LIST OF ACRONYMS

Table SCE 9-5

List of Acronyms in 2022 WMP Update

Acronym/ Abbreviation	Definition
AAA	Area Agency on Aging
AAR	After Action Report
AB	Assembly Bill
ABC	Aerial Bundled Cable
AC	Alternating Current
ACS	American Community Survey
ACS	Aerial Spacer Cable
ACSR	Aluminum Conductor Steel-Reinforced
ADMS	Advanced Distribution Management System
ADS	Aerial Detection Surveys
AFN	Access and Functional Need(s)
AHJ	Authority Having Jurisdiction
AHP	All Hazard Emergency Operations Plan
AI	Artificial Intelligence
ALJ	Administrative Law Judge
ANSI	American National Standards Institute
AOC	Area of Concern
API	Application Programming Interface
ASD	Audit Services Department
ASME	American Society of Mechanical Engineers
AWG	American Wire Gauge
BTU	British Thermal Unit
BVES	Bear Valley Electric Service, Inc.
BVLOS	Beyond Visual Line of Sight
C&Q	Compliance & Quality
CA	California
CAISO	California Independent System Operator
CAL FIRE	California Department of Forestry and Fire Protection
Cal OES	Governor’s Office of Emergency Services
Cal Poly-SLO	California Polytechnic State University, San Luis Obispo
CARE	California Alternate Rates for Energy
CAT	Customer Attitude Tracking
CATI	Computer-Assisted Telephone Interview

Acronym/ Abbreviation	Definition
CB	Circuit Breaker
CBO	Community Based Organization
CBOLM	Circuit Breaker Online Monitoring
CC++	Covered conductor combined with fire-resistant poles installation, asset inspections, FC settings for CB relays, along with vegetation management activities (as necessary) including HTMP, pole brushing, and line clearing
CCA	Community Choice Aggregators
CCBB	Critical Care Battery Backup
CCR	California Code of Regulations
CCV	Community Crew Vehicles
CEA	Canadian Electricity Association
CEC	California Energy Commission
CEMA	Catastrophic Event Memorandum Account
CEQA	California Environmental Quality Act
CES3	CalEnviroScreen version 3.0
CFO	Contact from Object
CFR	Code of Federal Regulations
CFRPD	Catastrophic Fire Probability
cGIS	Comprehensive Geographical Information System
CI/CL	Confidence Interval/Confidence Level
CIP	Communication Infrastructure Provider
CLF	Current-Limiting Fuse
CMI	Customer Minutes of Interruption
COVID-19	Coronavirus Disease 2019
CPUC	California Public Utilities Commission or Commission
CRC	Community Resource Center
CREI	Customer Resiliency Equipment Incentive
CSIRO	Commonwealth Scientific and Industrial Research Organization
CT	Current Transformer
CUEA	California Utilities Emergency Agency
DC	Direct Current
DER	Distributed Energy Resource
DFA	Distribution Fault Anticipation
DIMP	Distribution Inspection and Maintenance Program
DL	Dryness Level
DMS	Distribution Management System
DOH	Distribution Overhead Construction Standards
D-OPD	Distribution Open Phase Detection
DRI	Drought Relief Initiative (replaced by Dead & Dying Tree Removal)

Acronym/ Abbreviation	Definition
DRWG	Distribution Reliability Working Group
DSS	Department of Social Services
DVC	Disadvantaged Communities
DVC/DAC	Disadvantaged and Vulnerable communities
DVMP	Distribution Vegetation Management Plan
ECPMA	Emergency Customer Protections Memorandum Account
EEI	Edison Electric Institute
EFD	Early Fault Detection
EFF	Equipment and Facility Failure
EIA	U.S. Energy Information Administration
ENA	Energy Networks Australia
EOI	Enhanced Overhead Inspections
EONS	Emergency Outage Notification System
EPIC	Electric Program Investment Charge Program
EPRI	Electric Power Research Institute
ERC	Energy Release Component
ERM	Enterprise Risk Management
ES	Electric Services
ES IMT	Electric Services Incident Management Team
ESCC	Electricity Subsector Coordinating Council
ESI	Electrical System Inspector
ESRI	Environmental Systems Research Institute
EV	electric vehicle
EVM	Enhanced Vegetation Management
Ezy	Cloud Big Data and Artificial Intelligence Platform
FAA	Federal Aviation Administration
FBAN	Fire Behavior Analyst
FBO	Faith Based Organization
FC	Fast Curve
FCZ	Fire Climate Zone
FEMA	Federal Emergency Management Agency
FERA	Family Electric Rate Assistance
FERC	Federal Energy Regulatory Commission
FIC	Frequently Impacted Circuit
FIPA	Fire Incident Preliminary Analysis
FLM	Fuel loading modifier
FLOC	Function / Location
FMEA	Failure Modes and Effects Analysis

Acronym/ Abbreviation	Definition
FPI	Fire Potential Index
FRAP	CAL FIRE’s Fire Resource Assessment Program
FRP	Fire Resistant Pole
FTE	Full Time Employee
FWT	Fire Weather Threat
FWZ	Fire Weather Zone
GACC	Geographic Area Coordination Centers
GCC	Grid Control Center
GDB	Geodatabase
GFN	Ground Fault Neutralizer
GIS	Geographical Information System
GO	General Order
GPS	Global Positioning System
GRC	General Rate Case
GRCD	Grid Resiliency Clearance Distance
GSRP	Grid Safety and Resiliency Program
GTI	Gas Technology Institute
HASC	Hospital Association of Southern California
HD	High Definition
HDD	Horizontal Directional Drilling
HFRA	High Fire Risk Area(s)
HFRI	High Fire Risk Informed
HFTD	High Fire Threat District
Hi-Z	High Impedance
HPCC	High Performance Computing Cluster
HTMP	Hazard Tree Management Program
HWW	High Wind Warning
IBEW	International Brotherhood of Electrical Workers
ICS	Incident Command System
IEEE	Institute of Electrical and Electronics Engineers
IHSS	In-Home Supportive Services
ILC	Independent Living Center
IMT	Incident Management Team
IOU	Investor-Owned Utility
IPEMS	Integrated PSPS Event Management System
IPI	Intrusive Pole Inspection Program
IR	Infrared
ISA	International Society of Arboriculture

Acronym/ Abbreviation	Definition
ISO	International Organization for Standardization
IST	Incident Support Team
IT	Information Technology
IT	Isolation Transformer
IVM	Integrated Vegetation Management
IWRMC	International Wildfire Risk Management Consortium
kV	Kilovolt
kWh	Kilowatt hours
LED	Light Emitting Diode
LFM	Live Fuel Moisture
LFO	Live Field Observation
LiDAR	Light Detection and Ranging Technology
LOS	Line of Sight
LSI	Long Span Initiative
LTE	Long-Term Evolution
LTP	Long Term Plan
MADEC	Meter Alarming for Downed Energy Conductor
MARS	Multi Attribute Risk Score
MAVF	Multi-Attribute Value Function
MBL	Medical baseline
MCFSC	Mountain Communities Fire Safe Council
MGRA	Mussey Grade Road Alliance
ML	Machine Learning
MODIS	Moderate Resolution Imaging Spectroradiometer
MOU	Memorandum of Understanding
MPFR	Material Performance Failure Report
MSUP	Master Special Use Permit
NBC	Nonbypassable Charge
NCEP	National Center for Environmental Prediction
NDVI	Normalized Difference Vegetation Index
NEPA	National Environmental Policy Act
NERC	North American Electric Reliability Corporation
NFDRS	National Fire Danger Rating System
NGWMS	Next Generation Weather Modeling System
NIMS	National Incident Management System
NPV	Net Present Value
NRCI	Non-Residential Critical Infrastructure
NSF	National Science Foundation

Acronym/ Abbreviation	Definition
NWS	National Weather Service
O&M	Operation and Maintenance
OCBA	Online Circuit Breaker Analysis
OCFA	Orange County Fire Authority
OCM	Organizational Change Management
OCP	Overhead Conductor Program
ODI	Overhead Detail Inspections
ODRM	Outage Database and Reliability Metrics
OE	Owner’s Engineering
OEIS	Office of Energy Infrastructure and Safety / Energy Safety
OH	Overhead
OIR	Order Instituting Rulemaking
OMS	Outage Management System
OPD	Open Phase Detection
OSHA	Occupational Safety and Health Administration
OU	Operating Unit
PAPR	Wildfire Smoke Respirator
PCB	Polychlorinated biphenyls
PFM	Petition for Modification
PG&E	Pacific Gas and Electric Company
PLP	Pole Loading Program
PLS-CADD	Power Line Systems – Computer Aided Drafting and Design
PMA	Predictive Maintenance Assessment
POC	Period of Concern
POD	Probability of De-energization
POI	Probability of ignition
PRA	Probabilistic(ty) Risk Assessment
PRC	California Public Resources Code
PSPS	Public Safety Power Shut Off
QA	Quality Assurance
QC	Quality Control
QDR	Quarterly Data Report
QEW	Qualified Electrical Worker
QR	Quick Response
QRF	Quick Reaction Force
RAMP	Risk Assessment Mitigation Phase
RAR	Remote-Controlled Automatic Reclosers
RAVE	Risk Associated with Value Exposure

Acronym/ Abbreviation	Definition
RCD	Regulation Clearance Distance
RCP	Remedial Compliance Plan
RCS	Remote Controlled Switch(es)
REFCL	Rapid Earth Fault Current Limiter
REFCL++	REFCL combined w/ asset inspections, FC settings for CB relays, and vegetation management activities (as necessary) including HTMP, pole brushing, & line clearing
REST	Representational State Transfer
RFP	Request for Proposal
RFW	Red Flag Warning
RGS	Resonant Grounded Substations
ROW	Right-of-Way, Rights-of-Way
RSE	Risk Spend Efficiency
RSR	Remote Sectionalizing Recloser
SAP	Systems, Applications & Products
SAR	System Average Rates
SAWTi	Santa Ana Winds Threat Index
SB	Senate Bill
SCADA	Supervisory Control and Data Acquisition
SCE	Southern California Edison Company
SDG&E	San Diego Gas & Electric Company
SED	CPUC Safety and Enforcement Division
SEMS	Standardized Emergency Management System
SGI	Special Government Interest
SGIP	Self-Generation Incentive Program
SIR	Self-Insured Retention
SJSU	San Jose State University
S-MAP	Safety Model and Assessment Proceedings
SME	Subject Matter Expert
SOB	Standard/System Operating Bulletin
SP	Specialist
SRA	State Responsibility Area
SSP	Senior Specialist(s)
STEM	Science, Technology, Engineering & Math
T&D	SCE's Transmission and Distribution Business Unit
TCCI	Tree-Caused Circuit Interruption
TIGER	Topologically Integrated Geographic Encoding and Referencing
TIMP	Transmission Inspection and Maintenance Program
TOH	Transmission Overhead

Acronym/ Abbreviation	Definition
TOPD	Transmission Open Phase Detection
TRI	Tree Risk Index
TT	Thunderstorm Threat
TURN	The Utility Reform Network
TVMP	Transmission Vegetation Management Plan
UAA	Utility Arborist Association
UAS	Unmanned Aerial Systems
UCLA	University of California, Los Angeles
UCSB	University of California, Santa Barbara
UCSD	University of California, San Diego
UGS	Undergrounding Structures Standards
UI	User Interface
USFS	United States Forest Service
USZ	Utility Strike Zone
UVM	Utility Vegetation Management
VM	Vegetation Management
VMBA	Vegetation Management Balancing Account
VoLL	Value of Lost Load
VP	Vice President
WCCP	Wildfire Covered Conductor Program
WECC	Western Electricity Coordination Council
WEI	Western Electric Institute
WIRC	SJSU Wildfire Interdisciplinary Research Center
WisDM	Wildfire Safety Data Mart
WMP	Wildfire Mitigation Plan
WRF	Weather and Research Forecasting
WRM	Wildfire Risk Model
WRRM	Wildfire Risk Reduction Model
WSD	Wildfire Safety Division
WUI	Wildland Urban Interface
WUI FIRE	Wildland Urban Interface Fire Information Research and Education Institute (WUI FIRE Institute)
WWZ	Wind Weather Zone
Wx	Wind speed and dew point depression
XLPE	Crosslinked Polyethylene
ZOP	Zone of Protection

SCE-21-02, RSE Values Vary Across Utilities

Energy Safety found the following issue and associated remedies related to RSEs in ***SCE-21-02****, as described in SCE's Action Statement:*

> ***"Issue:*** *Energy Safety is concerned by the stark variances in RSE estimates, sometimes on several orders of magnitude, for the same initiatives calculated by different utilities. For example, PGE's RSE for covered conductor installation was 4.08*[270]*, SDGE's RSE was 76.73*[271] *and SCE's RSE was 4,192.*[272] *These drastic differences reveal that there are significant discrepancies between the utilities' inputs and assumptions, which further support the need for exploration and alignment of these calculations.*
>
> ***Remedy:*** *The utilities*[273] *must collaborate through a working group facilitated by Energy Safety*[274] *to develop a more standardized approach to the inputs and assumptions used for RSE calculations. After Energy Safety* completes its evaluation of the 2021 WMP Updates, it will provide additional detail on the specifics *of this working group.*
>
> *This working group will focus on addressing the inconsistencies* between the inputs and assumptions used by the utilities for their RSE calculations, which *will allow for:*
>
> *1. Collaboration among utilities;*
> *2. Stakeholder and academic expert input; and*
> *3. Increased transparency."*

Response:

The utilities have prepared a joint response to this Remedy. This response describes working group activities which have occurred since the utilities submitted their Progress Reports on November 1, 2021.

On December 9, 2021, Energy Safety facilitated a public workshop on utility risk spend efficiency (RSE) estimates. Each of the utilities presented the current status of their RSE calculation methodologies, and stakeholders had an opportunity to ask questions of utility representatives as well as RSE experts. RSE experts included Tom Long from The Utility Reform Network (TURN), Fred Hanes, senior utilities engineer from the California Public Utilities Commission (CPUC), and Joseph Mitchell from Mussey Grade Road Alliance (MGRA). The participants discussed RSE

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270 Value from PG&E's Errata (dated March 17, 2021, accessed May 19, 2021): https://www.pge.com/pge_global/common/pdfs/safety/emergency-preparedness/natural-disaster/wildfires/wildfiremitigation-plan/2021-Wildfire-Safety-Plan-Errata.pdf.

271 Value from Table 12 of SDGE's 2021 WMP Update submissions under the "Estimated RSE for HFTD Tier 3" column for "Covered Conductor Installation."

272 Value from Table 12 of SCE's 2021 WMP Update submissions under the "Estimated RSE for HFTD Tier 3" column for "Covered Conductor Installation."

273 Here "utilities" refers to SDG&E, PG&E, and SCE; although this may not be the case every time "utilities" is used through the document.

274 The WSD transitioned to Energy Safety on July 1, 2021.

calculation methodology best practices and how RSE estimates inform wildfire risk-based decision-making.

At the conclusion of the workshop, Energy Safety requested that the utilities submit reports providing a detailed description on their RSE calculation methodology. Each utility developed a report on their RSE calculation methodology, RSE estimate verification process, and RSE estimate initiative-selection process. These reports were submitted on December 17, 2021.

The utilities look forward to continuing to work with Energy Safety and other stakeholders in pursuit of utility collaboration, expert input, and increased transparency on RSE assumptions, inputs, and calculations.

SCE-21-03, Lack of Consistency in Approach to Wildfire Risk Modeling Across Utilities

Energy Safety found the following issue and associated remedies related to Risk Models in ***SCE-21-03****, as described in SCE's Action Statement:*

> *"**Issue:** The utilities do not have a consistent approach to wildfire risk modeling. For example, in their wildfire risk models, utilities use different types of data, use their individual data sets in different ways, and use different third-party vendors. Energy Safety recognizes that the utilities have differing service territory characteristics, differing data availability, and are at different stages in developing their wildfire risk models. However, the utilities face similar enough circumstances that there should be some level of consistency in statewide approaches to wildfire risk modeling.*
>
> ***Remedies:** The utilities[275] must collaborate through a working group facilitated by Energy Safety[276] to develop a more consistent statewide approach to wildfire risk modeling. After Energy Safety completes its evaluation of all the utilities' 2021 WMP Updates, it will provide additional detail on the specifics of this working group.*
>
> *A working group to address wildfire risk modeling will allow for:*
>
> *1. Collaboration among the utilities;*
>
> *2. Stakeholder and academic expert input; and*
>
> *3. Increased transparency."*

Response:

The utilities have prepared a joint response to this Remedy. This response describes working group activities which have occurred since the utilities submitted their Progress Reports on November 1, 2021.

Energy Safety established an initial schedule of bi-weekly working group meetings, starting October 20, 2021 and running through January 19, 2022, on various risk-modeling related topics such as modeling components, algorithms, data and impacts of other issues on modeling such as climate change and ingress/egress. However, based on input during the Wildfire Risk Modeling Workshop on October 5-6, 2021, as well as the first Working Group Meeting on October 27, 2021, Energy Safety subsequently issued a revised schedule and topics for the Working Group moving forward. A final version of schedule and topics was posted on November 8, 2021, which included comments on the October 5-6, 2021 workshop on November 6, 2021. The current working group schedule is:

Cadence:

- 2021 – Meet every 3 weeks
- 2022 – Meet monthly (except February)

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[275] Here "utilities" refers to SDG&E and Pacific Gas and Electric Company (PG&E), Southern California Edison Company (SCE), PacifiCorp, Bear Valley Electric Service, Inc. (BVES), and Liberty Utilities; although this may not be the case every time "utilities" is used through the document.

[276] The WSD transitioned to Energy Safety on July 1, 2021.

Meetings are scheduled for Wednesday afternoons for a length of three hours.

Topics:

2021	
10/27	Meeting Logistics; modeling baselines, alignment, and past collaboration
11/17	Fire consequence (drivers, meteorology/climatology, environment, and fuels data)
12/8	Likelihood of asset risk events and ignitions (data, inputs, and risk drivers relating to assets, faults/outages/ignitions)

2022	
1/12	Likelihood of vegetation risk events and ignitions (data, inputs, and risk drivers)
3/2	PSPS likelihood (data, inputs, and risk drivers)
4/6	PSPS consequence and reliability analysis and impacts (including potential safety issues, power quality impacts)
5/4	Modeling algorithms, including confidences (machine learning, weather modeling, fire behavior modeling)
6/1	Modeling components, linkages, interdependencies
7/6	Smoke and suppression impacts
8/3	Climate change impacts and ingress/egress
9/7	Finalize risk modeling guidelines

The utilities are collaborating through the working group with Energy Safety and stakeholders and have already dedicated and will continue to dedicate substantial time and resources to the working group. The utilities believe that there will be increased transparency for Energy Safety and stakeholders through the working group process.

On November 17, 2021 and December 8, 2021 meetings were held to discuss “Fire Consequence” and “Likelihood of asset risk events and ignitions,” respectively. Energy Safety provided an agenda before each meeting which listed discussion topics and tentative time allotments. The meetings followed the agenda in a “Question and Answer” discussion format with utility subject matter experts.

On January 11, 2022, Energy Safety postponed the working group session scheduled for January 12, and informed that the working group schedule would pick back up on March 2, 2022 with the topic of “Likelihood of vegetation risk events and ignitions.”

The utilities look forward to future sessions with Energy Safety and stakeholders to promote continued collaboration, incorporate additional expert input, and increase transparency in order to help better realize our shared goal of reducing wildfire and PSPS risks.

SCE-21-04, Limited Evidence to Support the Effectiveness of Covered Conductor

*Energy Safety found the following issue and associated remedies related to Covered Conductor in **SCE-21-04**, as described in SCE's Action Statement:*

> ***"Issue:** The rationale to support the selection of covered conductor as a preferred initiative to mitigate wildfire risk lacks consistency among the utilities, leading some utilities to potentially expedite covered conductor deployment without first demonstrating a full understanding of its long-term risk reduction and cost effectiveness. The utilities' current covered conductor pilot efforts are limited in scope[277] and therefore fail to provide a full basis for understanding how covered conductor will perform in the field. Additionally, utilities justify covered conductor installation by alluding to reduced PSPS risk but fail to provide adequate comparison to other initiatives' ability to reduce PSPS risk.*
>
> ***Remedy:** The utilities[278] must coordinate to develop a consistent approach to evaluating the long-term risk reduction and cost-effectiveness of covered conductor deployment, including:*
>
> *1. The effectiveness of covered conductor in the field in comparison to alternative initiatives.*
>
> *2. How covered conductor installation compares to other initiatives in its potential to reduce PSPS risk."*

Response:
The utilities have prepared a joint response to this Issue/Remedy.[279]

Introduction:
In the November 2021 Progress Report, the utilities outlined the approach, assumptions, and preliminary milestones to enable the utilities' to better discern the long-term risk reduction effectiveness of covered conductor to reduce the probability of ignition, assess its effectiveness compared to alternative initiatives, and assess its potential to reduce PSPS risk in comparison to other initiatives. In this report for the 2022 WMP Update, the utilities provide an update on their progress for each of the sub-workstreams, added efforts, and plans for 2022.

Overview:
As explained in the November 2021 Progress Report, the utilities believe that long-term effectiveness of covered conductor and its ability to reduce wildfire risk and PSPS impacts (and, in comparison to alternatives) requires multiple sets of information that need to be compiled, assessed, and updated over time. Since the November 2021 Progress Report, the utilities have made progress on each of the following sub-workstreams:

- Benchmarking

[277] Limited in terms of mileage installed, time elapsed since initial installation, or both. For example, SDG&E's pilot consisted of installing 1.9 miles of covered conductor, which has only been in place for one year.
[278] Here "utilities" refers to SDG&E and Pacific Gas and Electric Company (PG&E), Southern California Edison Company (SCE),PacifiCorp, Bear Valley Electric Service, Inc. (BVES), and Liberty; although this may not be the case every time "utilities" is used through the document.
[279] As each utility completes its review of their WMP leading up to their filing date, there may be changes in this report from previous utility submissions.

- Testing / Studies
- Estimated Effectiveness
- Additional Recorded Effectiveness
- Alternative comparison
- Potential to Reduce PSPS risk
- Costs

The utilities have also initiated discussions with the Institute of Electrical and Electronics Engineers (IEEE) Distribution Reliability Working Group (DRWG) to establish a peer-review process for estimating/measuring the effectiveness of covered conductor. The utilities have obtained additional information from benchmarking, the Phase 1 Testing Report, initial subject matter expert (SME) assessments of effectiveness of alternatives compared to covered conductor, an initial unit cost comparison, and have collected the utilities' estimated and recorded methods and results of covered conductor effectiveness. Each of these efforts are described further below. The information and assessments continue to indicate covered conductor effectiveness between approximately 60 to 90 percent in reducing the drivers of wildfire risk, consistent with past benchmarking, testing and utility estimates. The utilities plan to continue each sub-workstream in 2022 to obtain new test data, conduct further benchmarking, improve methods for estimating and measuring effectiveness, and further the alternative assessments and unit cost comparisons. Below, the utilities describe the progress made on each sub-workstream and steps planned to continue this effort in 2022.

Background:
Covered conductor is a widely accepted term to distinguish from bare conductor. The term indicates that the installed system utilizes conductor manufactured with an internal semiconducting layer and external insulating UV resistant layers to provide incidental contact protection. Covered conductor is used in the U.S. in lieu of "insulated conductor," which is reserved for grounded overhead cable. Other utilities in the world use the terms "covered conductor," "insulated conductor," or "coated conductor" interchangeably. Covered conductor is a generic name for many sub-categories of conductor design and field construction arrangement. In the U.S., a few types of covered conductor are as follows:

- Tree wire
  - Term was widely used in the U.S. in 1970s
  - Associated with a simple one-layer insulated design
  - Used to indicate cross-arm construction
- Spacer cable
  - Associated with construction using trapezoidal insulated spacers and a high strength messenger line for suspending covered conductor
- Aerial bundled cable (ABC)
  - Tightly bundled insulated conductor, usually with a bare neutral conductor

The current type of covered conductor being installed in each of the utilities' service areas is an extruded multi-layer design of protective high-density or cross-linked polyethylene material. In this report, "covered conductor" refers generally to a system installed on cross-arms, in a spacer cable configuration, or as ABC. Table SCE 9-6, below, provides a snapshot of the approximate amount and types of covered conductor installed in the utilities' service areas.

Table SCE 9-6

Covered Conductor Type and Approximate Circuit Miles Deployed by Utility

Utility	First covered conductor installation (year)	Type of covered conductor installed	Approx. miles of covered conductor deployed through 2021	Notes
SCE	2018	Covered Conductor	2,900	Includes WCCP and Non-WCCP
	Installed Historically	Tree Wire	50	
	Installed Historically	ABC	64	
PG&E	CC end of 2017, beginning of 2018	Covered Conductor	883	Primary distribution overhead only
	TW installed historically	ABC	3	
SDG&E	2020	Covered Conductor	22	
		Tree Wire	2	
		Spacer Cable	6	
Liberty	2019	Covered Conductor	9	
		Spacer Cable	2	
Pacificorp	2007	Spacer Cable	53	
Bear Valley	2018	Covered Conductor	20	

Workstream Scope:

The overall focus is on the long-term effectiveness of covered conductor to reduce wildfire risk and PSPS impacts in comparison to alternatives. The outcome of this workstream is not to determine the scope of covered conductor nor is this effort intended to compare system hardening decisions that utilities have made and will make. Instead, the outcome of this effort is intended to produce (and update over time) a consistent understanding of the effectiveness of covered conductor, in comparison with alternatives to mitigate wildfire risk at the driver level and to reduce PSPS impacts. Utilities can then use these improved sets of information in their decision making. As part of this effort, the utilities anticipate there will likely be lessons the utilities can learn from one another such as construction methods, engineering/planning, execution tactics, etc. that can help improve each utilities' deployment of covered conductor but this is not the focus of this workstream. Additionally, and as further described below, the costs of covered conductor deployment differ based on numerous factors including, for example, the utilities' covered conductor system design, types and amounts of structure/equipment replacements, topography, scale of deployment, resource availability and other operational constraints. This effort is not intended to compare nor contrast costs across all different variations and instead presents an initial high-level covered conductor capital cost per circuit mile comparison with descriptions of the factors that lead to higher or lower costs.

Benchmarking:

Each of the utilities' covered conductor programs have been informed by benchmarking. Benchmarking is a useful process to obtain insights, lessons learned, and continually improve performance. SCE, for example, previously researched covered conductor use in the U.S., Europe, Asia, and Australia. SCE benchmarked directly with 13 utilities abroad and in the U.S. and surveyed 36 utilities on covered conductor usage.[280] These efforts helped inform SCE's Wildfire Covered Conductor Program (WCCP). The utilities, as part of this joint working group, have conducted additional benchmarking. First, the utilities developed a survey consisting of 24 questions that focused on covered conductor usage, performance metrics, conductor applications, and system protection. The survey was then sent to approximately 150 to 200 utilities in the U.S. and abroad. To date, 19 utilities participated in the benchmarking survey[281] and are listed below.

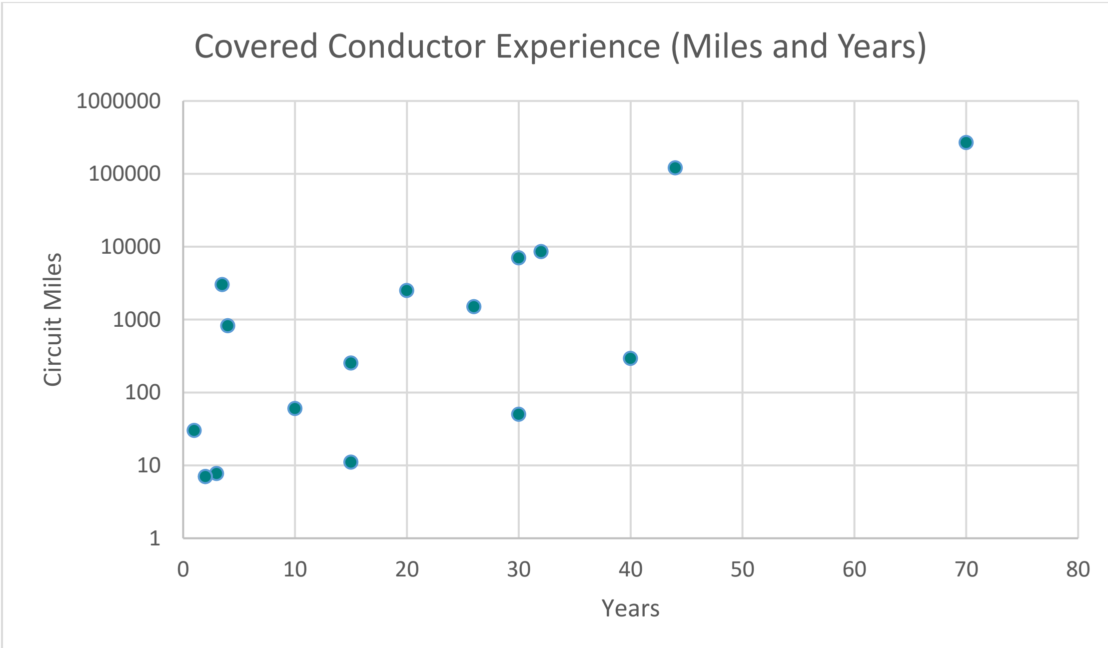
1. American Electric Power
2. Ausnet Services
3. Bear Valley Electric Service, Inc.
4. Duke Energy
5. Essential Energy
6. Eversource Energy (CT)
7. Korean Electric Power Corporation
8. Liberty
9. National Grid
10. Pacific Gas and Electric Company
11. PacifiCorp
12. Portland General
13. Powercor
14. Puget Sound Energy
15. San Diego Gas & Electric
16. Southern California Edison
17. TasNetworks
18. Tokyo Electric Power Company
19. Xcel Energy

Approximately 90% of participants indicated the usage of bare conductor and covered conductor in their distribution systems. Respondents using spacer cable and aerial bundled cable were at 58% and 47%, respectively. Note that while covered conductor designs varied among the utilities, the majority (63%) of utilities use the three-layer jacket design. There was also a wide range of experience among respondents in terms of the number of years and miles installed, as shown in Figure SCE 9-14 below.

[280] *See* SCE's Covered Conductor Compendium that was included in the November 1, 2021 Progress Report.
[281] *See* Covered Conductor Survey Results in Appendix 0.9.8.1

Figure SCE 9-14

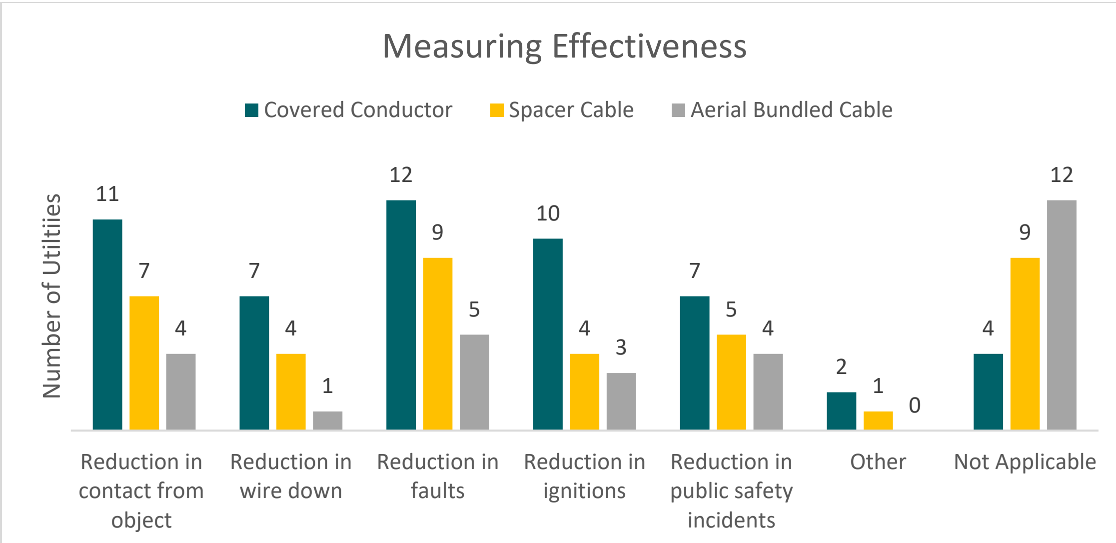
Covered Conductor (Open-crossarm and Spacer) Experience Among Respondents



Drivers for covered conductor deployment can vary by utility. Typical drivers include wildfire mitigation, reliability improvements, or reduction in public safety risk for contact with downed conductors. The utilities' performance metrics will differ depending on their associated drivers. The majority of utilities base the covered conductor's effectiveness in its ability to reduce faults and ignitions from contact-from-objects (CFO). These metrics are related to reliability and wildfire mitigation. Some utilities also measure the reduction in wire downs and public safety incidents to measure the covered conductor's effectiveness, which can be connected to public safety risk or ignition drivers. Figure SCE 9-15 illustrates the number of utilities using each metric to monitor the effectiveness of covered conductor, spacer cable, and aerial bundled cable.

Figure SCE 9-15

Covered Conductor Performance Metrics In Use by Utilities



While most utilities do not differentiate outages or ignitions between bare conductor and covered conductor, 84% of respondents reported that the use of covered conductor has reduced faults. Furthermore, 53% of respondents reported that covered conductor has reduced ignitions or ignition drivers. The remaining 47% of utilities do not track ignition data, had no prior ignitions, or do not have covered conductor in their system.

Approximately 80% of utilities reported undergrounding as an alternative to covered conductor. About 40% of utilities consider spacer cable while approximately 25% consider aerial bundled cable as alternatives to covered conductor. Typically, spacer cable is utilized in heavily forested areas or areas with clearance concerns. Aerial bundled cable is normally indicated as used in heavily forested areas. Only 5% of utilities indicated the use of other alternatives, such as line removal/relocation, animal guard, fast isolation device, remote grid, customer buyout, and vegetation management.

In terms of fault detection, most utilities utilize traditional overcurrent protection. The same protection system that is used for bare conductors. Other existing fault detection methodologies include SCADA connected devices, smart meters, and high impedance fault detection. Utilities are also exploring a multitude of different technologies, including early fault detection (EFD), distribution fault anticipation (DFA), open phase detection (OPD), sensitive ground fault, rapid earth fault current limiter (REFCL), downed conductor detection, etc.

Overall, the benchmarking survey provides a high-level overview of each utilities' covered conductor deployment and performance metrics. In 2022, the California Investor-Owned Utilities (IOUs) plan to conduct further deep dives with some respondents to gain a greater understanding of their covered conductor effectiveness, recorded data and methods they use to measure effectiveness, alternatives and new technology that have been evaluated, and their system hardening decision-making processes. The utilities will provide an update on these efforts in their 2023-2025 WMPs.

Testing:

Testing workstream objectives are to evaluate, through physical testing, the performance of covered conductors as compared to bare conductors for historically documented failure modes. As an example, testing covered conductor performance in preventing incidental contacts that cause phase-to-phase and phase-to-ground faults caused by vegetation, conductor slapping, wildlife, and metallic balloons.[282] To meet this objective, PG&E, SDG&E, and SCE collaborated on conducting additional research and testing of covered conductor. This effort, now joined by PacifiCorp, BVES and Liberty, has two phases. The first phase, which is now complete, had objectives to identify failure modes for covered conductors, document a utilities' consensus FMEA for covered conductors, and to collect all previously conducted testing on covered conductor performance that informs on the performance of covered conductor for identified failure modes. Lastly, to perform comparison between covered versus bare conductor performance for failure modes tested. PG&E contracted with Exponent, Inc. (Exponent) to develop a report for Phase 1, which was completed in December 2021, summarized below, and attached as Appendix 9.8.2 to this update. The Phase 1 study was led by Exponent and consisted of a literature review, discussions with SMEs, a failure mode identification workshop, and a gap analysis comparing expected failure modes to currently available test and field data. The outcome of the Phase 1 report identified gaps in previous testing and is informing the scope of laboratory testing that is currently being planned for in the ongoing Phase 2 step of this sub-workstream. As discussed below, SCE, PG&E, and SDG&E are proceeding with testing.

The literature review shows that covered conductors are a mature technology (in use since the 1970s) and have the potential to mitigate several safety, reliability, and wildfire risks inherent to bare conductors. This is due to the reduced vulnerability to arcing/faults afforded by the multi-layered polymeric insulating sheath material. Field experience from around the world, including North America, South America, Europe, Asia, and Australia, consistently shows improvements in reliability, decreases in public safety incidents, and decreases in wildfire-related events that correlate with increased conversion to covered conductor. The Phase 1 report includes data from several utilities that show a reduction of faults, increased reliability, and/or improvements in public safety metrics since the utilities began implementing covered conductor.

While high-level, field-experience-based evidence of covered conductor effectiveness is plentiful, relatively few lab-based studies exist that address specific failure modes or quantify risk reduction relative to bare conductors. A high-level failure mode identification workshop was conducted to identify operative failure modes relevant to overhead distribution systems for both bare and covered conductors. The workshop included SMEs from the six California IOUs and Exponent and identified hazards and failure modes applicable to bare and covered conductors. In total, 10 hazards and 55 unique failure mode / hazard scenario combinations were identified through the failure mode workshop. Of the 10 hazards that affect bare conductors, covered conductors have the potential to mitigate six hazards. Mitigated hazards include tree/vegetation contact, wind-induced contact (such as conductor slapping), third-party damage, animal-related damage, public/worker impact, and moisture. The report includes a risk reduction assessment of the failure modes that affect both bare and covered conductors. The report also

[282] *See* SCE's Covered Conductor Compendium that was included in the November 1, 2021 Progress Report.

summarizes failure modes mitigated by covered conductor. A total of 17 failure modes largely mitigated through the use of covered conductor were identified through the workshop exercise. The common theme among these failure modes is that they are created through contact with third-party objects, vegetation, or other conductors that create phase-to-ground or phase-to-phase faults. The primary failure mode of bare conductors is arcing due to external contact. Laboratory studies and field experience have shown that arcing due to external contact was largely mitigated with covered conductors. Therefore, a corresponding reduction in ignition potential would be expected. The report also summarizes failure modes unique to covered conductor. Several covered-conductor-specific failure modes exist that require operators to consider additional personnel training, augmented installation practices, and adoption of new mitigation strategies (e.g., additional lightning arrestors, conductor washing programs, etc.). For some failure modes, the report recommends further testing to bolster industry knowledge and to enable more effective risk assessment.

SCE, PG&E and SDG&E are pursuing testing based on the results of the Phase 1 report and SME input. SCE established a test plan for both 17 kV[283] and 35 kV covered conductor designs and expects to conduct approximately 35 testing scenarios that cover various contact-from-object, system strength, flammability, and water ingress scenarios. PG&E is in process of developing a complementary test plan to ensure coverage of failure modes and additional covered conductor types that may not be included in the SCE test plan. SDG&E is assessing conducting, for example, environmental, service life, UV exposure, degradation and mechanical strength tests. The utilities are collaborating on the testing plans to ensure the gaps identified in the Phase 1 report are covered and SME input is considered.[284] SCE began testing on February 1, 2022 and anticipates its testing and review process to extend for several months. SDG&E and PG&E timelines have not been finalized but are anticipating testing to start around Q2 to Q3 2022. The utilities will collaboratively review and assess the results of the tests. After the test results are reviewed and any issues are addressed (e.g., additional tests), the utilities will prepare a report (or reports in phases as testing is completed) and make the report(s) available. The test results are anticipated to further inform effectiveness of covered conductor and potentially identify any needed changes in design and construction standards to ensure failure modes are further limited by the use of covered conductor. Beyond the testing process, in 2022, the utilities will continue to collaborate on methods to quantify risk reduction of covered conductor relative to bare conductors taking into account the testing results and will establish any next steps for this sub-workstream based on the results of the testing. The utilities will provide an update on these efforts in their 2023-2025 WMPs.

Estimated Effectiveness:

Each utility's covered conductor programs are different due to factors such as location, terrain, and existing overhead facilities. Similarly, the utilities are at different phases of installing covered conductor as some have just started deployment while others have deployed hundreds to thousands of miles of covered conductor. These features, amongst others, result in data, calculations, and methods of estimating effectiveness that are different. As such, the utilities have been working on understanding differences and discussing methods for better comparability. While the utilities may differ in their covered conductor approach, the utilities each estimate that covered conductor will reduce wildfire risk. The

[283] SCE's 17 kV covered conductor design is the same as other utilities' 15 kV design. Through testing, SCE determined that the 15 kV design can withstand voltages below 17 kV so has named this covered conductor design 17 kV for operational purposes.

[284] SCE, PG&E, and SDG&E are also collaborating on potential cost sharing.

utilities' estimated covered conductor effectiveness values range from approximately 60 to 90 percent at reducing outages/ignitions and/or the drivers of wildfire risk. Below, the utilities describe their data, analyses, and methods used to estimate the effectiveness of covered conductor to mitigate outages/ignitions and/or the drivers of wildfire risk and present their estimated effectiveness values. Collectively, the utilities summarize next steps to improve consistency of data, calculations and methods.

Covered Conductor Estimated Effectiveness:

SCE:

SCE's WCCP consists of replacing bare conductor with covered conductor, the installation fire-resistant poles (FRPs) where applicable, wildlife covers (animal safe construction), lighting arresters, and vibration dampers below 3,000 feet. These activities are accounted for when determining the overall mitigation effectiveness of SCE's WCCP. To determine the mitigation effectiveness of WCCP, SCE evaluated the ability for covered conductor and FRPs to address each ignition risk driver. SME judgment was used to determine the mitigation effectiveness of covered conductor; this judgment was informed by benchmarking, analysis, and testing. The following tables explain the reasoning behind the effectiveness values. Table SCE 9-7 below, includes only the covered conductor values and not the combined covered conductor and FRP values used in SCE's risk reduction calculation. Table SCE 9-8 below, includes only the FRP mitigation effectiveness values. Additionally, mitigation effectiveness values at 0% or that were not applicable were omitted from both tables.

Table SCE 9-7

SCE Covered Conductor Mitigation Effectiveness Estimate

Driver		Mitigation Effectiveness	Reasoning
D-CFO	Vegetation contact-Distribution	60%	SCE conducted analysis that involved establishing four vegetation sub-drivers based on SCE's experience with vegetation contact. The four sub-drivers are: Heavy Contact (Tree), Heavy Contact (Limb), Light Contact (Frond/Branch), Light Contact (Grow In). SCE analyzed historical vegetation fault data from 2015-2018 and determined that percentage of occurrence between all four sub-drivers. • Heavy Contact (Tree): 30% • Heavy Contact (Limb): 22% • Light Contact (Frond/Branch): 43% • Light Contact (Grow In): 5% SCE testing supported that covered conductor will be 99% effective against both Light Contact drivers, which accounts for 1% of the line potentially being uninsulated at connection points or dead-ends. Additionally, SCE also determined that covered conductor will not be effective against Heavy Contact (Tree) due to being unable to mechanically support the weight of a tree. Covered conductor was determined to be 50% effective against limb contact, conservatively assuming that the limb will exceed the conductor's

Driver		Mitigation Effectiveness	Reasoning
			strength 50% of the time. The overall mitigation effectiveness value for vegetation is based on the weighted average of all four sub-driver and was calculated to be 60%.
D-CFO	Animal contact-Distribution	65%	SCE conducted analysis that involved establishing animal contact sub-drivers in terms of equipment affected. These Animal Contact sub-drivers include Conductor/Wire, Fuse/BLF/Cutout, Terminations, Transformer, etc. The percent of animal contact faults were calculated per sub-driver using 2015-2020 data. Next, SCE used SME knowledge to establish the percent of wildlife covers existing in the system for the applicable sub-driver. Lastly, SCE assigned a preliminary mitigation effectiveness based on SME judgement per sub-driver. Covered conductor is considered 100% effective for Conductor/Wire Animal contact based on testing. Other equipment with associated wildlife covers were assigned a 90% effectiveness to account for the wildlife cover installation required during WCCP. The preliminary mitigation effectiveness was multiplied by the percent of wildlife covers not existing in the system to adjust for the possibility that pre-WCCP structures already have wildlife covers. The weighted average of this adjusted mitigation effectiveness was calculated to be 65%.
D-CFO	Balloon contact-Distribution	99%	Covered conductor is estimated to be 99% effective against contact with metallic balloons. This is supported by testing and accounts for approximately 1% of the line potentially being uninsulated at connection points or dead-ends.
D-CFO	Vehicle contact-Distribution	50%	SCE analyzed the composition of historical wire downs from vehicle collisions and found that nearly all ignitions from a vehicle collision are caused by conductor contact. SCE testing established the covered conductor is effective against conductor-to-conductor contact. However, there is uncertainty regarding the effectiveness of covered conductor during a wire down due to exposed conductor at the dead-end or break-point. To account for this uncertainty, a mitigation effectiveness of 50% was assumed.
D-CFO	Other contact-from-object - Distribution	77%	Analysis found that foreign material accounts for 77% of the “Unspecified” driver, while Ice/Snow accounts for the other 23%. While covered conductor is effective against foreign materials, it is not effective against ice/snow.

Driver		Mitigation Effectiveness	Reasoning
D-CFO	Connection device damage or failure - Distribution	90%	Assumption that infrastructure replacement will lead to 90% mitigation effectiveness. Reconductoring with covered conductor will facilitate the replacement of aged hardware. Some hardware used in new installation will also be improved technology.
D-CFO	Unknown contact - Distribution	77%	Weighted average of vegetation contact, animal contact, balloon contact, and other contact.
D-EFF[285]	Splice damage or failure — Distribution	90%	Assumption that infrastructure replacement will lead to 90% mitigation effectiveness. Reconductoring with covered conductor will facilitate the replacement of aged hardware. Some hardware used in new installation will also be improved technology.
D-EFF	Crossarm damage or failure - Distribution	50%	Covered conductor is estimated to be 50% effective against crossarm failure. Reconductoring with covered conductor will facilitate the replacement of aged crossarms. Additionally, testing illustrated that covered conductor significantly reduced leakage current on the crossarm, reducing the occurrence of damage due to electrical tracking.
D-EFF	Insulator damage or failure- Distribution	90%	Assumption that infrastructure replacement will lead to 90% mitigation effectiveness. Reconductoring with covered conductor will facilitate the replacement of aged insulators.
D-EFF	Wire-to-wire contact / contamination- Distribution	99%	Covered conductor is estimated to be 99% effective against wire-to-wire contact. This is supported by testing and accounts for approximately 1% of the line potentially being uninsulated at connection points or dead-ends.
D-EFF	Conductor damage or failure — Distribution	90%	Assumption that infrastructure replacement will lead to 90% mitigation effectiveness. Reconductoring with covered conductor will facilitate the replacement of aged conductor. Additionally, conductor failure due to faults will also be reduced because: (1) covered conductor will prevent contact-from-object faults from occurring and (2) the covered conductor will have a larger short circuit duty.
D-EFF	Insulator and brushing damage or failure - Distribution	90%	Assumption that infrastructure replacement will lead to 90% mitigation effectiveness. Reconductoring with covered conductor will facilitate the replacement of aged insulators.

Table SCE 9-8

[285] EFF represents Equipment / Facility Failure

SCE Fire Resistant Pole Mitigation Effectiveness

Driver		Mitigation Effectiveness	Reasoning
D-EFF	Crossarm damage or failure - Distribution	50%	Replacing existing poles with FRPs will facilitate the replacement of aged wood crossarms with composite crossarms. Additionally, fire-resistant composite poles significantly reduce leakage current on the crossarm, reducing the occurrence of damage due to electrical tracking. The improved crossarm design and reduction of leakage current accounts for the 50% effectiveness against crossarm damage or failure.
D-EFF	Conductor damage or failure — Distribution	5%	Replacing poles with FRPs will facilitate the replacement of aged equipment.
D-EFF	Fuse damage or failure - Distribution	5%	Replacing poles with FRPs will facilitate the replacement of aged equipment. The new fuses used will be improved technology.
D-EFF	Switch damage or failure- Distribution	5%	Replacing poles with FRPs will facilitate the replacement of aged equipment. The new switches may be improved technology.
D-EFF	Insulator and bushing damage or failure - Distribution	50%	Replacing poles with FRPs will facilitate the replacement of aged equipment.
D-EFF	Transformer damage or failure - Distribution	50%	Replacing poles with FRPs will facilitate the replacement of aged equipment. The new equipment may be improved technology (e.g., FR3 transformers).

PG&E:

PG&E's covered conductor program consists of primary and secondary conductor replacement with covered conductor along with pole replacements, replacement of non-exempt equipment, replacement of overhead distribution line transformers with transformers with FR3 insulating fluid, framing and animal protection upgrades, and vegetation clearing which makes up the entire Overhead Hardening program. PG&E understands the focus of this issue to be centered on covered conductor, however, PG&E's efforts to estimate effectiveness extend to include all elements of its Overhead Hardening program as PG&E considers this approach more complete.

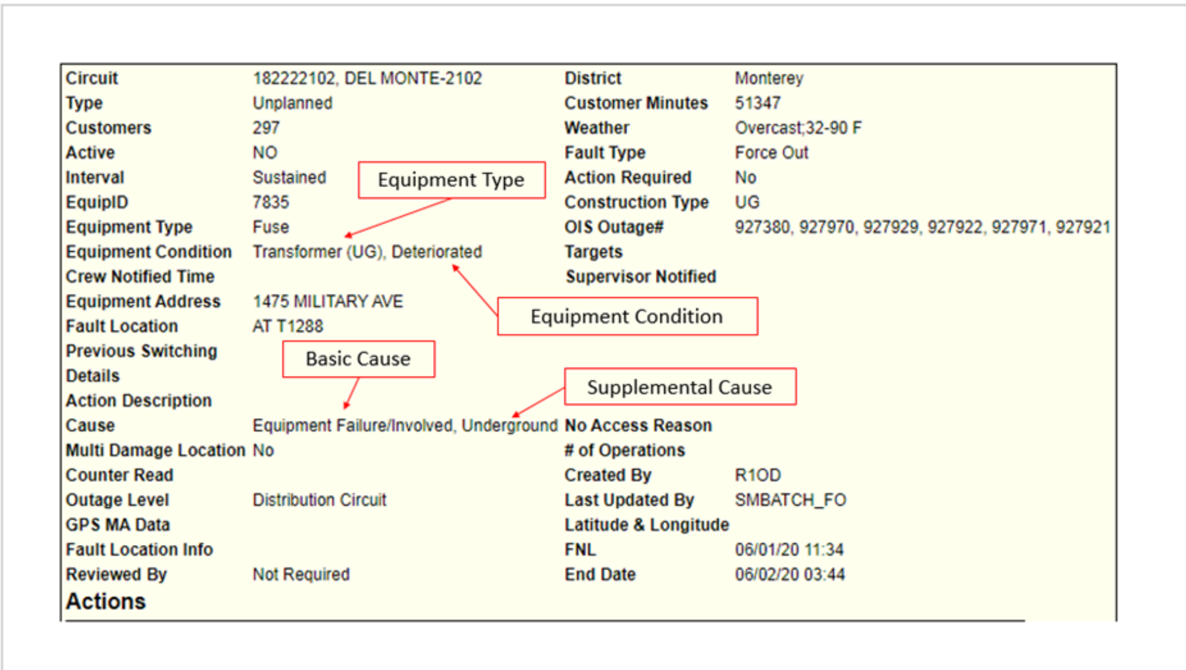
Determining whether a specific event could result in an ignition depends upon a wide variety of factors, including the nature of the event itself and prevailing environmental conditions (e.g., weather, ground moisture level, time of year). As PG&E does not have complete information to make this determination for each event, estimating overhead hardening effectiveness relies upon the following proxy, outlined below, to derive its estimates. Most distribution outages (momentary and sustained) typically involve a fault condition. Thus, for purposes of estimating overhead hardening effectiveness, it is assumed that all distribution outages could potentially result in an ignition, regardless of other prevailing conditions. This approach aligns with what has been previously stated in PG&E's 2020 WMP as well as its 2020 RAMP filing.

With the above assumption, PG&E took the following approach to estimate a general effectiveness factor for overhead hardening:

1. SMEs identified 4,336 distinct outages by using all known combinations of basic cause, supplemental cause, equipment type and equipment condition from the distribution outage database as show in Figure SCE 9-16 below. Whenever an outage is reported, an operator fills in different fields that provide information about the outage, through SME evaluation, it was decided that the combination of the four fields aforementioned provide an appropriate distinction of different outage types.

Figure SCE 9-16

PG&E Distribution Outage Database Record



Circuit	182222102, DEL MONTE-2102	District	Monterey
Type	Unplanned	Customer Minutes	51347
Customers	297	Weather	Overcast;32-90 F
Active	NO	Fault Type	Force Out
Interval	Sustained	Action Required	No
EquipID	7835	Construction Type	UG
Equipment Type	Fuse	OIS Outage#	927380, 927970, 927929, 927922, 927971, 927921
Equipment Condition	Transformer (UG), Deteriorated	Targets	
Crew Notified Time		Supervisor Notified	
Equipment Address	1475 MILITARY AVE		
Fault Location	AT T1288		
Previous Switching Details			
Action Description			
Cause	Equipment Failure/Involved, Underground	No Access Reason	
Multi Damage Location	No	# of Operations	
Counter Read		Created By	R1OD
Outage Level	Distribution Circuit	Last Updated By	SMBATCH_FO
GPS MA Data		Latitude & Longitude	
Fault Location Info		FNL	06/01/20 11:34
Reviewed By	Not Required	End Date	06/02/20 03:44

Actions

2. SMEs identified whether overhead hardening would eliminate, reduce significantly, reduce moderately, reduce minimally, or will not have an effect on the likelihood of a certain type of outage occurring leading to an ignition when an asset has been hardened. From this classification the following qualitative categorization was performed:

   - All = Eliminates likelihood of a certain type of outage occurring resulting in an ignition
   - High = Reduces likelihood significantly of a certain type of outage occurring resulting in an ignition
   - Medium = Reduces likelihood moderately of a certain type of outage occurring resulting in an ignition
   - Low = Reduces likelihood minimally of a certain type of outage occurring resulting in an ignition

- None = Will not have an effect on likelihood of a certain type of outage occurring resulting in an ignition

3. Each of qualitative categories were assigned a quantitative value, which measured the likelihood of outage reduction:
   - All = 90%
   - High = 70%
   - Medium = 40%
   - Low = 20%
   - None = 0%

4. The above criteria were applied to historical outages, this resulted in likelihood of outage reduction for each outage.

5. Outages were classified by drivers, the outage drivers identified are: Animal, D-Line Equipment Failure, Human Performance, Natural Hazard, Other, Other PG&E Assets or Processes, Physical Threat, RIM, Third Party, Vegetation. The Wildfire Mitigation driver is excluded as this captures all PSPS triggered outages.

6. The final step in preparing the data was to add meteorology data that provides historical wind events times during the analyzed period 2015-2019, as well as weather signal data to allow for further analysis with meteorology experts.

7. A Pivot table is then created to aggregate Outages in HFTD that occurred during acute wind events days, this is understood to be the time where the equipment would be most stressed by the environment as well as the area where Overhead Hardening is being conducted. The aggregation is done at the outage driver level

The results from the analysis detailed in the steps above are interpreted as Overhead Hardening having an effectiveness of approximately 63% for sections where Overhead Hardening has been completed. Therefore, a section of a line that has been hardened is approximately 63% less likely to have an outage of any type. Similarly, a section of a line that has been hardened is approximately 63% less likely to have an outage of each of the drivers. Below, Table SCE 9-9 provides a summary of the results from the analysis.

Table SCE 9-9

PG&E Covered Conductor Mitigation Effectiveness Estimate

Driver	Count of Incident ID	Average of Overhead Hardening Effectiveness Percentage
Animal	36	76%
D-Line Equipment Failure	179	71%
Human Performance	3	0%
Natural Hazard	285	35%

Other	256	90%
Other PG&E Assets or Processes	15	47%
Third Party	20	62%
Vegetation	204	63%
Grand Total	**998**	**63%**

SDG&E:

SDG&E initially began to examine covered conductor from a personnel safety and reliability standpoint. The three-layered construction showed prospective reduction of injuries to people in the event of an energized wire-down in which the wire contacted a person and/or also might reduce the step potential to people in the vicinity. Outages that result from light momentary contacts (e.g., mylar balloons, birds, and palm fronds) also have shown the potential to be reduced. In late 2018, focus was shifted towards using covered conductor as an alternative to SDG&E's traditional overhead hardening program with the primary focus of reducing utility-caused ignitions.

SME's conducted research on the history and use of covered conductor in the industry. Additionally, the SMEs reached out to utilities on the East Coast and internationally to receive their feedback of the effectiveness and work methods for installation purposes.

In addition to other studies/tests that have been and will be performed by SCE and PG&E, as described in the Testing section, SDG&E will have a third party evaluate the likelihood and effect specific to conductors clashing at various wind speeds. Accelerated aging studies will also be performed to mimic a 40-year service life; after which, the samples will be subjected to tests designed to understand the potential for both mechanical degradation, as well as a reduction in the dielectric strength of the covering. These tests will be performed in accordance with ASTM or other industry recognized standards.

In order to quantify the risk reduction of wildfires that would be achieved by covered conductor, SDG&E evaluated 80 events that resulted in ignitions. SMEs weighed in on the likelihood that covered conductor installation would prevent an ignition for the particular type of outage depending on the severity of the incident. As seen in Table SCE 9-10 below, the result is a reduction in ignitions from 80 to 28.4, and a resulting effectiveness estimate of 64.5%.

Table SCE 9-10

SDG&E Covered Conductor Mitigation Effectiveness Estimate

Fault/Ignition Cause	*Number of Ignitions*	*SME Effectiveness*	*Post-Mitigation Ignitions*
Animal contact	5	90%	0.5
Balloon contact	8	90%	0.8
Vegetation contact	10	90%	1.0
Vehicle contact	14	20%	11.2
Other contact	4	10%	3.6

Other	2	10%	1.8
Equipment - All	34	80%	6.8
Unknown	3	10%	2.7
Total	80	64.5%	28.4

PacifiCorp:

PacifiCorp has some experience with installing a spacer cable system, which primarily includes covered conductor, a structural member (messenger), and specialized attachment brackets. The company pursued this design due to historical experience with elevated outage count from trees, limbs, and incidental contact (resulting in grow in) throughout its service territory. Additionally, access conditions on some of its circuits are extremely difficult in certain times of the year, and those circuits also tend to have elevated outage rates. For the above-mentioned reasons, when siting its spacer cable pilot projects, PacifiCorp tended to focus its deployment on circuit-segments that had above average vegetation and/or animal outage rates in conjunction with difficult access.

Spacer cable systems employ an engineered weak-link system where covered conductors are in a spaced bundle configuration. The bundle is supported by a high-strength tensioned cable which has shown to be able to support the cables even when the system is under extreme stress.[286] This system is secured to poles primarily with fixed or flex tangent brackets, in which the messenger is the only connected conductor. The covered conductors are not tensioned (nor are they structural members) and instead are held together with spacers attached to a tensioned messenger and placed approximately 30-feet apart. PacifiCorp's spacer cable systems are currently installed using components rated at or above 35 kV, where the only deviation is in the covered conductor itself, whereas it uses two voltage classes; 15 kV for energized voltages of 12.47 kV and below and 35 kV for energized voltages of 20.8 kV to 34.5 kV.

Originally contemplated as a reliability improvement tool, PacifiCorp has now moved to leveraging spacer cable as a wildfire mitigation tool; a natural progression given the similarities in risk drivers such as contract-from-object or damage from vegetation. In their original installations, reliability improvement was the driver, but because of the newness of the technology it was trialed in several different environments with differing installation approaches; the first was focused on contact-from-object/animals and subsequently two of them were focused on contact-from-object/vegetation, one in a coastal environment and another in a mountainous environment, which was followed by projects heavily targeting mitigation of contact-from-object as well as blow-in (and other incidental vegetation); the projects formed the basis for targeting covered conductor (specifically spacer cable) as a mitigation measure for ignition risk drivers.

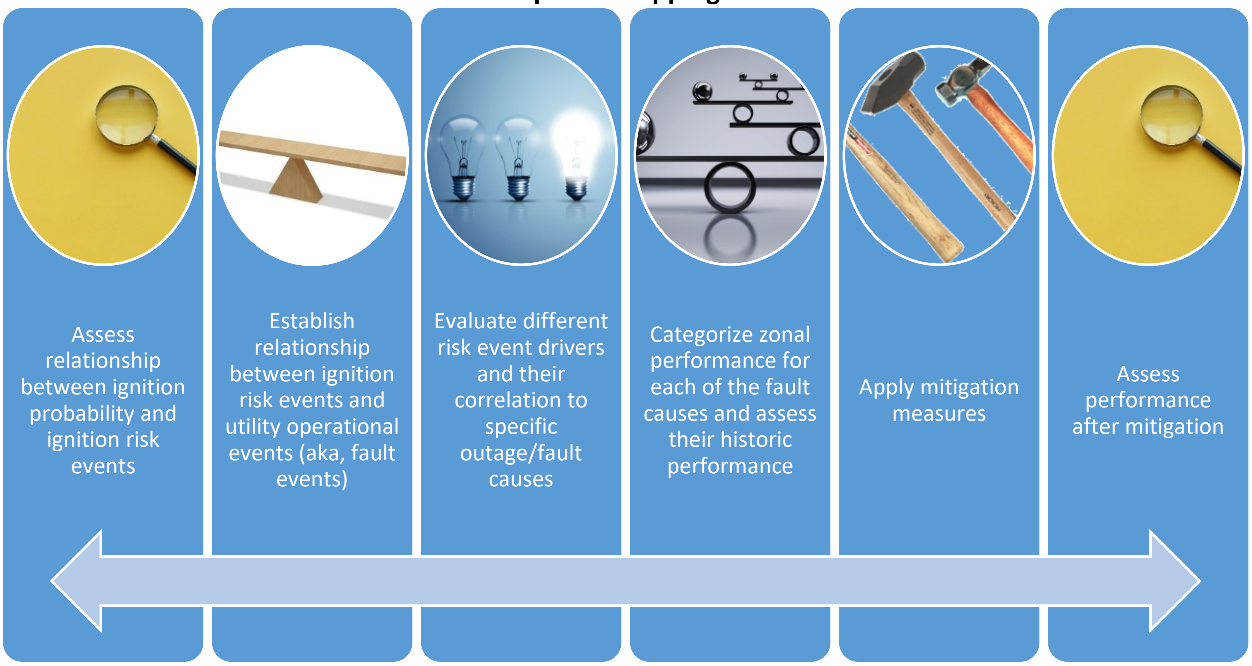
PacifiCorp's process for evaluating ignition risk drivers, mitigation measures and effectiveness of measures (in order to long term calculate risk spend efficiency) is detailed below.

[286] Bouford, James D. "Spacer cable reduces tree caused customer interruptions." 2008 IEEE/PES Transmission and Distribution Conference and Exposition. IEEE, 2008.

The company prepared a mapping exercise to evaluate which risks could be addressed with what alternatives, recognizing that covered conductor and a variety of other measures might all be valid approaches. As a starting point, the company evaluated its outage data to align against risk event drivers and correlating against mitigation alternatives. This process is shown graphically in Figure SCE 9-17 below.

Figure SCE 9-17

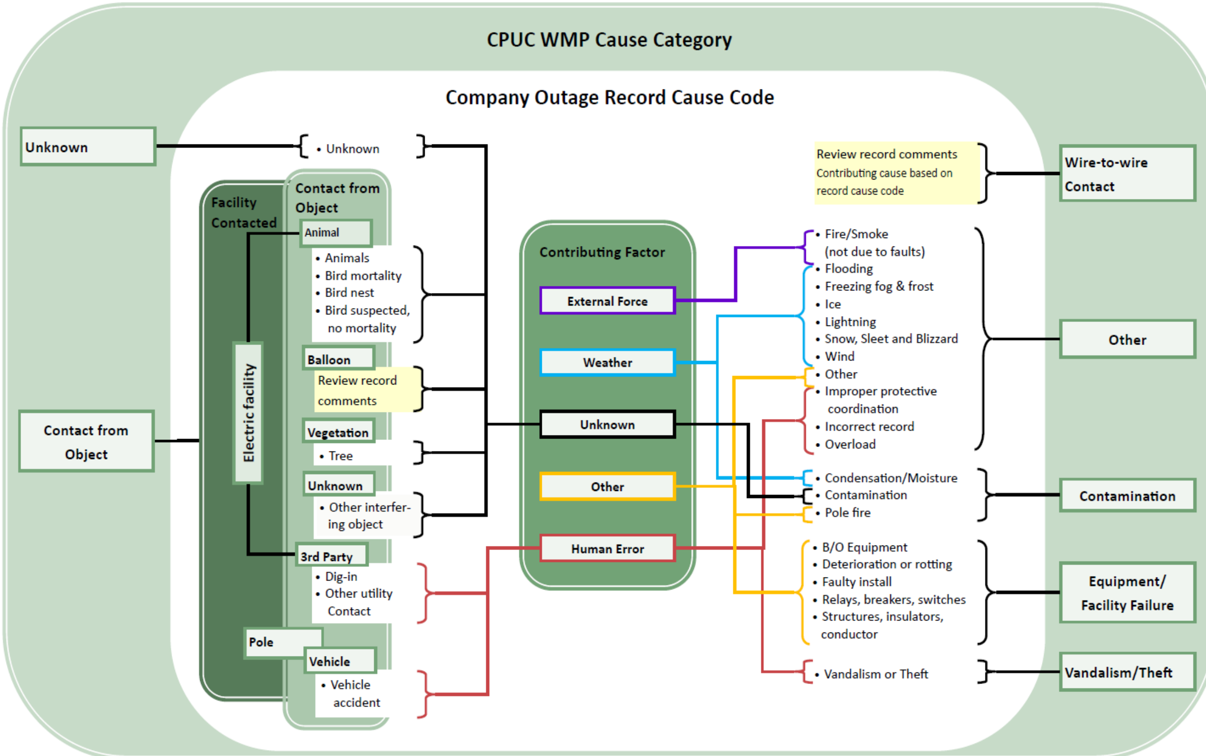
PacifiCorp Risk Mapping Exercise



With this process, as outlined below in Figure SCE 9-18, PacifiCorp evaluated outage causes (and sub-causes, as well as commented information) to establish a relationship between forced outages and risk event drivers.

Figure SCE 9-18

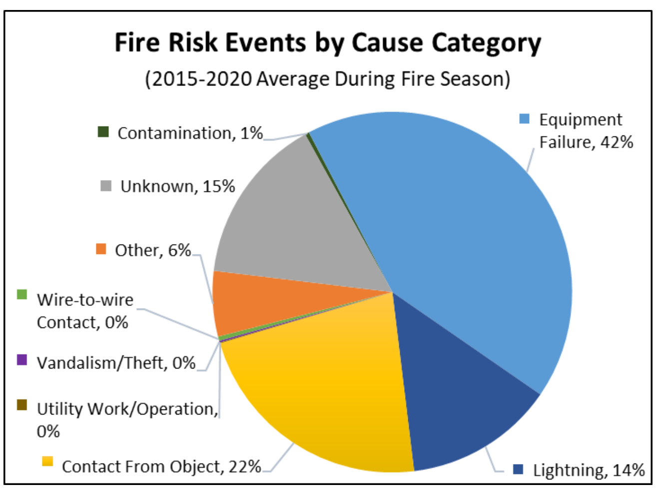
PacifiCorp Outage Cause Evaluation



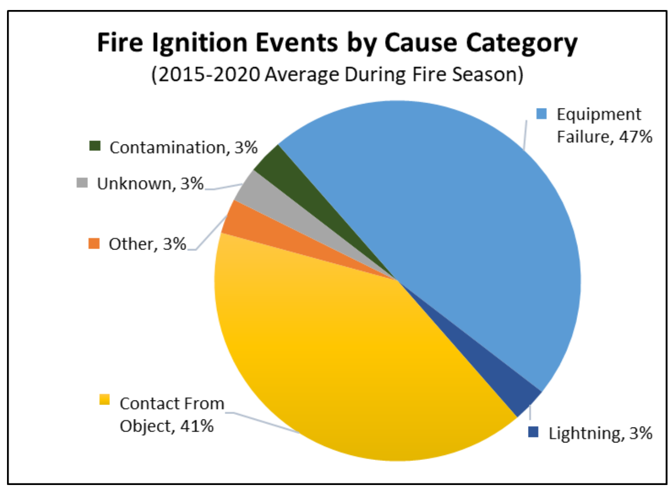
The company then determined the average percentage of fire risk events and ignition events over the 2015-2020 period as shows in the figures below.

Figure SCE 9-19

PacifiCorp Fire Risk Events by Cause Category



PacifiCorp Fire Ignition Events by Cause Category



The company then evaluated the probability (qualitatively scored and informed by the information above) of each ignition risk driver and its potential for ignition based on the season (fire and non-fire season) as shown in Figure SCE 9-20 below. It was also segmented by transmission and distribution system, since the probabilities of each risk event driver and ignition risk were not equivalent. Qualitatively, PacifiCorp designated each cause either a low (L), medium low (ML), medium (M), medium high (MH), and high (H) by fire and non-fire season for the likelihood of the cause to result in an ignition to help establish priorities of mitigations.

Figure SCE 9-20

PacifiCorp Fire Risk Events Assessment

Risk Event Driver		Non-Fire Season		Fire Season	
		Transmission	Distribution	Transmission	Distribution
Wire down event (regardless of cause)		M	M	H	H
Contact-from-object	Veg. contact	M	M	H	H
	Animal contact	L	L	L	ML
	Balloon contact	L	L	L	ML
	Vehicle contact	L	ML	M	MH
	Other contact-from-object	L	L	L	ML
Equipment / facility failure	Connector damage or failure	M	M	H	H
	Splice damage or failure	M	M	H	H
	Crossarm damage or failure	L	L	M	ML
	Insulator damage or failure	L	L	L	ML
	Lightning arrestor damage or failure	L	M	L	H
	Tap damage or failure	L	L	L	ML
	Tie wire damage or failure	L	L	L	L
	Other	L	L	L	L
Wire-to-wire contact	Wire-to-wire contact / contamination	L	L	ML	M
Contamination		L	L	L	ML
Utility work / Operation		L	L	L	ML
Vandalism / Theft		L	L	L	ML
Other		L	L	L	L
Unknown		L	L	L	L

Based on PacifiCorp's spacer cable pilot projects, the company is experiencing a 90% reduction in outage events. In order to evaluate this, PacifiCorp prepared pre-reconductor performance and contrasted it against post-reconductor performance and determined that the reduction in outages was approximately 90%. It is important to note that for these projects, since they were targeted specifically to environmental parameters that are visible (such as tree canopies or animal habitats), only the at-risk segments were reconductored (i.e., the entire zones of protection were not reconductored). The effect of this approach results in a high degree of confidence in the intended purpose of the project (against the specific risk driver). Should the measure be broadly extrapolated throughout the company's system, in the areas where these risk drivers are not prevalent their effectiveness is more problematic to evidence, since a longer duration of the countermeasure must be in place to determine that it was in fact, effective. To further explain, if an area is not prone to a specific risk driver, a longer history is required to experience a given risk event.

In the future, as the company reconductors entire zones of protection, it will have better certainty about the effectiveness of the mitigation against each ignition risk driver within that zone. For the initial projects, the scoping was directly motivated by reducing contact, primarily vegetation outage rates, and as a result the outage rates being measured are directly influenced by that decision. Even though the data is not perfect, it still provides a valuable insight into the expected reduction in risk from covered conductor. As the company constructs more projects and as time passes for outage events to accrue, PacifiCorp expects to further refine the outage rate reduction by ignition risk driver. For the ignition risk drivers that it is not able to confidently measure, PacifiCorp takes the 90% reduction in outage rate and modifies it with SME input to create estimated effectiveness values. The ignition risk drivers, the estimated reduction, and the explanation is summarized in Table SCE 9-11 below.

Table SCE 9-11

PacifiCorp Covered Conductor Mitigation Effectiveness Estimate

Ignition Risk Driver	Estimated Effectiveness Percent Reduction	Discussion
Vegetation Contact	90%	Vegetation contact is one of two primary drivers for the pilot project selection.
Animal Contact	90%	Animal contact is the second of two primary drivers for the pilot project selection.
Balloon Contact	99%	In general, expect contact from balloons to be mitigated.
Vehicle Contact	90%	Due to the increased strength of spacer cable systems, combined with increased resilience to wire-to-wire contact, estimate a 90% effectiveness.
Equipment Failure	90%	Much of the equipment used to construct bare overhead systems is replaced with different components. Additionally, phase conductors are not under tension. This estimated effectiveness is not incorporating downstream equipment such as transformers and protective devices.
Wire to Wire Contact	99%	Due to the forces experienced from vegetation contact, instances of wire-to-wire contact have been observed. No faults occurred.
Contamination	75%	Risk of contamination is estimated to be reduced due to systems being insulated beyond their standard NESC minimum ratings.
Vandalism/Theft	50%	In general, spacer cable has less risk of conductor theft as well as vandalism. Believe there are two areas where there could be increased risk of vandalism and theft, for example, damage from “gunshot” to the conductor covering, and theft of copper ground wiring.

Ignition Risk Driver	Estimated Effectiveness Percent Reduction	Discussion
Lightning	50%	Given spacer cables unique design where the messenger (neutral) is the topmost conductor, it acts as a grounded shield wire for the phase conductors. In addition, earth grounds are utilized every approximately 500 feet to further ground the system. With diligence in lightning arrester placement, estimate a 50% reduction in lightning-related faults.
Third Party	90%	Third-party including contact from joint use, boom arms, etc. should be mostly mitigated with spacer cable.

BVES

BVES has approximately 211 circuit miles of overhead conductor between 34.5 kV and 4.16 kV in its system. BVES started a covered conductor pilot program in Q2 2018 and completed it in Q3 2019 using two different types of cover conductor wires (394.5 AAAC Priority wire and 336.4 ACSR Southwire). Then BVES started the cover conductor Wildfire Mitigation Plan (WMP) late 2019 with a plan to cover 4.3 circuit miles on 34.5 kV over the next 5 years and 8.6 circuit miles on 4.16KV over the next 10 years. As of the end of Dec. 2021, BVES has covered approximately 21.1 miles between its 34 kV and 4 kV systems. BVES' average span length is approximately 150 feet and installing covered conductor on cross arms with Hendrix insulators. As part of its covered conductor program when there are spliced locations, BVES installs premade cold shrink kits (3M) and installs avian protection (raptor protection/wildlife guard).

Based on benchmarking with other utilities' estimated effectiveness against ignition risks, discussions with its covered conductor supplier, and the short amount of time that it has installed covered conductor, BVES believes that the estimate of effectiveness on ignition risk drivers in its service territory is approximately 90%. This is BVES's first initial look and as it installs more covered conductor and gathers more historical data, it will continue to assess the estimate of effectiveness. BVES presents its estimated effectiveness in Table SCE 9-12 below.

Table SCE 9-12

BVES Covered Conductor Mitigation Effectiveness Estimate

Ignition Risk Driver	Percent Reduction	Discussion (Contacts on Cover Conductor cable)
Vegetation Contact	90% +	Vegetation contact on 1, 2, 3 phase and/or neutral wire.
Animal Contact	90% +	Animal contact on 1, 2, 3 phase and/or neutral wire.

Ignition Risk Driver	Percent Reduction	Discussion (Contacts on Cover Conductor cable)
Balloon Contact	90% +	Balloon contact on 1, 2, 3 phase and/or neutral wire.
Wire down contact	90% +	Due to the following: tree/tree limb fallen on line, car hit pole , wind gust, etc.
Vehicle Contact	90% +	Vehicle Contact due to wire down on vehicle.
Wire to Wire Contact	90% +	Due to the wind gust forces causing tree/tree limb fall on line or just wire to wire contact.
Splice location contact	90% +	BVES installs Avian protection/raptor protection/wildlife guards and uses premade cold shrink kits (3M) on splice locations.
Vandalism/Theft	90% +	In BVES' service territory there is a low risk of conductor theft as well as vandalism. If vandalism occurs, Ex. damage from "gunshot" to the conductor covering installed.
Lightning Contact	90% +	During raining seasons, sometimes encounter a good amount of lightning strikes in BVES' service territory. BVES using priority covered conductor (flame resistant) cable.
Third Party	90% +	Third party including contact from joint use, boom arms, etc. should be mostly mitigated with covered conductor cable.
Flame Propagation along the covered conductor	90% +	Caused by Lightning or other.
Flame particle dripping	90% +	Caused by Lightning or other.

Liberty

To estimate the effectiveness of its Covered Conductor WMP initiative in mitigating wildfire risk, Liberty evaluated the ability of covered conductor to reduce each ignition risk driver, as seen in Table SCE 9-13 below. Liberty employed an internal risk working group to assess the effectiveness of covered conductor and other system hardening initiatives in reducing wildfire risk. This working group consisted of SMEs across its engineering, operations, wildfire prevention and regulatory teams. The SMEs convened weekly to discuss in detail each ignition risk driver and the mitigation effectiveness of covered conductor and other system hardening initiatives. SMEs referenced Liberty's historic outage data, including the location and cause of the outage and any associated dispatch or filed notes included in its outage management database. SMEs discussed the extent to which covered conductor would reduce, eliminate, or not have an effect on the likelihood of a specific type of outage occurring and leading to an ignition. Outages were classified by the ignition risk drivers listed in the table below and an estimated mitigation effectiveness percentage was developed for each risk driver.

The table below explains the reasoning for the estimated effectiveness values. Liberty continues to benchmark its evaluation within the industry. As Liberty continues to collaborate and benchmark with its peer utilities, including through the Joint IOU Covered Conductor Working Group, it will revisit the estimated effectiveness metrics and revise as necessary.

Table SCE 9-13

Liberty Covered Conductor Mitigation Effectiveness Estimate

Ignition Risk Driver	Covered Conductor Mitigation Estimated Effectiveness (%)	Reasoning
Animal contact	90%	• Line is potentially uninsulated at connection points, transformer taps and dead-ends (locations with higher probability of animal activity).
Vegetation contact	95%	• CC will handle most tree branches falling on it, and grow-in, but not an entire tree (fall-in).
Vehicle contact	50%	• If a car takes a pole out, there is a reasonable chance the circuit will remain in service. • A wire-down event from car-hit-pole will result in fewer faults with covered conductor.
Conductor failure	80%	• Conductor not totally fail-proof from branches (larger, heavier, falling further) or tree falls, potentially breaking poles and crossarms. Steel poles/fiberglass crossarms might mitigate some of this vs. wood.
Conductor failure - wire slap	95%	• Covered conductor largely eliminates mid-span wire-slap phase-to-phase faults
Conductor failure - wires down	80%	• See logic for vehicle contact
Other - Including unknowns	75%	• Liberty suspects that many 'unknown' OMS outage cause codes are non-failure

Ignition Risk Driver	Covered Conductor Mitigation Estimated Effectiveness (%)	Reasoning
		wire slap, light veg contact, lightning or animal because no damaged component can be found as a reason for protective device operation.
Weather - Snow (better defined)	90%	• Liberty's covered conductor installation typically includes new poles and crossarms due to higher conductor loads. Poles designed to meet the GO 95 strength requirements.
Weather - Lightning	15%	• Messenger wire on ACS attracts lightning strikes away from conductors.
Weather - Wind	90%	• Covered conductor largely eliminates mid-span wire-slap phase-to-phase faults
Pole Fire	80%	• ACS prevents bare wire from laying on the cross-arm and burning. • Tree wire has multi-layer jacket which greatly reduces opportunity for bare wire contact with wood supporting apparatus.

Next Steps:
As detailed above, the utilities estimate the effectiveness of covered conductor between approximately 60 and 90 percent. In 2022, the utilities will continue to meet on a regular basis to discuss estimated effectiveness methods, data and calculations. The utilities will learn from the benchmarking, testing, and recorded results and collaborate to improve each utilities' understanding and approach to estimate effectiveness. The utilities plan to discuss opportunities to align data and methods for greater comparability and will provide an update on these efforts in their 2023-2025 WMPs.

Recorded Effectiveness:
The utilities are in the early phases of covered conductor deployment and measuring its effectiveness. Though the utilities' data is limited, the early outcomes, as presented below, show covered conductor effectiveness at reducing the risk drivers that can lead to wildfires range between approximately 60 to 90 percent, which is consistent with the utilities' estimated effectiveness values, benchmarking, past testing results, and the results of the Phase 1 testing report. With the limited amount of data and the fact that the utilities have taken different approaches to measuring the effectiveness of covered conductor, in 2022, the utilities will work towards developing a common methodology (or multiple methods) all utilities can use for better comparability. The utilities also plan to continue discussions with the IEEE DRWG on methodologies to measure the effectiveness of covered conductor as part of a peer-review process.

Below, the utilities describe data and analyses they have conducted regarding measuring the recorded effectiveness of covered conductor and collectively the utilities summarize future steps to improve these methods and updates to the data sets.

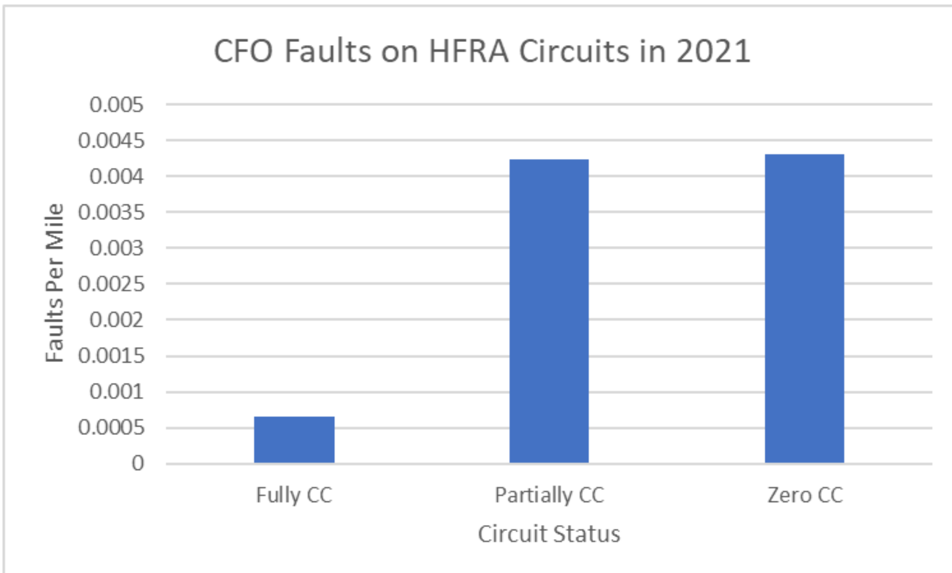
Covered Conductor Recorded Effectiveness:

SCE

SCE is measuring the overall effectiveness of covered conductor by comparing events (primary wire downs, primary conductor caused ignitions and faults) on fully covered circuits to bare circuits in its HFRA on a per-mile basis in current years. As of 2021, SCE's fire data does not show any events occurring on fully covered circuits. The data shows that circuits fully covered experience approximately 85% less or 15% of the faults caused by CFO then that of bare conductor do (see Figure SCE 9-21 below).

Figure SCE 9-21

SCE Faults on HFRA Circuits in 2021



As seen in the figure above, SCE is using current (2021) data by comparing results (e.g., faults per mile) in HFRA for circuits that have been fully covered, partially covered and not covered as opposed to historical data, which may either over- or under-represent the benefits by not capturing weather variations year after year and data quality improvements in identifying and tracking risk events.

Since 2018, SCE has documented known contact-related events with covered conductor. In one instance, a tree fell on covered conductor lines, making contact with all three phases. In another case, energized covered conductor lines fell into adjacent trees after a vehicle struck a pole, as shown in Figure SCE 9-22 below. These events did not result in faults, wires down, or ignitions because covered conductor was deployed and provide examples of effectiveness of covered conductor in the field.

Figure SCE 9-22

Covered Conductor Contact with Vegetation After Car-Hit-Pole
Ojai, California – July 24, 2020

<u>PG&E</u>

To align with the estimated effectiveness approach, in 2021, PG&E started to analyze its hardened facilities' performance with regard to recorded outages, incidents, and ignitions so that it can continue to refine its strategy and improve the scope and design of its Overhead Hardening Program. PG&E will also analyze the performance of any hardened facilities that experienced a wildfire in order to validate assumptions about the life expectancy and effectiveness of hardened facilities in various conditions.

The Overhead Hardening Program is still in its infancy which makes it difficult to have the amount of data needed to have statistical significance from this type of analysis. Initial analysis has been limited to counts of outages at the circuit segment level that compare the annual average from 2015-19 (pre-overhead hardening) to the 2020 (hardened) total count of outages where overhead hardening was completed in 2019 as shown in Table SCE 9-14 below.

Table SCE 9-14

PG&E Pre-Overhead Hardening Compared to Post Hardened Count of Outages

2015-2019 Average Outage Count	2020 Outages	Change	Percent [Ave -2020] / Ave
591	225	-366	62%

While the calculated outage reduction percentage (used as a measure of recorded effectiveness) matches the initial 62% estimated effectiveness, the results are understood to be preliminary and lack the geospatial accuracy needed for a truly recorded effectiveness.

Additionally, PG&E considered including ignitions, and incidents such as a wire down, or PSPS incidents (damage / hazard) in hardened sections to enhance the measurement of effectiveness of the Overhead Hardening Program, however the data scarcity was even greater for a meaningful analysis.

Going forward, PG&E's focus is to find ways to better capture geo location of a fault, and, if applicable, the damage and broken equipment. Industry-wide, fault location has historically been assigned to the device operated and not necessarily the actual coordinates where a fault occurs. This improvement in the quality of spatial data guarantees a more precise analysis of areas where overhead hardening has been completed.

Lastly, PG&E remains committed to explore ways to best calculate effectiveness and has established a biannual monitoring cadence with its Wildfire Governance Steering Committee to ensure continued improvement. These efforts will be shared with this working group to continue to improve methods to measure the effectiveness of system hardening initiatives.

<u>SDG&E</u>

SDG&E follows the same approach used to calculate the effectiveness of its Overhead Distribution Hardening, which is discussed in SDG&E's WMP in Section 4.4.2.3. SDG&E does not have sufficient data yet to draw any conclusions on the recorded effectiveness of covered conductor, as there is approximately only eighteen miles of covered conductor installed with an average age of less than one year. Across this small sample size, there have not been any faults on these covered conductor sections.

Moving forward, SDG&E will continue to track the mileage, years of service, and faults on all covered conductor circuit segments and will continue to collaborate with this working group to improve methods to measure the effectiveness of its system hardening initiatives. SDG&E's approach is to calculate the risk events per one hundred miles per year on segments that have been covered and compare the risk event rate before and after the installation of covered conductor.

<u>PacifiCorp</u>

As outlined above, PacifiCorp tracks risk events (forced outages) within each zone of protection (ZOP) with known conductor types and assumes homogenous performance across the ZOP; current processes do not establish specific locations where fault events occur, but are reconciled to the device that protects the ZOP. To establish the recorded effectiveness, PacifiCorp queried pre- versus post-installation performance with risk event drivers for all ZOPs having covered conductor (specifically spacer cable construction). It was important to recognize that legacy projects were focused on reliability and thus did not require reconductoring of the entire ZOP. As such, the recorded effectiveness calculations accounted for the percentage of the ZOP that wasn't reconductored. The smaller the percentage of the ZOP the less the confidence of the recorded effectiveness, while the higher the percentage of the ZOP the higher the confidence of the calculation.

Table SCE 9-15 below shows the performance before and after covered conductor installation, with several of the more recent projects not yet having sufficient history to calculate the effectiveness. As such, the table below summarizes PacifiCorp's experience of about 15-20 miles of the total covered conductor installed.

Table SCE 9-15

Improvement Percentage for Covered Conductor/Spacer Cable Projects

Project Circuit	Install Year	Pre Install Fault Rate (per Mile)	Post Install Fault Rate (per Mile)	Improvement %	Zone Spacer Cable After (%)
4W8	2018	0.11737	0	100	35.72
4W8	2018	0.80326	1.11155	-38.38	78.82
5A15	2017	0.15403	0.09387	39.06	27.67
5A93-1	2007	0.55552	0.35134	36.75	15.92
5A93-2	2017	0.85087	0.41872	50.79	16.1
5K50	2018	0.23498	0.10819	53.96	63.42
5L82	2013	0.55291	0.14227	74.27	100
5L82	2013	0.39609	0	100	100
5L82	2013	0.13227	0	100	66.19

This data is summarized graphically below in Figure SCE 9-23, where the improvement percentage is compared against the percentage of the ZOP that was reconductored. As can be seen, the higher the percentage of the ZOPs, the higher the recorded effectiveness when measured by faults (risk events) per mile.

Figure SCE 9-23

Percentage of Covered Conductor (Spacer Cable) in Zone Versus Improvement Percentage

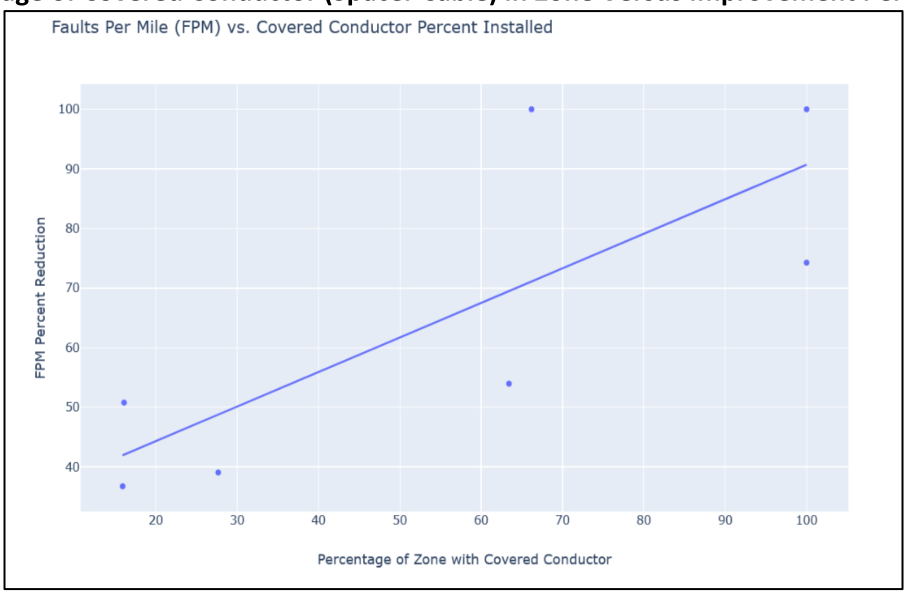
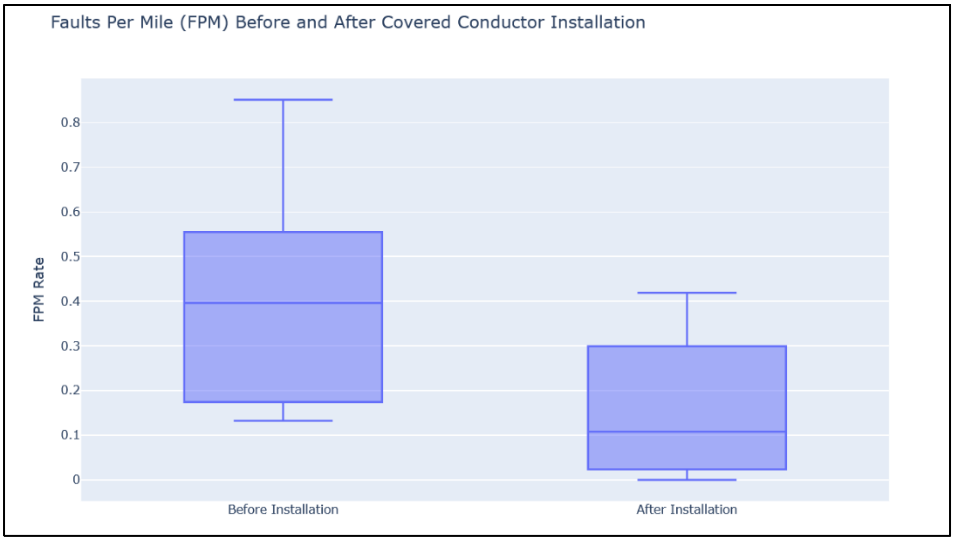


Figure SCE 9-24 below shows how the ZOPs performed before the mitigation was completed versus after the mitigation was completed, normalized based on the faults-per-mile recorded.

Figure SCE 9-24

Comparison of Faults Per Mile Performance Before Versus After Covered Conductor (Spacer Cable) Installation



PacifiCorp has also documented known contact-related events with covered conductor. As shown in Figure SCE 9-25 below, these events did not result in faults, wires down, or ignitions because spacer cable was deployed and provide examples of effectiveness in the field.

Figure SCE 9-25

Examples of Effectiveness of Covered Conductor to Risk Events

BVES

BVES has approximately 211 circuit miles of overhead conductor between 34.5 kV and 4.16 kV in its system. BVES started a covered conductor pilot program in Q2 2018 and completed it in Q3 2019 using two different type of cover conductor wires (394.5 AAAC Priority wire and 336.4 ACSR Southwire). Then, BVES started the cover conductor WMP late 2019 with planning on covering 4.3 circuit miles on 34.5KV next 4 years and 8.6 circuit miles on 4.16KV next 10 years. As of end of Dec. 2021, BVES has covered approximately 21.1 miles between its 34 kV and 4 kV system.

In Q3 2018, BVES started a new tree-trimming contract with a new tree service contractor. BVES has been very aggressive with its vegetation manage program having up to four tree crews or more at a time to complete its three-year cycle and remediating any issue trees which has helped reduce outages from vegetation contacts.

As part of its WMP, in June 2019, BVES began replacing all expulsion fuses in its service area with Trip Savers and Elf Fuses. BVES completed this project in May 2021, which eliminated the potential for ignitions from expulsion fuses.

Currently, BVES has not had any outages, wire down, tree limbs and/or ignitions on the lines that have been covered. BVES is still in the early stages of its covered conductor program. As more areas are covered and as more time passes, BVES will be able to compile more recorded data to inform on the effectiveness of covered conductor. Table SCE 9-16 below provides a simple assessment of recorded outages since 2016 in BVES' system which shows a reduction of outages beginning in 2019.

Table SCE 9-16

BVES 2016-2021 Recorded Outages Assessment

BVES, Inc.	12/10/2021
Year	# of outage
2016	163
2017	256
2018	118
2019	61
2020	84
2021	65

Liberty

Liberty's covered conductor program is relatively new, with the only significant projects being completed in 2020 and 2021. Because the program is new, data on the performance of covered conductor effectiveness will not yet demonstrate meaningful results based on the limited sample period and the wide variations in weather conditions. In addition, the covered conductor projects completed thus far represent a small percentage of each circuit and the outage data has only been evaluated on a circuit by circuit basis.

As an example, Liberty's Topaz 1261 circuit has 3.17 miles of covered conductor installed on the circuit which consists of an overall length of 55.6 miles. The illustrative table below shows historic 5-year forced outage data by outage risk driver for the Topaz 1261 circuit. As discussed in the Estimated Effectiveness working group section, Liberty identified significant outage risk drivers that could be mitigated with covered conductor and will use those outage risk drivers in its assessments of the effectiveness of its covered conductor projects. Liberty's forced outages on the Topaz 1261 circuit for 2021 are lower than the historic 5-year average. However, there were more forced outages in 2021 with a tree cause compared to previous years. In 2021, there were no outages recorded with wire slap as the cause, but there are only two recorded wire-slap causes in the study period. This example demonstrates that Liberty needs additional data to draw valid conclusions.

Table SCE 9-17

Historic Forced Outages by Risk Driver for Topaz 1261 Circuit (2017-2021)

Outage Risk Driver	Historical Average (2017-2020)	2021
Wind/Flying Debris	2.5	1
Hardware/Equipment Failure	4	4
Vegetation	1	4
Deterioration	1	0
Wire Down	0.5	0
Animal	0.5	0
Wire Slap	0.5	0
Wildfire	0.25	0
Fire on Company Equipment	0.25	0
Total for Risk Drivers Listed	10.5	9

While Liberty's outage management system does provide five years of useful historic forced outage data by geospatial location, the following are data limitations that Liberty has identified and is working to improve:

- Only the approximate outage locations are documented by field crews. While the general area affected is valuable for evaluating performance, Liberty is working with its field crews to document location at a more specific level.
- There are limits to the way dispatchers code outages within Liberty's existing outage management system (OMS). Liberty is currently undergoing an upgrade to its OMS and is working with its operations, dispatch and engineering teams to improve the data and to identify outage metrics and risk drivers to include in the upgrade.
- The planned OMS upgrade will coincide with a budgeted GIS upgrade, closely followed by a budgeted AMI implementation. These combined implementations are expected to better capture cause documentation, geo location of faults, outage extent/duration, and protective device operation.

Next Steps

In 2022, the utilities will continue to discuss methods of measuring the effectiveness of covered conductor, document the risk events and data utilities track, and work towards developing common methods to measure the effectiveness of covered conductor for better comparability. Since each utility has different processes and technical systems related to the collection of outage data, the utilities will work towards aligning on common methods. Of particular concern is ensuring a method or methods that all utilities can employ given the complexity in interruption data and differences in, for example, outage management systems, communication technologies, business practices, and causation identification and reporting. Methods the utilities plan to discuss include, for example, measuring faults in HFRA per hundred circuit miles per year comparing results pre- and post-covered conductor installation. Other methods include, for example, measuring the number of faults experienced in the current year for circuits that have been covered and circuits that have not been covered in HFRA and other metrics to demonstrate ignition performance. This will require SME discussions and review of outage, wire-down and ignition data across the utilities. The utilities also plan to refresh its data sets and discuss any incidents, trends, anomalies, etc.

Alternative Comparison:
The utilities identified an initial list of viable alternatives to covered conductor and conducted workshops with SMEs from the six utilities to assess the effectiveness of these alternatives against the same risk drivers that covered conductor is designed to mitigate. A viable alternative is a mitigation or group of mitigations that would address, to a similar or greater degree, the risk drivers that covered conductor is designed to mitigate. The utilities also included existing and a new bare conductor system as part of this assessment. The utilities used the risk drivers in Energy Safety's non-spatial data requirements (specifically, the non-repeated distribution causes and sub-cause categories in the WMP Guidelines, Table 7.1) to conduct the assessment. Below, the utilities describe the covered conductor system and alternatives that were selected for this assessment, the general assumptions that were applied, present the results of its assessment including descriptions of the factors that lead to lower or higher effectiveness, and describe the additional analyses the utilities plan to perform in 2022 to further the utilities understanding of the effectiveness of covered conductor compared to alternatives.

Covered Conductor System:
A covered conductor system generally refers to installing a conductor that is covered, replacing equipment/components that are required because of the covered conductor, such as insulators, cross arms, or poles (where applicable), replacing other equipment that is determined to reduce risk, improve resiliency/reliability and/or are cost-effective, and adding other protection measures such as animal guards or avian proofing where conditions merit or are otherwise applicable in the respective environment.

In very limited situations, it may be possible to simply re-string bare conductor with covered conductor. These limited situations would require all existing poles to withstand the heavier covered conductor and where polymer insulators are already in place. Simply re-stringing covered conductor would be a rare occurrence as it is not usually possible. As such, the utilities are comparing the relative effectiveness of alternatives to a covered conductor system, as described above, in their ability to reduce the risk drivers of ignitions.

Some of the risk drivers, such as Animal Contact, cannot be fully mitigated with covered conductor by itself. For example, you may also mitigate Animal Contact on a bare wire system by installing, wider crossarms (to increase the phase spacing) and coverings on jumper wires and at device connections. This presents some challenge in estimating the effectiveness of a system since it's not simply the covered conductor itself, but rather the combined mitigations working together to mitigate any given risk driver. As such, the utilities assumed that all overhead conductor-related alternatives include animal covers except the existing bare conductor system that is essentially a "do nothing" alternative.

Alternatives:

Below, the utilities describe the alternative mitigations that were compared with a covered conductor system.

Existing Bare Conductor System (status quo)

Existing systems, with enhanced maintenance activities and advanced system protection measures can be viewed as an alternative for covered conductor depending on the specific locational risk within the specified area. For purposes of this assessment, the utilities assumed a "do nothing" scenario regarding any system hardening upgrades. In the analysis below, this is labeled as Existing Bare Conductor. While the six utilities may have different existing overhead bare conductor systems in their HFRA, the utilities generally assumed existing bare conductor systems

New Bare Conductor System (like-for-like replacement)

This involves re-conductoring existing bare systems with like-for-like replacement of bare conductor, crossarms, connectors, etc. and added protection measures such as animal guards or avian proofing where conditions merit or are otherwise applicable in the respective environment. This type of system can reduce wire downs by mitigating conductor failures caused by fault current surpassing the ampacity threshold the conductor was designed for. However, this system will still be vulnerable to contact-from-object risk, wire slap, and some types of equipment failure.

Upgraded and Fire Hardened New Bare Conductor System (stronger conductor tensile strength, increased spacing, and stronger/taller steel poles)

This alternative is patterned after SDG&E's original fire hardening of its 69 kV transmission and 12 kV distribution systems located in its HFRA. SDG&E evaluated years-worth of reliability data in which one of the findings was that small wire conductor, #4 AWG and #6 AWG, was a significant driver for risk-related events. This information, coupled with the increased awareness of localized wind speeds in high risk areas, led to design changes of how these lines were constructed. The minimum size of the conductors was increased for additional tensile strength in addition to sometimes using dual steel core for support instead of single steel core. Under the previous design standards, lines were constructed to withstand working loads under stress of 56 mph wind speeds. The new design standard was able to withstand higher wind speeds, in some cases 85 mph and even up to 111 mph in specific cases. In addition to upgrading the conductor, wood poles were replaced with steel poles and increased phase spacing was used to minimize the potential of wire slap or phase-to-phase and phase-to-ground contacts.

Spacer Cable System

The spacer cable system utilizes a diamond shaped spacer to support covered conductor in a spaced bundle configuration, a high-strength messenger wire using a weak-link design concept, wherein the poles are the strongest member of the system, with the messenger the next strongest, and specialized attachment brackets that are the least strongest, such that if an impact load is experienced on phase conductors or poles, the system remains intact, but that "fails" the attachment of the bracket to the pole allowing for it to be quickly reattached. This system is secured to poles primarily with fixed or flex tangent brackets, in which the messenger is the only connected conductor. The utilities generally assumed poles would be replaced with stronger steel and/or fire-resistant poles to support this system. The covered conductors are not tensioned (nor are they structural members) and instead are held together with spacers attached to a tensioned messenger and placed approximately 30-feet apart. The high-strength messenger wire provides greater strength than a covered conductor system. The utilities also generally assumed equipment/components would be replaced similar to a covered conductor system and added protection measures such as animal guards or avian proofing where conditions merit or are otherwise applicable in the respective environment.

Aerial Bundled Cable System

An Aerial Bundled Cable (ABC) system consists of one, two, or three individual cables that are fully insulated. The cables are wrapped together and, similar to a spacer cable system, supported by a high-strength messenger with a lashing wire. Because the cables in ABC are fully insulated, ABC can withstand continuous contact-from-objects for an indefinite time period. The high-strength messenger also provides the ABC system with mechanical protection from objects falling onto the line. For purposes of the assessment, the utilities assumed the ABC would be installed using stronger structures that combined with the high-strength messenger would provide greater strength than a covered conductor system. The utilities also generally assumed equipment/components would be replaced similar to a covered conductor system and added protection measures such as animal guards or avian proofing where conditions merit or are otherwise applicable in the respective environment.

Underground System

An underground system consists of underground cable (e.g., crosslinked polyethylene cable (XLPE) installed in PVC conduit), above-ground pad-mounted equipment (e.g., transformers) or equipment in vaults, cable terminations and joints, surge arrestors and grounding electrodes. Underground cable can be direct-buried, direct-buried in conduit, or encased in concrete. For purposes of this assessment, the utilities generally assumed an undergrounded system with above-ground pad-mounted equipment and the cable/conduit encased in concrete. Undergrounding of electric infrastructure can significantly reduce wildfire risk and potentially reduce the need and frequency for PSPS outages. Additional potential benefits of undergrounding include an increase in service reliability, especially during wind events, and the reduction of the need for vegetation management work, and in general, improved public safety. An underground system can take significantly longer to complete and is more costly to construct as compared to other system hardening alternatives. An underground system can also be very complex to construct taking into account, for example, topography, geology, environmental or culture considerations, and land rights. In some instances, it is infeasible to construct.

Remote Grid

This alternative is patterned after PG&E's Remote Grid program designed to remove long feeder lines and serve customers from a Remote Grid. A "Remote Grid" is a concept for utility service using standalone, decentralized energy sources and utility infrastructure for continuous, permanent energy delivery, in lieu of traditional wires, to small loads, in remote locations, at the edges of the distribution system. As an example, in PG&E's service area there are pockets of isolated small customer loads that are currently served via long electric distribution feeders, some of which traverse HFRA and require significant annual maintenance, vegetation management, or system hardening solutions. The reduction in overhead lines as these Remote Grids are built can reduce fire ignition risk as an alternative to, or in conjunction with system hardening and other risk mitigation efforts. The utilities generally assumed in its assessment the differences between either covering a long distribution feeder line or eliminating the long distribution feeder line and installing a Remote Grid. The utilities did not include in its assessment any remaining fire risks associated with serving the small customer loads from either the covered conductor line or within the Remote Grid, i.e., only the long overhead distribution feeder line was considered in this assessment. While Remote Grids are not a general alternative to covered conductor, as the assessment below indicates, they can be effective at reducing wildfire risk for a particular long overhead distribution feeder line that serves small customer loads.

Comparison:

The utilities conducted workshops over multiple days to discuss each sub-driver (from Table 7.1 of the WMP Guidelines) and assessed whether the alternatives have lower, similar or higher effectiveness than a covered conductor system. The results are shown in Table SCE 9-18 below. A red arrow represents a lower effectiveness, an orange arrow represents similar effectiveness, and a green arrow represents a higher effectiveness.

Table SCE 9-18

Mitigation Effectiveness Comparison of Alternatives to Covered Conductor

Risk Event Driver	Sub-driver	Existing Bare Conductor System	New Bare Conductor System	Upgraded and Fire Hardened New Bare Conductor System	Spacer Cable System	Aerial Bundled Cable System	Undergrounding System	Remote Grid System
Contact-from-Object	Veg. contact	↓	↓	↓	↑	↑	↑	↑
	Animal contact	↓	↓	↓	↔	↔	↑	↑
	Balloon contact	↓	↓	↓	↔	↔	↑	↑
	Vehicle contact	↓	↓	↑	↑	↑	↑	↑
	Other contact from object	↓	↓	↓	↑	↑	↑	↑
Equipment / Facility Failure (EFF)	Connector damage or failure	↓	↔	↔	↔	↔	↑	↑
	Splice damage or failure	↓	↔	↔	↔	↔	↑	↑
	Crossarm damage or failure	↓	↔	↔	↑	↑	↑	↑
	Insulator damage or failure	↓	↔	↓	↔	↑	↑	↑
	Lightning arrestor damage or failure	↔	↔	↔	↔	↔	↑	↑
	Tap damage or failure	↓	↔	↔	↔	↔	↑	↑
	Tie wire damage or failure	↓	↔	↔	↑	↑	↑	↑
	Capacitor bank damage or failure	↔	↔	↔	↔	↔	↑	↑
	Conductor damage or failure	↓	↓	↓	↑	↑	↑	↑
	Fuse damage or failure	↓	↓	↓	↔	↔	↑	↑
	Switch damage or failure	↓	↓	↓	↔	↔	↑	↑
	Pole damage or failure	↓	↔	↑	↑	↑	↑	↑
	Voltage regulator / booster damage or failure	↔	↔	↔	↔	↔	↑	↑
	Recloser damage or failure	↓	↓	↓	↔	↔	↑	↑
	Anchor / guy damage or failure	↓	↓	↓	↔	↔	↑	↑
	Sectionalizer damage or failure	↓	↓	↓	↔	↔	↑	↑
	Connection device damage or failure	↓	↔	↔	↔	↔	↑	↑
	Transformer damage or failure	↔	↔	↔	↔	↔	↔	↔
	Other	↓	↓	↓	↔	↔	↑	↑
Wire-to-wire contact	Wire-to-wire contact / contamination	↓	↓	↓	↔	↑	↑	↑
Contamination	Contamination	↓	↓	↓	↔	↑	↑	↑
Utility work / Operation	Utility work / Operation	↓	↔	↔	↔	↔	↔	↔
Vandalism / Theft - Distribution	Vandalism / Theft	↓	↓	↓	↔	↔	↔	↔
Other- Distribution	All Other - Distribution	↓	↓	↓	↔	↔	↑	↑
Unknown- Distribution	Unknown - Distribution	↓	↓	↓	↔	↔	↑	↑

The analysis shows that covered conductor has greater effectiveness than existing, new, and fire hardened overhead bare conductor systems. In some instances, a fire hardened overhead bare conductor system could provide slightly higher mitigation effectiveness. For example, for car-hit pole (vehicle contact) or other pole damage causes, a hardened overhead bare conductor system was assumed to have much stronger poles preventing occurrences of pole damage and/or wire down from a car-hit-pole scenario. In general, a spacer cable system and an ABC system provide higher effectiveness than a covered conductor system due to their strength and in the case of ABC both its strength and greater insulation properties. An underground or Remote Grid system provides the highest effectiveness, noting that the analysis of the Remote Grid System scenario was based only upon eliminating a long overhead distribution feeder line serving an isolated community and does not account for any overhead facilities beyond the long overhead distribution feeder line.

Next Steps:
In 2022, the utilities plan to expand this assessment of alternatives to mitigate wildfire risk by including other technologies and mitigations such as replacing fuses, installing RARs/RCSs, as well as newer technologies that the utilities are exploring including, for example, REFCL technologies, OPD, EFD, and DFA. Additionally, the utilities will assess how to estimate the relative percent difference of effectiveness for the alternatives.

Potential to Reduce the Need for PSPS:
As part of this sub-workstream, the utilities have documented their general approach to PSPS and conducted a comparison analysis, similar to the Alternatives analysis above, by conducting workshops with SMEs from the six utilities to assess alternatives compared with covered conductor in their ability to reduce PSPS impacts. The utilities used the same alternatives as described in the section above to conduct this assessment. Below, the utilities describe their PSPS approach. Collectively, the utilities summarize the ability of a covered conductor system to reduce PSPS impacts, provide an assessment of alternatives ability to reduce PSPS impacts compared to covered conductor, and describe additional analyses the utilities plan to perform in 2022 to further the utilities' understanding of the ability of covered conductor compared to alternatives to reduce PSPS impacts.

Utilities' PSPS Approach:
Below, the utilities describe their company's approach to activating a PSPS event and whether they consider raising thresholds when circuits are covered.

<u>SCE</u>
SCE activates PSPS largely based on two factors. The first factor used to drive PSPS decisions is the FPI, which estimates the likelihood of a spark turning into a major wildfire. FPI is calculated using forecasted wind speed, dewpoint depression, and various fuel moisture variables which are generated from SCE's customized version of the Weather Research and Forecasting (WRF) model. SCE's FPI scores range from 1 to 17, and any score at or above 12/13 (based on, for example, fire climate zone) is considered high risk. SCE reviews fire potential related products from the NWS and the GACC to confirm the wildfire threat related to PSPS. The second factor used to drive PSPS decisions is wind speed. SCE considers the NWS Wind Advisory levels (defined as 31 mph sustained wind speed and 46 mph gust wind speed) and the 99th percentile of historical wind speeds in the area to set activation thresholds. The Wind Advisory level is chosen because of the propensity for debris or vegetation to become airborne, while a circuit's 99th percentile wind speeds represent rare or extreme wind speeds that a particular circuit sees around four times per year. In 2021, SCE raised its de-energization thresholds for isolatable segments or circuits that have had covered conductor installed. The de-energization threshold for isolatable segments with

covered conductor is 40 mph sustained and 58 mph gusts, which aligns with the NWS high wind warning level for windspeeds at which infrastructure damage may occur. [287]

Once SCE's meteorologists confirm weather forecasts show an upcoming breach of FPI and circuit-specific wind speed thresholds, SCE activates its PSPS IMT and begins preparations for the upcoming event. Whether remotely due to the COVID-19 pandemic, or in-person at SCE's Emergency Operation Center, the IMT begins notifying affected parties. Notifications are sent to first responders, public safety partners, local governments, tribal governments and critical infrastructure providers approximately 72 hours prior to de-energization, followed by notifications to all other customers in scope approximately 48 hours prior to de-energization. SCE continues to provide additional notifications as well as notifications of imminent de-energization as information becomes available during the PSPS events (discussed in Section 8.2.4), develop event and circuit-specific de-energization triggers (inputs to which are discussed in 8.2.2) and direct resources to perform pre-patrols of all circuits in scope. Decision-making factors and protocols for PSPS de-energization are discussed in SCE's WMP Section 8.2.2.

PG&E

PG&E does not make specific changes in its PSPS protocols due to new improvements and mitigation initiatives, including grid hardening. The underlying models are based on historical data and not on estimating the effect of changes to system operations before they have occurred, which PG&E believes would be less accurate. However, since PG&E's PSPS models are based on historical data, new improvements and mitigation initiatives will be included in the models once the current changes are reflected in the historical data which the model incorporates over time. For example, when PG&E improves the quality of some specific assets, it expects a reduction in the chance of that asset causing an ignition. However, PG&E does not manually input a reduction in the ignition probability in the model. Over time, the historical observed data is expected to change, and this data will feed into PG&E's models and gradually change its models' parameters.

PG&E's thresholds for PSPS are based on a risk assessment that combines the probability of utility related outages and ignitions, called the Ignition Probability Weather (IPW) model, and the probability of catastrophic fires, called the Fire Potential Index (FPI). This combination is called the Catastrophic Fire Probability (CFPD) and is given by the equation:

$$CFPD = p\ ignition * p\ catastrophic\ fire\ ignition = IPW * FPI$$

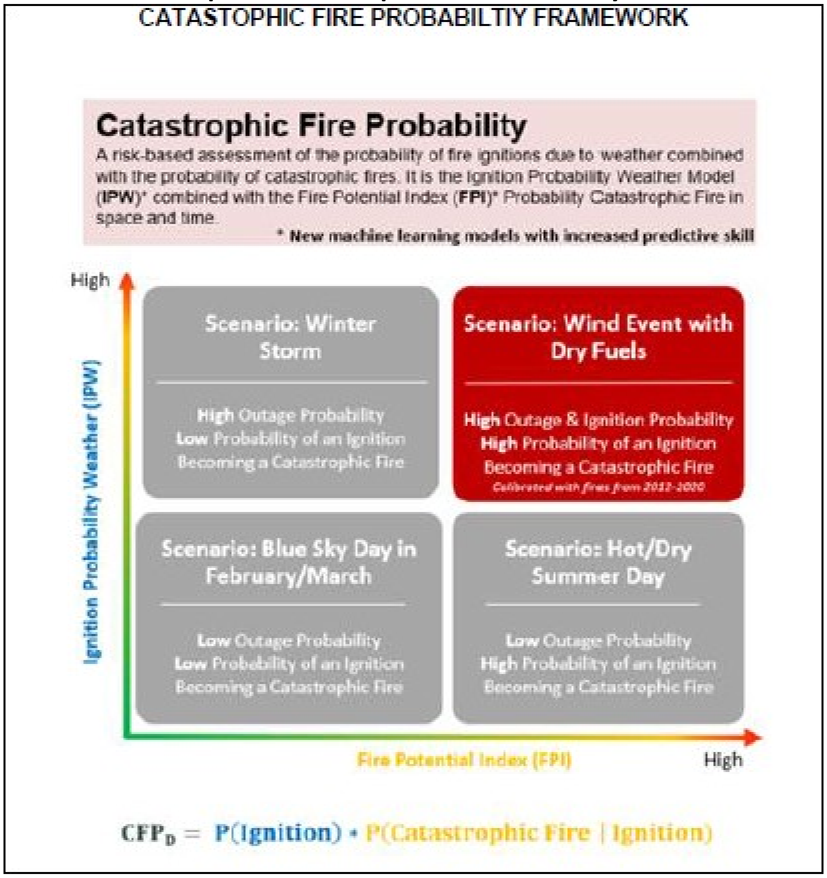
The IPW is a function of grid-performance given the weather conditions and is built using historical hourly weather data, outages, and ignitions in a machine learning model framework for localized areas. The guidance values PG&E utilizes when making a PSPS decision through the lens of this framework is a CFPD (IPW*FPI) value > 9. This value was determined by running 70 PSPS sensitivity studies from 2008 through 2020. Through this 13 year "lookback" analysis, PG&E evaluated the customer impacts through multiple dimensions (size, duration, frequency, repeat events, etc.), the days PSPS events would have occurred, as well as whether historic fires caused by utility

[287] If actual conditions suggest more risk, or in large-scale events when many circuits are under consideration for shutoff, the de-energization thresholds may be lowered (discounted), meaning power on a circuit will be turned off at lower wind speeds.

infrastructure would have been de-energized using this analysis. The conceptual CFPD framework is presented in Figure SCE 9-26 below.

Figure SCE 9-26

PG&E Conceptual Catastrophic Fire Probability Framework



PG&E data scientists and meteorologists have taken steps to quantify the probability of outages, ignitions and catastrophic fires using both logistic regression and machine learning models. PG&E does not use wind speed thresholds on a per-circuit basis as a gauge of outage or ignition probability and therefore do not increase or decrease its wind speed thresholds where hardening has been performed. In PG&E's framework, the effects of grid-hardening and covered conductor would be handled in the IPW, which predicts the probability of utility-caused ignitions.

Overhead system hardening is expected to reduce the probability of outages and ignitions. PG&E believes that adjustments to PSPS thresholds should be considered carefully and based on robust performance data of survivability in the field during actual weather events. Covered conductor, for example, does not drive the fire ignition risk to zero. Trees can still fall into overhead lines and break covered conductor and cause an ignition. Based on aerial LiDAR, there are several million trees that have the potential to strike assets in PG&E's HFRA, which is an ignition pathway that has caused several catastrophic fires recently.

PG&E has built a PSPS model framework that can account for changes overtime based on actual performance data. The machine learning IPW framework (probability of ignitions) is flexible as PG&E does not have to consider each individual program such as covered conductor and EVM to adjust wind or PSPS thresholds on each circuit or circuit segment. Rather, the model framework addresses positive and negative changes in grid performance and reliability year-over-year as PG&E applies a time-weighted approach to weight more recent years of learned performance more heavily in the final model output. The model accounts for the performance of local grid areas hour-by-hour based on the wind speed observed at that hour and if outages or ignitions occur or not. The IPW model is 13 models trained on each year separately from 2008-2020 using hourly data and hourly outages. PG&E applies an exponential time-weighted approach to capture more rapid changes in local areas to be captured in the model (both negative - increased tree mortality, asset degradation, drought etc.; and positive – conductor and pole replacement, EVM, etc.). PG&E is in the process of updating the model with 2021 outage, ignition and historical weather data. When the model is updated, performance in 2021 will have the most model influence while 2008 will have the lowest.

Since the IPW model accounts for changes over time and it evaluates PSPS through the risk-based assessment above, PG&E does not propose at this time adjusting its CFPD thresholds for circuits where grid-hardening has been performed. Instead, any positive effects from grid hardening, EVM, inspections, and other improvements will be trained in the Machine Learning IPW through this learned performance approach. Positive changes from any program or exogenous factors will lower the probability of outages and ignitions in these areas accordingly. In addition, if PG&E adjusts CFPD values to some circuits, it could make the fatal mistake of double counting the performance benefit achieved as changes in performance are inherently accounted for in the IPW model. PG&E welcomes feedback on its risk-based approach and ideas on how it can improve. One of the ideas PG&E is contemplating for future development of models is utilizing areas that have been hardened as a local feature of the IPW model.

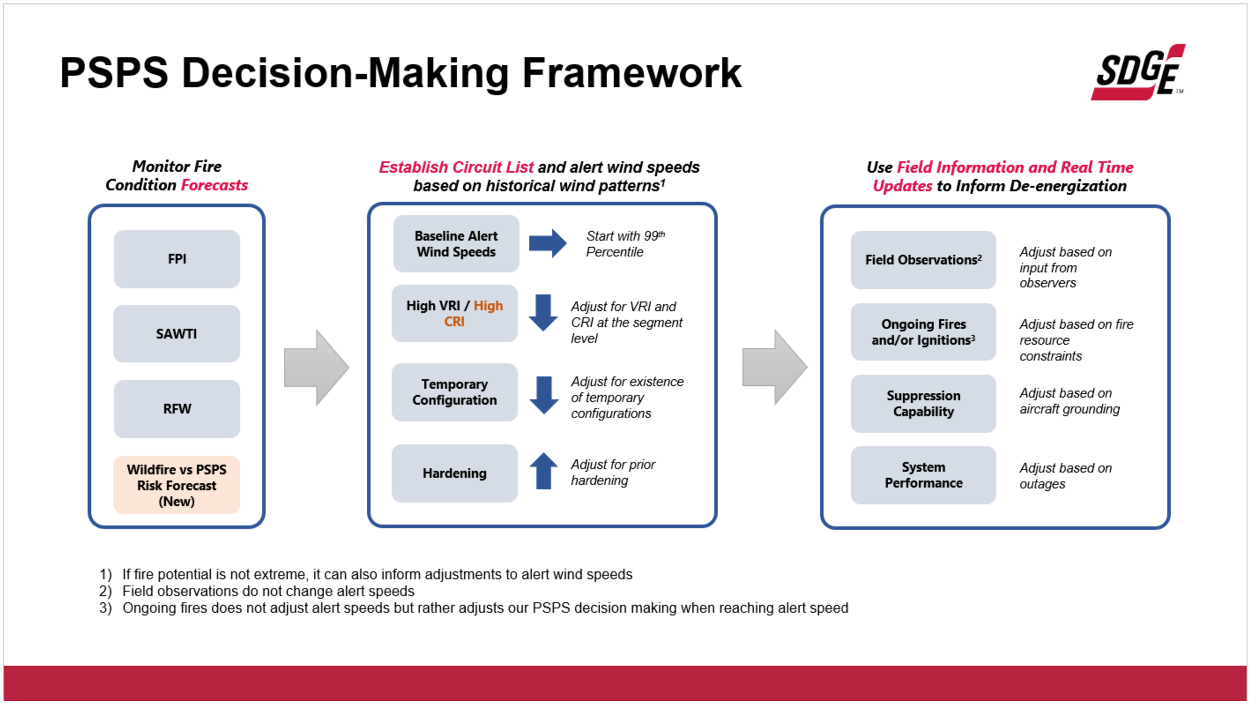
SDG&E

SDG&E utilizes multiple factors to assist in the decision to de-energize. See Figure SCE 9-27 below, that illustrates this PSPS decision-making framework. Some factors pertain to information in the field based on known compliance issues on the electrical system, active temporary construction/configuration of the electrical system, and a Circuit Risk Index (CRI) to identify locations in the system with a potential of having higher failure rates. Due to the dynamic nature of wildfire conditions SDG&E uses a real–time situational awareness technique to determine when to use PSPS, considering a variety of factors such as:

- Weather Condition - FPI
- Weather Condition - Red Flag Warnings
- Weather Condition - SAWTI
- Weather condition - 72-hour circuit forecast
- Vegetation conditions and Vegetation Risk Index (VRI)
- Probability of Ignition/Probability of Failure
- Field observations and flying/falling debris
- Information from first responders
- Meteorology, including 10 years of history, 99th and 95th percentile winds
- Expected duration of conditions
- Location of any existing fires
- Wildfire activity in other parts of the state affecting resource availability
- Information on temporary construction

Figure SCE 9-27

SDG&E PSPS Decision-Making Framework



To-date, SDG&E has installed approximately 18 miles of covered conductor with an average age of less than one year. Therefore, SDG&E has not yet accumulated sufficient data to determine exactly how PSPS criteria will differ on circuit-segments that consist entirely of covered conductor versus bare conductor, though SDG&E does anticipate higher wind speed tolerances in these areas. In addition to real-world experience, and operations and benchmarking with other utilities, SDG&E will have a third-party evaluate the likelihood and effect specific to covered conductors clashing at various wind speeds to understand and help quantify any potential increases to wind speed tolerances on covered conductor segments.

PacifiCorp

PacifiCorp has historically leveraged multiple factors when deciding to implement a PSPS. Throughout 2021, PacifiCorp's newly established meteorology department worked to develop the capability to support real time risk assessments and forecasting and inform decision making protocols during periods of elevated risk such as PSPS assessment and activation. Situational awareness reports are generated daily which identify where fuels (dead and live vegetation) are critically dry, where and when critical fire weather conditions are expected (gusty winds and low humidity), and where and when the weather is forecast to negatively impact system performance and reliability. It is the intersection of these three factors that highlights an elevated risk to be considered for a potential PSPS event. These factors are then layered alongside real time local conditions such as real time weather measurements and field observer reports, as well as dynamic input from Public Safety Partners to characterize the local impact of a PSPS. All of these factors combined are used to determine whether to implement a PSPS.

During 2021, the following forecasted factors were considered in the decision to implement a watch:

- Comparison of forecasted wind gusts to localized history trends
- GACC-7 Day Fire Potential Outlook (High Risk with a Wind Trigger)
- Presence of any advisories such as the Fuels and Fire Behavior Advisory in effect for Northern California
- Local drought conditions
- Vapor Pressure Deficit
- Keetch-Byram Drought Index
- Presence of any Red Flag Warnings

In addition, the following real time observations were additionally included in the decision to de-energize:

- Actual wind gusts in the area
- Field observer reports
- Observer input regarding any observed precipitation (or other meteorological input)
- Measured wind speeds at utility owned weather stations
- Approximate relative humidity forecasted vs actual
- Local public safety partner input

While PacifiCorp continues to refine its methodology for determining inputs critical to making PSPS decision, however, at least for 2022, PacifiCorp does not anticipate at this time that covered conductor coverage will modify its PSPS decision-making process because PacifiCorp does not have full covered conductor coverage on any circuit or controllable sub-circuit. However, as the company increases covered conductor coverage, it will continue to assess its effectiveness, and expect it to impact its decision-making once the necessary coverage and operational history is obtained.

Liberty

In evaluating when a PSPS event should be initiated, Liberty monitors local weather conditions with its weather stations throughout its service territory and collaborates with Reax Engineering, a fire and weather scientific consultant, the NWS in Reno, Nevada, and local fire officials. The initiation of PSPS events are influenced by the following factors:

a. Red Flag Warnings: Issued by the NWS to alert of the onset, or possible onset, of critical weather or dry conditions that would lead to increases in utility-associated ignition probability and rapid rates of fire spread.
b. Low humidity levels: Potential fuels are more likely to ignite when relative humidity is low and vapor pressure deficit is high.
c. Forecast sustained winds and gusts: Fires burning under high winds can increase ember production rates and spotting distances. Winds also can transfer embers from lower fire risk areas into high risk areas, igniting spot fires and increasing wildfire potential.
d. Dry fuel conditions: Trees and other vegetation act as fuel for wildfires. Fuels with low moisture levels easily ignite and can spread rapidly.
e. Observed Energy Release Component (ERC)
f. Observed wind gusts
g. Observed Fosberg Fire Weather Index (FFWI)
h. Observed Burning Index (BI)

Liberty employs two de-energization decision trees, one for the Topaz and Muller 1296 r3 PSPS zones, and another for all other zones. In each case, the ERC, observed wind gust, and FFWI criteria are evaluated simultaneously to test whether any exceed the defined threshold. The figures below represent the de-energization decision trees:

Figure SCE 9-28

Liberty De-energization Decision Tree (Topaz and Muller 1296 r3 Zones)

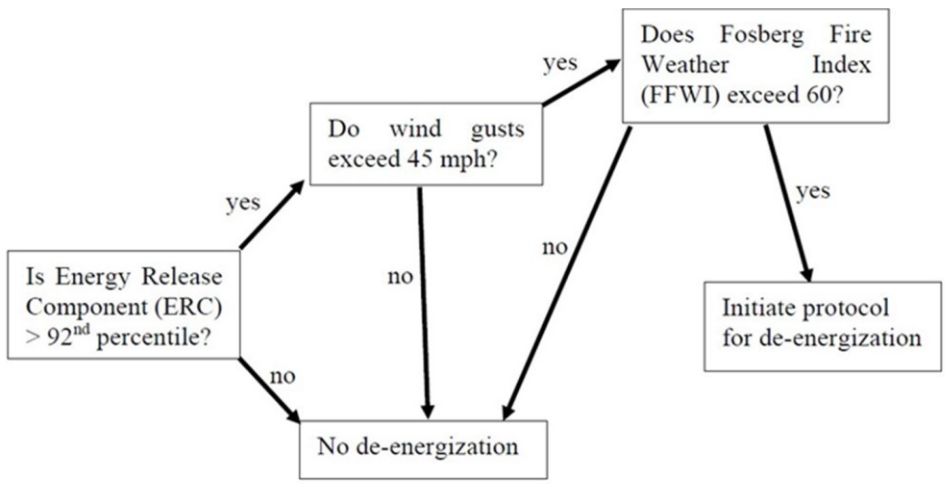
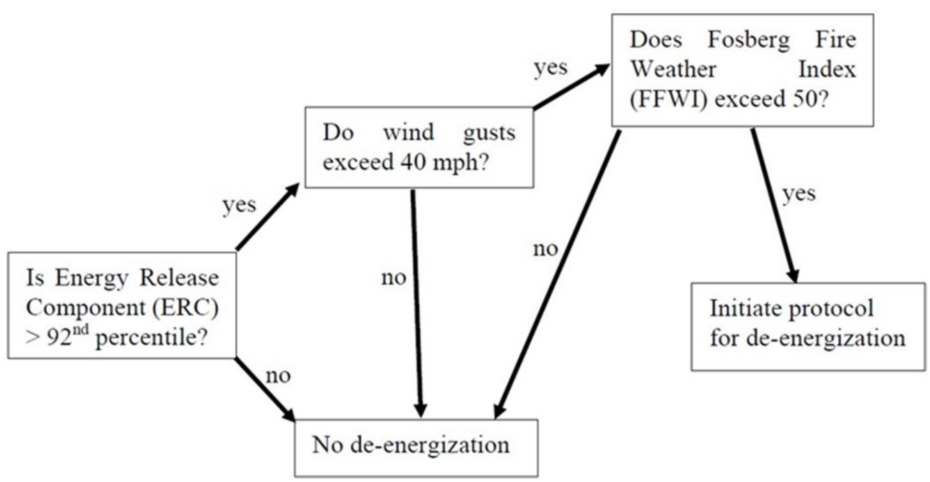


Figure SCE 9-29

Liberty De-energization Decision Tree (All Other Zones)

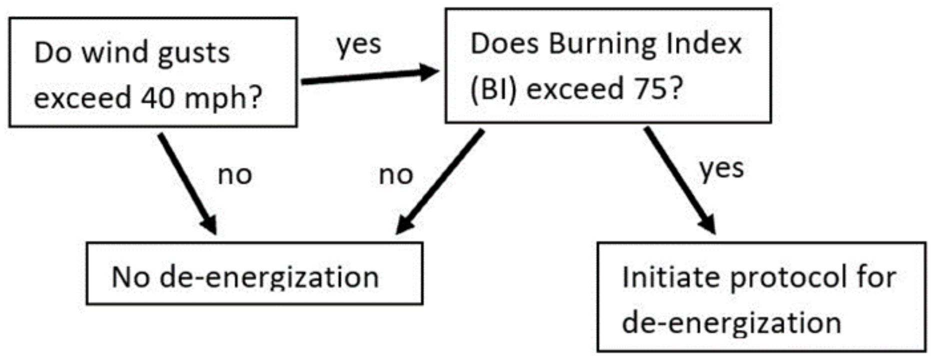


In January 2021, Liberty's Fire and Weather Scientific consultant, Reax Engineering, formulated an enhanced version of its fire weather forecasting tool to include an additional parameter known as Burning Index (BI). BI adds an increased layer of information regarding fire potential to its already robust predictive formula. It accounts for predominant fuel type, live and dead fuel moisture, and short-term fluctuations in fire weather conditions. Use of this new formula with increased information from newly installed additional weather stations enables further granularity in the area of alternative responses to initiating a PSPS, such as managing recloser technology, de-energizing specific circuits and /or increasing patrols in specific geographic areas of concern. Liberty now utilizes both the current predictive formula and the enhanced model in order to assess improved data.

The figure below shows the current BI/gust de-energization formulation that is being evaluated by back testing against historical weather station observations and archived weather forecast data. The purpose of this formulation is to try to better capture "black swan" events, where extremely high winds may still have the ability to cause dangerous fire conditions even though temperatures are low and humidity levels are not critical, which can happen in the spring or fall more than the middle of the typical fire season.

Figure SCE 9-30

Liberty's Current Burning Index / Gust De-energization Formulation



<u>BVES</u>

BVES evaluates many factors when initiating a PSPS event. However, in general, BVES will initiate a PSPS event when the NFDS fire danger forecast is high Risk (Brown, Orange or Red), and the actual sustained wind or 3-second wind gusts exceed 55 mph. In addition, BVES may initiate a PSPS if in the Utility Manager's judgement, actual conditions in the field pose a significant safety risk to the public. Individual circuits are evaluated for PSPS and may be individually de-energized to limit the area impacted by a PSPS.

Once complete overhead circuits are hardened and covered conductor is installed, BVES will consider raising the wind speed threshold for PSPS. The revised wind speed threshold for overhead structures with covered conductors is currently under evaluation. To date, BVES has never been required to activate a PSPS event.

Covered Conductor Potential to Reduce PSPS Risk:

As described in the sections above, utilities generally believe that a fully-isolatable circuit-segment or zone of protection that has covered conductor can reduce PSPS impacts beyond an overhead bare conductor system. SCE, for example, increases its de-energization threshold for isolatable circuit-segments with covered conductor from 31 mph (sustained wind gusts) and 46 mph (gust) to 40 mph (sustained) and 58 mph (gust), which aligns with the National Weather Service (NWS) high-wind warning level for windspeeds at which infrastructure damage may occur. However, the rule of thumb starting point is not always 31 mph and 46 mph and instead is based on NWS high wind warning (potential asset damage). Furthermore, through back-casting analysis of 2021 PSPS events, SCE estimates that its efforts in grid hardening (largely due to covered conductor), situational awareness, and improved risk modeling (which allowed for adjustments to PSPS thresholds) helped reduce Customer Minutes of Interruption (CMI) by 43%, the number of customers de-energized by 42%, and the number of circuits de-energized by 29% from what they otherwise would have been under the same weather conditions. These data demonstrate that covered conductor provides PSPS benefits compared to overhead bare conductor systems. As the other utilities gain experience in installing more covered conductor, they plan to continue to assess raising their de-energization criteria for isolatable circuit-segments or zones of protection that are fully covered.

Alternative Comparison:

The utilities conducted workshops over multiple days to discuss and assess whether the alternatives have lower, similar or higher benefits than a covered conductor system in reducing PSPS impacts. The utilities considered three PSPS benefits: 1) reduce PSPS frequency (# of de-energizations), reduce PSPS duration (CMI), and reduce number of customers impacts by PSPS (i.e., customers in scope). The results are shown in Table SCE 9-19 below. A red arrow represents a lower benefit, an orange arrow represents similar benefits, and a green arrow represents a higher benefit.

Table SCE 9-19

PSPS Impact Benefits Comparison of Alternatives to Covered Conductor

PSPS Event Impact	Existing Bare Conductor System	New Bare Conductor System	Upgraded and Fire Hardened System	Spacer Cable System	Aerial Bundled Cable System	Undergrounding System	Remote Grid System
Reduce PSPS Frequency (# of de-energizations)	↓	↓	↔	↑	↑	↑	↑
Reduce PSPS Duration (CMI)	↓	↓	↔	↑	↑	↑	↑
Reduce Number of Customers Impacted by PSPS (customers in scope)	↓	↓	↔	↑	↑	↑	↑

The analysis shows that covered conductor has greater PSPS benefits than existing and new overhead bare conductor systems. SDG&E's upgraded and fire hardened system has shown benefits in reducing PSPS frequency, duration, and number of customers impacted. The utilities did not quantify these benefits to determine how much different are the benefits of a fire hardened bare overhead system compared to a covered conductor system and thus identified for this initial assessment a similar benefit. Similar to the assessment in the section above, a spacer cable system and an ABC system provide could provide higher benefits than a covered conductor system due to their strength and in the case of ABC both its strength and greater insulation properties. An underground or Remote Grid system provides the highest-level of benefits. Please note that the Remote Grid System scenario was based only on a long overhead distribution feeder line serving an isolated community and does not account for any overhead facilities beyond the long feeder line.

Next Steps:

In 2022, the utilities plan to expand this assessment of covered conductor and alternatives in their ability to reduce PSPS impacts by including other alternative technologies and mitigations such as replacing fuses, installing RAR/RCS as well as newer technologies that the utilities are exploring including, for example, REFCL technologies, D-OPD, EFD and DFA. Additionally, the utilities will assess how to estimate the relative percent difference of the benefits for the alternatives.

Costs:

The utilities have prepared an initial capital cost per circuit mile comparison of the installation of covered conductor. To construct this unit cost comparison, the utilities organized their capital costs (and/or estimates) into six cost categories. These categories include labor, material, contract, overhead, other, and financing. Labor represents internal utility resources, such as field crews, that charge directly to a project work order. Materials include conductor, poles, etc. that get installed as part of a project. Contract represents all contractors, such as field crews and planners, and consultants utilities use as part of their covered conductor programs. Overhead represents costs, such as engineers, project managers and administrative and general, that get allocated to project work orders. Other represents costs such as land fees, permit fees and costs not assignable to the other categories. Financing represents allowance for funds used during construction (AFUDC) which is the estimated cost of debt and equity funds that finance utility plant construction and is accrued as a carrying charge to work orders. These cost categories are intended to capture the total capital cost per circuit mile of covered conductor installations. For purposes of this report, the utilities obtained recorded and/or estimated costs for construction that occurred during 2021. Table SCE 9-20, below, shows the initial covered conductor capital unit cost per circuit mile comparison across the six utilities.

Table SCE 9-20

Comparison of Covered Conductor Capital Costs Per Circuit Mile

	SCE		PG&E		SDG&E		Liberty		PacifiCorp		Bear Valley	
Cost Components	Cost per Circuit Mile	%	Cost per Circuit Mile	%	Cost per Circuit Mile	%	Cost per Circuit Mile	%	Cost per Circuit Mile	%	Cost per Circuit Mile	%
Labor (Internal)	$ 8,000	1%	$ 209,000	19%	$ 182,000	13%	$ 56,000	4%	$ 2,000	0%		
Materials	$ 115,000	20%	$ 161,000	15%	$ 130,000	9%	$ 132,000	8%	$ 204,000	34%	$234,000	23%
Contractor	$ 335,000	59%	$ 470,000	43%	$ 481,000	34%	$1,167,000	75%	$ 272,000	45%	$733,000	71%
Overhead (division, corporate, etc.)	$ 96,000	17%	$ 226,000	21%	$ 418,000	29%	$ 188,000	12%	$ 62,000	10%	$38,000	4%
Other	$ 5,000	1%	$ 6,000	1%	$ 173,000	12%	$ -	0%	$ 60,000	10%	$26,000	3%
Financing Costs	$ 6,000	1%	$ 11,000	1%	$ 43,000	3%	$ 9,000	1%	$ 6,000	1%		
Total	$ 565,000	100%	$ 1,083,000	100%	$ 1,427,000	100%	$1,553,000	100%	$ 606,000	100%	$1,031,000	100%

As illustrated in Table SCE 9-20, the capital cost per circuit mile ranges from approximately $565,000 to approximately $1.5 million. The capital cost per circuit mile for covered conductor varies due to multiple factors such as type of covered conductor system and components installed, terrain, access limitations, permitting, environmental requirements and restrictions, construction method (e.g., helicopter use), amount of poles/equipment replaced, degree of site clearance and vegetation management needed, and economies of scale. Below, the utilities generally describe the make-up of their covered conductor capital costs and the factors that contribute to the cost differences.

Covered Conductor Capital Costs:

SCE

CC Unit Cost Make Up:

The costs in SCE's WCCP incur through the main cost categories of labor, materials, contracts, overhead, and other and are captured in SAP work orders. SCE's unit costs have historically been presented as direct costs only (exclude corporate overheads and financing costs) and is the average cost of nine different regions within SCE's service area. For purposes of this report, SCE has added corporate overheads (to the overhead cost category) and financing costs to its direct unit cost for comparison with the other utilities.

SCE has two covered conductor designs that vary depending on system voltage requirements. These include 17 kV and 35 kV covered conductor designs, the former of which SCE utilizes on its 12 kV and 16 kV distribution systems, and the latter of which SCE utilizes on its 33 kV distribution systems. The primary difference between these two designs is the thickness of the inner and outer layers. For example, 35 kV covered conductor design has a thicker covering, allowing it to withstand intermittent contact at higher voltages. Additionally, SCE uses four ACSR conductor sizes (i.e., 1/0 AWG, 336.4 (18x1) AWG, 336.4 (30/7) AWG, 653.9 AWG) and three copper conductor sizes (i.e., #2 AWG, 2/0 AWG, 4/0 AWG). Circuit and customer loading requirements will determine the conductor size. SCE may also use higher strength conductors to resolve ground clearance issues in areas subject to ice. The vast majority (99%) of SCE's covered conductor installations have been with the 17 kV covered conductor design which is lower cost than the 35 kV covered conductor design.

SCE installs covered conductor in an open-crossarm configuration. In this configuration, the conductor is self-supporting and attached to insulators on crossarms at the structure. SCE's WCCP also includes the installation of FRPs, composite crossarms, wildlife covers, polymer insulators, and vibration dampers. SCE uses FRPs, which are more expensive than wood poles, when pole replacements are required to meet pole-loading criteria. SCE replaces, on average, between 10 to 12 poles per circuit mile. Composite crossarms are also used to replace traditional wood crossarms as part of the WCCP. Like composite poles, composite crossarms are also higher cost than wood crossarms. SCE also employs wildlife covers and installs them on dead-ends, terminations, equipment jumper wires, connectors, and equipment bushings. In areas below 3,000 feet in elevation or high-tension installations, SCE requires the use of vibration dampers to mitigate conductor damage due to Aeolian vibration.

SCE primarily uses contractors to construct its covered conductor projects and a mix of contract and SCE labor to design its covered conductor projects. SCE field labor and contract field labor costs are charged directly to the project work orders. SCE design resources charge a division overhead account that gets allocated to work orders because SCE planners work on multiple types of projects. Costs for design scope performed by contractors is charged directly to the covered conductor work order (contract category) because this contracted work is specific to covered conductor projects. Materials such as conductor, poles, and crossarms are charged directly to the project work order. The Overhead category includes operational resources and items centrally managed and include costs such as equipment (e.g., vehicles, tools and supplies for field work) and managerial resources that are allocated to work orders. As noted above, the Overhead category also includes corporate overheads, which includes costs for administrative and general, pension and benefits, payroll taxes, injuries and damages, and property taxes.

Cost Drivers:

SCE's covered conductor projects have an estimated timeframe of 16 – 24+ months from initial scoping to project completion. There are many factors that may impact the total project lifecycle and costs, including permitting and environmental requirements, easements, geography and terrain, construction resource availability, and other construction-related factors. The largest driver of the cost is typically the contract cost for which contractor rates and construction time vary across locations in SCE's HFRA. For example, regions with more difficult terrain and mountainous areas typically have higher contractor rates. Projects in these areas also typically take longer to construct and require more costly construction methods (e.g., helicopter use). Beyond challenging terrain, projects can take more time due to other factors such as permitting, weather (e.g., rain/snow conditions, Red Flag Warning (RFW) days, etc.), and environmental restrictions (e.g., nesting birds that don't allow crews to work in certain areas until the birds have fledged). There are also many other drivers that can increase costs such as local agency restrictions (e.g., only night work allowed), direct environmental costs (e.g., if biological monitors are required), vegetation (i.e., requires vegetation clearing), access constraints (i.e., requires helicopter construction and/or access road rehabilitation), customer impact (i.e., temporary generation required for a circuit), and operating restrictions (e.g., crews are pulled off work). Many of these factors can also limit flexibility and reduce productivity causing construction costs to increase. The cost per circuit mile in some regions, such as SCE's Rurals Region, is more expensive than other regions. In some instances, this cost difference can be $300,000 or more per circuit mile.

As seen in Table SCE 9-20 above, SCE's unit cost is the lowest of the six utilities. While SCE has described many factors that affect its covered conductor costs, some of the reasons why SCE's costs may be lower than the other utilities include economies of scale with SCE installing over 1,000 circuit miles per year and its ability to bundle work for its contractors. Bundling work enables multiple projects to be completed in the same general area which minimizes mobilization and demobilization costs and increases contractor productivity. SCE has also not generally observed a steady nor large amount of vegetation management or access road rehabilitation costs across its installations. With thousands of circuit miles installed, these types of incurred costs are low when averaged across SCE's portfolio of completed installations. As noted above, SCE also only replaces, on average, 10 to 12 poles[288] per circuit mile and its WCCP is focused on covered conductor and does not include other major equipment upgrades.

<u>PG&E</u>

<u>CC Unit Cost Make Up:</u>

PG&E's data set represents System Hardening projects scoped by Asset Management and approved by its Wildfire Steering Governance Committee. The covered conductor projects go through the following major phases to completion:

- Estimating and Design
- Dependency (Permitting, Land Rights and Environmental Review)
- Construction Resourcing and Contracting
- Construction
- Document and Close Out

A subset of these projects is "Fire Rebuild" projects. These set of System Hardening projects arise from hardening scope after a fire or other emergency events in Tier 2/3. Due to the emergency nature to rebuild assets quickly to serve the community, all the steps described above in base System Hardening are accelerated.

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[288] SCE's average number of poles per circuit mile is approximately 29. As such, 10-12 poles represent approximately 34% to 41% of the average number of poles per circuit mile.

PG&E's unit cost analysis is based on fully completed projects with costs-since-inception (including costs from previous years) recorded in its system of record (SAP). Based on that criteria, the data set captures 111 miles worth of projects that were completed in 2021. Construction transpired in 11 different divisions with varying terrains and conditions. 14 miles were Fire Rebuild, which typically have a lower unit cost, the remaining 96 were Base (regular) System Hardening.

Costs were organized per the six main categories agreed upon with the other utilities. The summary table blends both contract and internally resourced projects. 44 miles were constructed using external crews, categorized as Contract and 66 miles were constructed using Internal labor, categorized as Labor.

PG&E's Overhead Hardening (covered conductor installation) scope achieves risk reduction through these foundational elements: bare primary and secondary conductor replacement with covered equivalent, pole replacements, non-exempt equipment replacement, overhead distribution line transformer replacement with transformers that have FR3 fluid, framing (composite crossarms and insulators) and animal protection, and vegetation clearing.

<u>Cost Drivers:</u>
PG&E's covered conductor installation costs are driven by these key contributors:

- Pole replacement – nearly 100% of the poles require replacement due to the additional weight/sag of the new covered conductor.
- PG&E incorporates numerous initiatives into a single hardening project. Non-exempt equipment and ignition component replacement impacts the cost by including the material and labor installation cost of the new equipment where it requires replacement.
- Vegetation clearing in support of the new overhead line can be a significant cost added to these projects. Both the increased height of the poles, the widened cross-arms, and the increased sag of the line can vary the cost considerably. This cost alone can add between $50,000 to $400,000 per mile depending on the terrain and the location of the line. The rural nature of much of the high-risk HFTD infrastructure drives this need.

<u>SDG&E</u>
<u>CC Unit Cost Make Up:</u>
Each project goes through a six-stage gate process as follows:

Stage 1 – Project Initiation (duration ~1-3 months)

Stage 2 – Preliminary Engineering & Design (duration ~6-9 months)

Stage 3 – Final Design (duration ~3-5 months)

Stage 4 – Pre-Construction (duration ~1-2 months)

Stage 5 – Construction (duration ~3-4 months)

Stage 6 – Close Out (duration 8~-10 months)

The total duration of a project has an estimated duration of approximately 22 to 33 months.

SDG&E's covered conductor per mile unit capital costs is made up of the following six major cost categories:

1. Labor (internal) – directs costs associated with SDG&E full-time employees (FTE), including but not limited to individuals from project management, engineering, permitting, environmental, land management, and construction departments. This cost assumes approximately 25% of the electric work is completed by internal SDG&E construction crews.
2. Materials – estimated costs of material used for construction including steel poles, wire, transformers, capacitors, regulators, switches, fuses, crossarms, insulators, guy wire, anchors, hardware (nuts, bolts, and washers), signage, conduit, cable, secondary wire, ground rods, and connectors.
3. Contractor – estimated costs for construction-related services, including civil construction contractors for pole hole digging, anchor digging and substructures, and street/sidewalk repair; electrical construction for pole setting, wire stringing, electric equipment installation and removals; vegetation management where required including tree trimming or removal, and vegetation removal for poles and access paths; environmental support services including biological and cultural monitoring; traffic control; and helicopter support for pole setting, wire stringing, and removals. This cost assumes approximately 75% of the electric work is completed by contract crews.
4. Overheads – estimated costs associated with contracted services not related to construction including engineering, design, project management, scheduling, reporting, document management, GIS services, material management, constructability reviews by Qualified Electrical Worker (QEW), staging yard leases/setup/teardown/maintenance, and permitting support throughout the entire lifecycle of a project, as well as services related to program management including long term planning and risk assessment.
5. Other – estimated costs associated with indirect capital costs. These costs are estimated to be approximately 14.3% of direct capital costs that accumulate on a construction work order. This includes administrative pool accounts that are not directly charged to a specific project, including internal labor vacation, sick, legal, and other expenses.
6. Financing Costs – estimated costs associated with the collection of AFUDC when a construction work order remains active. Most SDG&E jobs are active for approximately 6 to 10 months from the time the job is issued to construction until it is fully completed and the collection of AFUDC charges stop.

<u>Cost Drivers:</u>

Costs can vary significantly from project to project for a variety of reasons, including engineering and design, land rights, environmental, permitting, materials, and construction. Below is a description of these factors and why the costs can vary from project-to-project.

Engineering & Design: SDG&E collects LiDAR (Light Imaging Data and Ranging) survey data before the start of design and again after construction is completed. During the LiDAR data capture, other data including photos (i.e., ortho-rectified images of the poles and surrounding area, and oblique pole photos), and weather data is acquired. After collection of the raw LiDAR and Imagery data, it is processed to SDG&E's specification and includes feature coding and thinning of the LiDAR data, and selection and processing of the imagery data. The entire process for delivery to SDG&E's specification can take weeks to months depending on the size of the data capture. This LiDAR data capture is used to support the base-mapping, engineering, and design processes (Stage 1 and Stage 6).

Currently, the engineering and design of all covered conductor projects are conducted by engineering and design consultants, and their deliverables are reviewed by a separate Owner's Engineering (OE) consultant to ensure compliance with SDG&E standards and guidelines. At this time, SDG&E does not have the resources to conduct the engineering and design required at this scale of work; however, there is an assigned SDG&E full time engineering staff that provide oversight of all engineering and design consultants, including the OE. The engineering component of work relates to the structural analysis, including Power Line Systems – Computer Aided Drafting and Design (PLS-CADD) modeling, foundation calculations, or geotechnical studies. The design component includes the drafting, entering design units into SAP for material ordering and costing, and building the job packages that are sent to construction. In some cases, one consultant can perform both the engineering and design function, and in others cases an engineering consultant collaborates with a design consultant. In all cases, SDG&E's Owner's Engineer will perform both engineering and design review support. Costs from consultants can vary depending on the size and complexity of the project, and due to various other factors including environmental constraints, land constraints, permitting requirements, or scoping changes that can occur from the start of design and throughout construction. The design stage (i.e., start of design to issuance of job package to construction) typically takes anywhere from six months to two years depending on the size and complexity of the project and the challenges with acquisition of land rights, environmental release, and permitting.

SDG&E requires every pole be engineered using PLS-CADD software during two stages of the project lifecycle, the design phase and the post-construction phase. This software allows SDG&E to leverage LiDAR survey data (pre- and post-construction) and AutoCAD drawings, and to design the poles, wire, and anchors to meet General Order (GO) 95 Loading (Light and Heavy Loading) and Clearance Requirements, and to meet Known Local Wind requirements (e.g., 85 mph and in some cases 111 mph wind). SDG&E also requires its engineering and design contractors who use the PLS-CADD software to have a California-registered Professional Engineer oversee and stamp the final PLS-CADD design.

Land and Environmental**:** SDG&E requires all projects to go through a land and environmental review process at each stage of the design process. These processes are predominantly supported with the help of land management and environmental service consultants but are overseen by SDG&E representatives in each respective department. The land process includes research of SDG&E's land rights, interpretation, and may include support obtaining the proper land rights when required. Through the land rights review process, SDG&E determines the land ownership its facilities (e.g., poles, anchors, and wire) are within and get an interpretation of the limits of its land rights. The results are shared with the engineering and design team and environmental. Once the land rights are determined, environmental performs an assessment, determines the environmental impacts if any, and provides input to the design process to minimize and/or avoid environmental impacts. These land and environmental reviews can drive changes to the design and add time and cost to the project. For example, in many cases, SDG&E does not have the land rights to build the overhead covered conductor design within its existing easement, or in some cases it only has prescriptive rights. In those cases, SDG&E must amend or acquire the proper land rights, or redesign the project, if possible, to stay within the land and/or environmental constraints. If acquiring or amending land rights is required, this can take weeks to months depending on the property owner (e.g., private, BIA, State, Federal, or Municipality) and the level of change to the existing conditions.

Materials: SDG&E's philosophy with covered conductor, like SCE, is to install it in an open-crossarm configuration. In this configuration, the conductor is self-supporting and attached to insulators on crossarms at the structure. Where connections are necessary, piercing connectors are used to avoid stripping the wire and causing damage to the conductor and negating the need to wrap the connection with insulating tape. SDG&E also requires the use of vibration dampers, where necessary, to mitigate conductor damage due to Aeolian vibration. SDG&E replaces most wood poles to steel, and in some cases replaces existing steel poles if they are not adequate to support the new wire (e.g., inadequate clearance and/or mechanical loading capacity). In many cases equipment is replaced during these reconductor projects if it is older, is showing signs of failure, and/or needs to be brought up to current standards. The reason to replace wood poles with steel is due to several reasons, including the fact steel is more resilient to fires than wood and is seen as a defensive measure, steel is a man-made material and the strength and dimensions are consistent and have much smaller tolerances than wood, and because many of SDG&E's wood poles are over 50 years old. In some cases, SDG&E may also need to relocate the pole line to an area where it is more accessible to build and maintain but will require obtaining a new easement. SDG&E also replaces wood crossarms with fiberglass crossarms, insulators with polymer insulators, switches, and regulators. For transformers, SDG&E developed specific criteria for replacement. For example, where a transformer will be replaced if it is internally-fused regardless of age, if it's greater than 7 years old, if it has visual defects or damage (leaks, burns, corrosion, etc.), is less than 25 kVA, or if the transformer does not pass volt-drop-flicker calculation. SDG&E also replaces secondary wire that is either open (non-insulated) or "grey wire" (covered secondary wire where the insulation is grey in color). On most projects, there is a smaller underground job associated with the overhead work. This occurs when a pole feeds underground (e.g., a Cable or Riser Pole) and the new pole location may be too far from the existing position such that the existing cable, conduit, and terminations may not reach the new pole position. In these cases, a small job will be initiated to have the crews intercept the run of underground conduit, install a new handhole, install a new run of conduit and cable to the new pole location, and splice the cable in the new handhole to make the connection to the existing underground system.

In 2021, SDG&E experienced significant material supply chain issues, especially with covered conductor materials due to impacts from COVID-19. In the case of covered conductor, SDG&E currently sources the wire from multiple suppliers; however, the associated materials such as piercing connectors and piercing dead-ends come from one supplier out of Europe and experienced significant delays in getting orders delivered due COVID-19 and issues with US Customs paperwork. SDG&E also experienced delays receiving other material due to COVID-19 supply chain disruptions and competition for the same materials used by other utilities including transformers and other materials common to various utilities across the country. Material delays can cause construction delays or cause construction to work less efficiently, thus impacting project schedules and costs.

Construction: One of the most significant variables, and most difficult to predict, is the civil portion of construction. The civil portion of a project includes the pole hole and anchor hole digging and can vary significantly depending on several factors including accessibility (truck accessible versus non-truck accessible), soil conditions (rock versus soft soil), methods of digging (hand tools versus machine), and environmental constraints that may limit the method of digging or dictate access protocols. For example, a 0.7 miles project completed a couple of years ago was on the side of a steep mountain side and all the material, equipment (pneumatic drill and hand tools), and crews had to be flown in and out every day for months. The civil crews encountered significant rock at most locations and the spoils from the digging had to be flown out via helicopter due to the restrictions placed on construction due to environmental concerns rather than be spread-out on location. Each pole and anchor were back-filled with concrete using helicopters because of the slope of the mountain and due to the significant mechanical loading due to winter storms. In contrast to this mountain side project example, SDG&E has had other projects that are truck accessible, that do not require concrete backfill and allow it to reuse the spoils for backfill or spread out on location.

Another reason costs can vary significantly from project to project is due to the time of year and location. SDG&E often deals with elevated fire weather conditions which requires a dedicated fire watch crew to be present at each location where there is work happening that can be a fire risk. In some cases, SDG&E has multiple dedicated fire watch crews on a project as there may be multiple civil or electric crews working at different locations at the same time on the same project. Some locations are also so remote that the drive time from the staging yard to the site can take a significant amount of time out of each workday that the crew may work longer hours and/or over the weekend, including Sundays, thus increasing overtime hours for the construction crew and all other support services (e.g., traffic control, environmental monitors, etc.). In some cases, generators are used due to the remote nature of some customers and the lack of ties with other circuits in SDG&E's service area. Generators require special protection schemes, equipment, and resources to adequately plan, deploy, setup, monitor, and tear-down which increase the installation costs.

Lastly, construction costs can vary depending on the crew building the project and issues encountered during construction that were not anticipated during design. SDG&E currently uses four primary construction contractors who perform the electrical construction and typically sub-contract the civil work (e.g., pole hole and anchor digging), helicopter, traffic control and dedicated fire watch. SDG&E also uses internal electric construction teams who typically contract out the helicopter, traffic control, dedicated fire watch and civil work (pole hole and anchor digging). Based on SDG&E's experience with its traditional hardening program, 75% of the work is performed by contractors and 25% by internal crews. The costs between external and internal crews can vary depending on the work scope, location (rural versus very rural), methods of construction (e.g., truck accessible versus non-truck accessible), time of year (e.g., fire season and non-fire season and wet weather versus dry), and issues encountered during construction. Larger projects (typically 20 or more poles) that are not assigned to an internal crew are sent out to bid with the four prime construction contractors and often bundled together on the same circuit to gain economies of scale. SDG&E has determined that its ideal bid size is 100-200 poles; however, some bids have been significantly greater (e.g., approximately 1,400 poles and over 60 projects) and some can be much smaller. The size of bids can change significantly depending on the location of a project, time of year, and schedule of the project. SDG&E also sees changes with pricing due to competition for construction resources with the other utilities in the state and this can drive-up costs depending on the volume of work and timing with other projects statewide.

PacifiCorp

CC Unit Cost Make Up:

As included in its 2021 WMP Update Change Order filed November 1, 2021, PacifiCorp has historically broken down the costs of covered conductor into four main categories: Design, Materials, Construction, and Program Management. However, to better align with other utilities, and avoid confusion, for the purposes of this report, PacifiCorp reports the costs of covered conductor in the six main categories. These six categories are described below.

1. Labor (Internal): Internal labor charged directly to the project including project managers, project support staff, engineers, and field personnel.

2. Materials: All materials installed as part of covered conductor projects.

3. Contractor: Contracted services which are primarily design, estimating, permitting, vegetation management, and construction labor.

4. Overhead: Costs allocated to covered conductor projects such as surcharges for material handling and engineering overheads.

5. Other: Direct costs not covered in one of the other categories.

6. Financing Costs: AFUDC charges on the projects.

<u>Cost Drivers:</u>
PacifiCorp has identified five main cost drivers for the installation of covered conductor. The cost drivers are discussed below in terms of cost increases that have been experienced, highlighting how impactful these components can be on the overall project cost.

Access: PacifiCorp includes costs for required access to facilitate project construction in covered conductor projects charged to the work order. These costs may include vegetation clearing, road construction, or other site preparation activities. These costs will typically be included in the contractor total for purposes of this cost analysis as this work is predominantly contracted. Additionally, these costs can also range significantly between projects based on the specific location and terrain where work is conducted.

Pole Replacement: PacifiCorp evaluates all poles for strength and clearance using PLS CADD. Poles are then selected for replacement for the following reasons: insufficient strength to accommodate covered conductor, insufficient minimum clearance, relocation is required, or not constructible in current state. Through 2021, the average pole replacement rate has ranged from 2 to 22 per mile leading to significant variability in the per mile job cost. Pole replacements also significantly impact labor and material costs (as described below) due to the change in scope of the project. Current cost forecasts assume 20 poles per mile will need to be replaced. Additionally, nearly all poles identified are replaced with non-wood fire resistant materials (predominantly fiberglass) at a greater cost than like-for-like replacement with wood.

Construction Labor: As included in its 2021 Change Order, PacifiCorp experienced significantly higher than anticipated labor costs in 2020 and 2021 based on regional contract rates, construction complexity/time, and overtime requirements to meet project deadlines. Current cost forecasts indicate that this increase will continue in 2022 and future years.

Materials: As included in the company's 2021 Change Order, PacifiCorp also experienced additional material costs due to the number of pole replacements. Currently, incremental pole replacements add approximately $3,500 per pole in material costs alone. Additionally, supply chain constraints in 2021 resulted in the need for expedite fees, crew re-mobilization costs, and/or use of alternate materials at higher costs.

Permitting: As included in the company's 2021 Change Order, significant cost increases have been experienced for locations requiring access into seasonal wetlands and transmission under build projects. Future projects include environmentally sensitive areas that have been in National Environmental Policy Act (NEPA) or CEQA review with high environmental review costs.

Based on the cost drivers discussed above, PacifiCorp anticipates higher costs for projects in 2022 and beyond.

BVES

CC Unit Cost Make Up:

The following costs are charged to project work orders: Design, materials, construction labor and overhead cost. BVES contracts out most of the work with a BVES Field Inspector overseeing the whole project. The design consists of BVES contractor performing field visits, wind loading calculations, developing the design and assembling the material lists. BVES purchases the materials and its contractor does the construction. The overhead costs consist of BVES internal groups. The capital cost per circuit mile are based on a double circuits' area in 2021.

Cost Drivers:

BVES service area is in mountainous terrain at approximately 7,000 ft elevation and consists of a 34.5 kV Delta 3-wire system and a 4.16 kV Wye ground 4-wire system. For the 34.5 kV system, 394.5 AAAC is the primary source of covered conductor and 336.4 ACSR is used as a secondary source of covered conductor. For the 4.16 kV 3-phase system, 394.5 AAAC is the primary source of covered conductor and 336.4 ACSR is used as the secondary source of covered conductor. In addition, BVES uses the 4.16 KV (2 or 1) phase system 1/0 ACSR covered conductor. When constructing covered conductor, BVES follows the CPUC's GO 95 Rule 43.1 Grade A Heavy Loading District Construction Standard (Grade A Standard). Based on the Grade A Standard, new poles are required to have a safety factor of 4.0 whereas an existing pole safety factor is 2.67. BVES and BVES's contractor are required to wind load each pole with 6lb/ft wind speed + 0.5 inches of ice. Due to the higher elevation and Grade A standard, BVES is required to replace a pole with a larger size pole to meet the required safety factor. These large poles have a much higher cost than a standard size pole. BVES replaced approximately 70% of its poles per mile of covered conductor installation. The installation and material costs of the replacement poles is one driver that has increased costs for BVES covered conductor projects.

Liberty

CC Unit Cost Make Up:

Liberty's covered conductor program is relatively new and limited in scope compared to the other utilities. Liberty first piloted covered conductor projects in 2020 in select areas that already needed line upgrades because of asset age and condition, and later focused on projects that targeted short line segments in HFTD areas, had reliability issues, and were in remote areas. An average of recent covered conductor projects amounted to less than one circuit mile per project and only a total of eleven miles of covered conductor were installed over the last two years. Liberty's covered conductor work is substantially less compared to, for example, SCE's approximate 1,000 miles of covered conductor installed each year.

Liberty's covered conductor unit costs will vary depending on the terrain, number of poles replaced, type of conductor installed, project design and permitting requirements, and amount of vegetation management work required for the job order.

Liberty's covered conductor capital costs per mile is made up of the following six major cost categories:

1. Labor (internal) – Internal Labor represents Project Management, Engineering, Operations, Arborists and Line Crews dedicated to the capital job, and cost of removal.
2. Materials – Materials includes poles, crossarms, insulators, down guys, anchors, transformers, hardware, and covered conductor wire purchased through Liberty supply chain operations.
3. Contractor – Contract charges are for construction contractors and professional services to design and execute project scopes. Contract costs also include line clearance qualified tree crews needed to prune and remove trees along the covered conductor line route.
4. Overheads – Overheads are allocated to active job orders monthly based on capital spend. At Liberty, this could include indirect labor, A&G, capital overheads, fleet, and small tools allocations.
5. Other – Other is reserved for taxes applied to the job.
6. Financing Costs – Financing costs capture AFUDC accumulated costs in the covered conductor job order.

<u>Cost Drivers:</u>
Liberty's project life cycle ranges from 18-36 months depending on project scope and permitting complexity. There are many factors that may impact the total project life cycle and costs, including permitting and environmental requirements, easements, geography and terrain, and construction resource availability. A major cost driver for Liberty is the contractor costs for construction in its service territory. Projects typically take longer to construct because of the mountainous terrain and require more costly construction methods like helicopter use, dewatering, hard rock excavation and hand digging. Other factors include permitting, weather, and environmental restrictions that will limit scheduling flexibility and reduce productivity, causing construction costs to increase.

Conductor Type: Liberty has two covered conductor designs that vary depending on project site access and terrain. These include 14.4 kV delta Aerial Spacer Cable (ACS) and tree wire solutions at this voltage level. In addition, Liberty has piloted the use of tree wire solution on its 12.5 kV grounded Wye system. Liberty selects the two different system options based on installation and maintenance considerations of the two solutions.

The ACS solution has 2 or 3 covered conductors supported by a steel messenger. The framing for ACS includes brackets that hold the messenger under tension and for the current carrying conductors at full sag, or zero tension. Installing and maintaining spacers requires a bucket truck, however, if accessibility is an issue, crews might require a Bosun Chair to access the line, adding to the costs.

The tree wire solution includes various sizes of covered wire such as a 1/0, 2/0, or 397 kcmil AAC. The ACS solution projects have installed 1/0AA wire with 1-052 AWA messenger and 1/0 AAC with 6AW messenger. Tree wire is installed with framing similar to bare conductor wire in an open-crossarm configuration for framing and installation. Tree wire is the preferred solution in areas with limited bucket truck access. Conductors are sized based on circuit load for both solutions. Wind and Ice loading are concerns in the Liberty territory, so Liberty does not utilize conductors smaller than 1/0.

Location: A vast majority of Liberty's service territory is in HFTD Tier 2 and Tier 3. In the initial phases of its covered conductor program, Liberty selected areas of its service territory based on local knowledge of the wildland/urban interface, locations of high fire threat districts, remoteness of overhead lines, and the age and condition of the infrastructure. Areas were also chosen based on their accessibility and egress options during an emergency. Most of Liberty's covered conductor projects are in Tier 2 and Tier 3 at elevations between 6,200 to 7,500 feet over rugged, rocky terrain with limited seasonal access. Projects typically utilize helicopter pole sets and crews are tasked with digging pole holes with pneumatic tools by hand versus with trucks with augers. Pole holes take days versus hours to excavate, increasing labor hours and costs.

Pole and Asset Replacements: Most of the covered conductor projects Liberty has designed and constructed have required a significant number of pole replacements per circuit mile. When replacing existing poles, Liberty uses taller and larger class poles. This is due to new loads and increased weights of the covered conductor, as well as the age of existing infrastructure. Projects include installation of poles, insulators, crossarms, anchors (rock anchors), down guys, transformers, and switches. One example is the Lily Lake covered conductor project that required 50 pole replacements for the approximately two miles of covered conductor installed. The terrain at Lily Lake is remote and characterized by massive, expansive boulder fields; making pole hole digging a very labor-intensive operation. Most of the work was conducted by hand crews and helicopters due to the remote terrain.

Economies of Scale: Compared to SCE and PG&E, that have thousands and hundreds of covered conductor circuit miles installed, Liberty has limited contract resources available during its construction period. Liberty's ratio of miles installed when compared to utilities with significantly more miles installed likely leads to higher contract costs on a per mile basis. This factor has likely contributed to Liberty's higher covered conductor cost per circuit mile.

Construction: Liberty's primary construction window is from May 1st to October 15th due to weather and TRPA (Tahoe Regional Planning Agency) dig season restrictions. The construction window also coincides with seasonal tourism, a high number of Red Flag Warning (RFW) days, and during the typical fire season that further limits construction efforts and effects costs. These restrictions also constrain resources and adds a premium on labor during construction season.

In 2021, Liberty's prime construction season was impacted by fires in Northern California. For example, the Tamarack fire in Markleeville required Liberty to utilize all internal and contract resources to respond to the fire and restore power. This was a 3- to 4-week impact where contractors working on covered conductor projects had to be re-assigned to respond to the fire. Liberty has also experienced extremely poor air quality due to area fires with Particulate Matter (PM) 2.5 > 500 ug/m^3. The poor air quality frequently interrupted construction causing increased mobilization and demobilization costs. The poor air quality impacted project schedules by approximately three to four weeks with no workdays when AQI was +500 in the Tahoe Basin. Finally, the Caldor fire forced evacuations in South Lake Tahoe, where the majority of Liberty's covered conductor projects were located further impacting construction costs.

Vegetation Management: Liberty's service territory is in a high elevation and mountainous terrain that is densely forested, averaging over one hundred trees per mile within maintenance distance of the conductor given recent 2020 LiDAR data. Vegetation management inspectors and tree crews often need to access work sites on foot while carrying tools and equipment resulting in much higher labor costs compared to typical work areas. In addition, due to the robust tree canopy in the Tahoe region, tree crew cost per circuit mile of construction has increased significantly due to SB 247 labor rate increases. Tree removals and pruning costs are unique to Liberty's service area and will increase the overall covered conductor project costs.

Next Steps:

In 2022, the utilities plan to continue this sub-workstream and will further discuss and document covered conductor recorded/estimated unit costs and cost drivers as well as assemble and compare initial unit costs for alternatives. The utilities will provide an update on these efforts in their 2023-2025 WMPs.

Conclusion:

This report provides descriptions of the progress of this Joint IOU effort to better understand the long-term effectiveness of covered conductor and its ability to reduce wildfire risk and PSPS impacts (and, in comparison to alternatives). The utilities have made progress on each sub-workstream and describe plans for 2022 to improve the data and analyses that have been compiled, including assessing methodologies that can be employed across all utilities to improve comparability. These efforts continue to show that covered conductor has an effectiveness between approximately 60% and 90% at reducing the drivers of wildfire risk. Additionally, the report shows covered conductor is effective at reducing the impacts of PSPS in comparison to bare conductor systems. The alternative analyses also present high-level assessments of select alternatives in comparison with covered conductor at reducing PSPS impacts. The utilities look forward to continuing these efforts in 2022 and providing an update in their 2023-2025 WMPs.

SCE-21-07, Inadequate Joint Plan to Study the Effectiveness of Enhanced Clearances

*Energy Safety found the following issue and associated remedies related to Enhanced clearances in **SCE-21-07**, as described in SCE's Action Statement:*

> "**Issue:** *RCP Action-SCE-18 (Class A)[289] required SCE, PG&E, and SDG&E to "submit a joint, unified plan" to begin a study of the effectiveness of extended vegetation clearances.[290] SCE, PG&E, and SDG&E presented the "joint, unified" plan to the WSD on February 18, 2021. While it was apparent the three large utilities had discussed a unified approach, each utility presented differing analyses that would be performed to measure the effectiveness of enhanced clearances.*
>
> *This presentation's content was not included in the February 26, 2021 Supplemental Filing. Instead, SCE submitted its own plan to study the effectiveness of extended vegetation clearance as part of its February 26, 2021 Supplemental Filing.*
>
> *Energy Safety acknowledges the complexity of this issue; any study performed assessing the effectiveness of*

[289] A note about the numbered conditions referenced in this document: "RCP Action-SDGE-[#]" here refers to one of the actions required by the WSD in its evaluation of SDG&E's Remedial Compliance Plan of 2020, issued Dec. 30, 2020. The WSD issued four such orders (RCP Action-SDGE-1 through RCP Action-SDGE-4). There are two other related sets of references in this document: "SDGE-[#]" refers to one of the actions required by the WSD in its evaluation of SDG&E's 2020 WMP issued June 11, 2020 (SDGE-1 through SDGE-16). "QR Action-SDGE-[#]" refers to one of the actions required by the WSD in its evaluation of SDGE's first quarterly report issued Jan. 8, 2021 (QR Action-SDGE-1 through Action-SDGE-49). Additionally, there are conditions that may be referenced by "Guidance-[#]", which refer to the requirements made of PG&E, SCE, SDG&E, Bear Valley Electric Service, Liberty Utilities, and PacifiCorp, addressing key areas of weakness across all six WMPs in Resolution WSD-002 "Guidance Resolution on 2020 Wildfire Mitigation Plans" issued June 19, 2020 (Guidance-1 through Guidance-12).

[290] WSD Evaluation of Southern California Edison's Remedial Compliance Plan, December 30, 2020, p. 10.

enhanced clearances will take years of data collection and rigorous analysis.

Remedies: *SDG&E, PG&E, and SCE will participate in a multi-year vegetation clearance study. Energy Safety will confirm the details of this study in due course. The objectives of this study are to:*
1. Establish uniform data collection standards.
2. Create a cross-utility database of tree-caused risk events (i.e., outages and ignitions caused by vegetation contact).
3. Incorporate biotic and abiotic factors[291] into the determination of outage and ignition risk caused by vegetation contact.
4. Assess the effectiveness of enhanced clearances.

In preparation for this study and the eventual analysis, SCE must collect the relevant data; the required data are currently defined by the WSD Geographic Information System (GIS Data Reporting Standard for California Electrical Corporations - V2). Table 2 outlines the feature classes which Energy Safety believes will be most relevant to the study.
Energy Safety will also be updating the GIS Reporting Standards in 2021, which may include additional data attributes for vegetation-related risk events."

Response:

SDG&E, PG&E, and SCE (jointly, investor-owned utilities or IOUs) have begun collaboration on a vegetation clearance study. This is expected to be a multi-year effort which will benchmark vegetation management practices and data collection methodologies across IOUs in order to help develop uniform data standards. Bi-weekly meetings began on September 9,2021 and eight meetings have been held to date, with attendees from the IOUs and Energy Safety at each meeting.

The IOUs are focused on addressing the required remedies of this study, which include:

- Establish uniform data collection standards
- Create a cross-utility database of tree-caused risk events (i.e., outages and ignitions caused by vegetation contact)
- Incorporate biotic and abiotic factors[292] into the determination of outage and ignition risk caused by vegetation contact
- Assess the effectiveness of enhanced clearances

Initial meetings began with each utility discussing their existing data collection standards and early analysis of enhanced vegetation clearances. The IOUs discussed definitions being used and began to standardize definitions including "enhanced clearance," "inventory tree," "tree-caused risk event," and

[291] Biotic factors include all living things (e.g., an animal or plant) that influence or affect an ecosystem and the organisms in it; abiotic factors include all nonliving conditions or things (e.g., climate or habitat) that influence or affect an ecosystem and the organisms in it.

[292] Biotic factors include all living things (e.g., an animal or plant) that influence or affect an ecosystem and the organisms in it; abiotic factors include all nonliving conditions or things (e.g., climate or habitat) that influence or affect an ecosystem and the organisms in it.

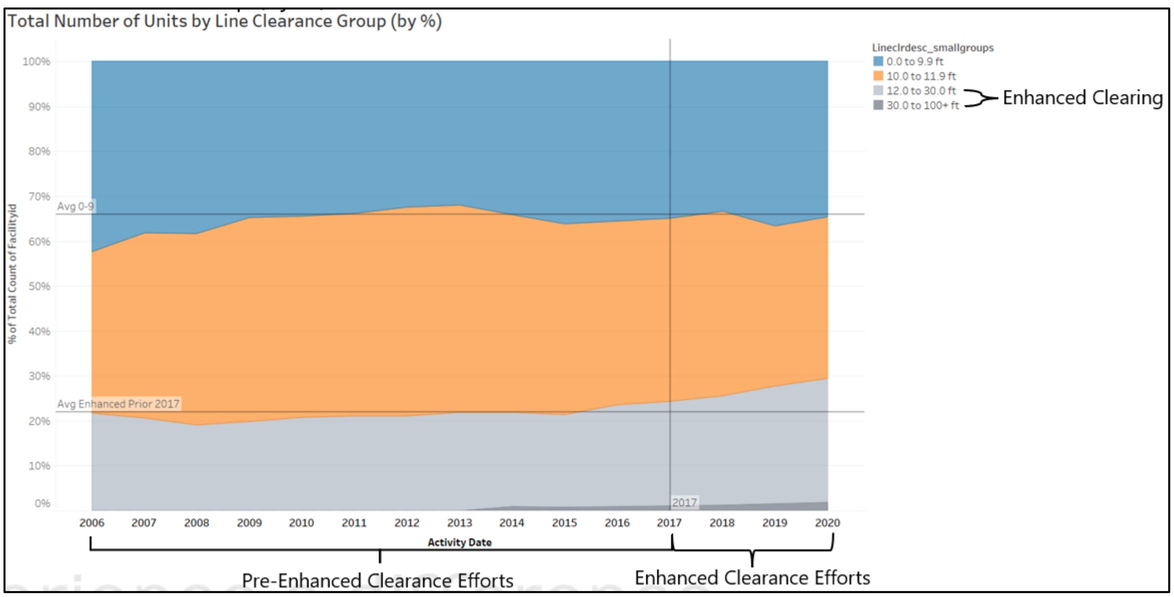
"post-trim clearance." The different types and methods of creating a cross-utility database of tree-caused risk events were reviewed. There are pros and cons to the various methods discussed, with more work to be completed in the future on the format and location of this database.

The most recent meetings, which took place after the November 1, 2021 Progress Report, focused on each IOU demonstrating its current analysis around the effectiveness of enhanced clearances.

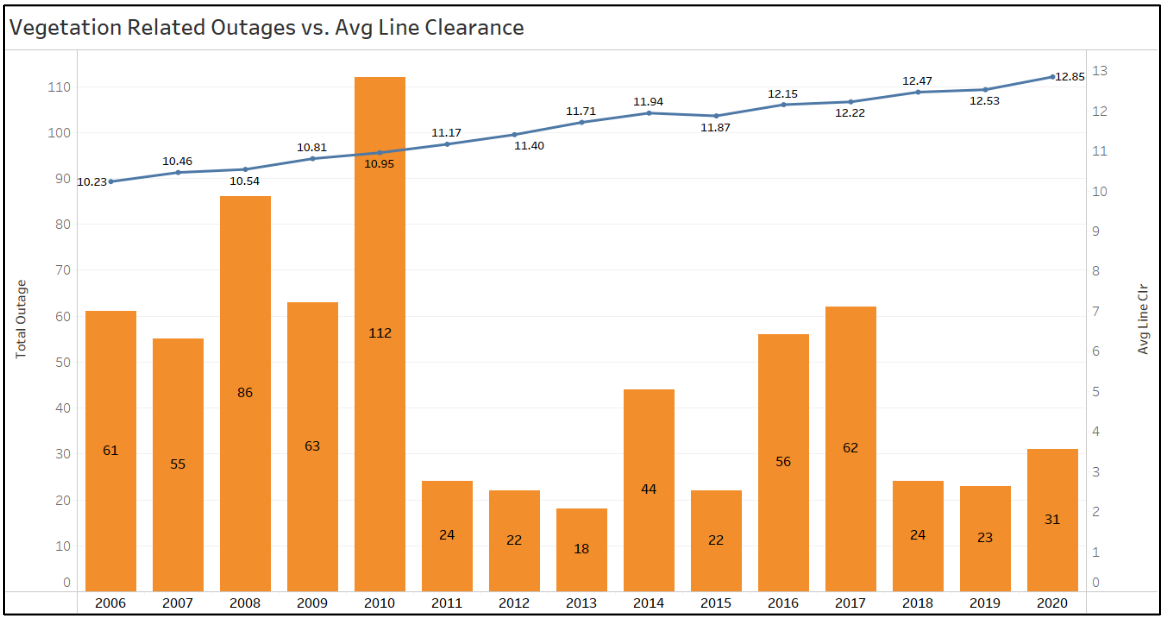
Initial analysis focus on outage/interruption events as these are precursors to ignition events. Ignition data does not have a sufficient population sample size to evaluate at this time. These initial analyses are presented below for each IOU:

SDG&E

Initial analysis performed by SDG&E studied the relationship between line clearance and vegetation related outages on the system. The outages being studied are related to unplanned forced outages, excluding instances where the line is de-energized for safety to allow crews to work in the area. The IOUs have defined enhanced clearance as trimming the vegetation at least twelve feet from the energized conductor. Enhanced clearance efforts ramped up beginning in 2017, as shown in the graph below where the percent of SDG&E's inventory trees trimmed to enhanced clearances increases to near 30%.



SDG&E sees an increase in average line clearance over time, with a related relative decrease in vegetation related outages over time. This decrease in vegetation related outages will likely lead to fewer events that could result in an ignition leading to a wildfire. Data from 2006-2016, the pre-enhanced clearance timeframe, compared to data from 2017-2020, the post-enhanced clearance timeframe, show that vegetation-related outages have decreased by thirty-eight percent since these enhanced clearance efforts began.



	Inventory Trees Inspected	Vegetation Related Outages	Outage Rate
Pre-Enhanced Clearance (2006-2016)	4,667,075	554	1.19E-04
Post-Enhanced Clearance (2017-2020)	1,863,658	137	7.35E-05
Difference			-38%

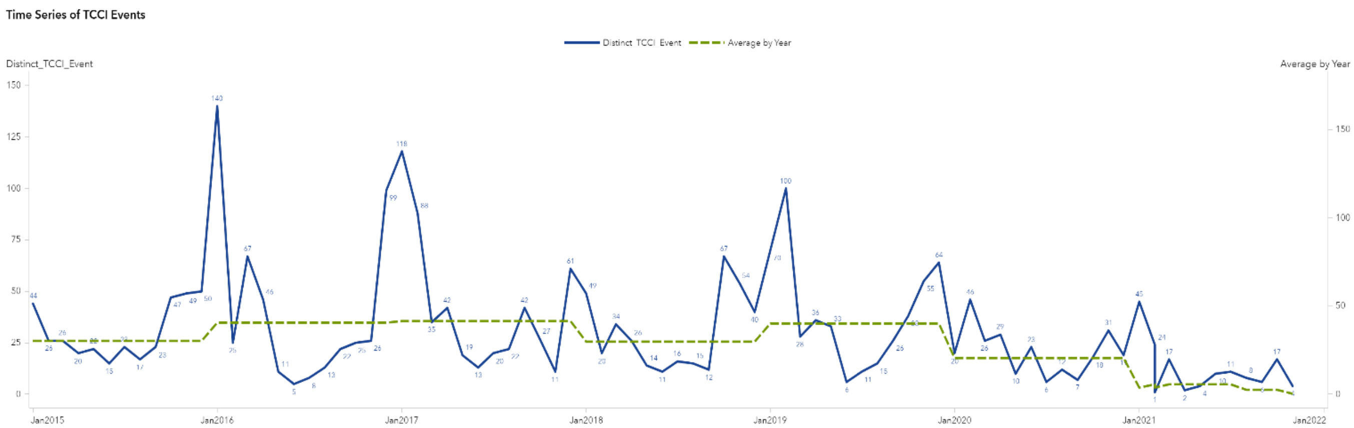
SCE

In late 2018, consistent with D.17-12-024 which amended GO 95 to increase recommended clearance distances at time of trimming in HFTDs, SCE implemented enhanced clearance programs to achieve greater trimming distances. For purposes of this analysis and considering the time to operationalize enhanced clearances to establish SCE's Grid Resiliency Clearance Distances (at least 12' clearance in HFTD and 6' in non-HFTD) across SCE's service territory, the "pre-enhanced" time frame is considered to be 2015-2019, and "post-enhanced" is focused on 2020 and future years. Outage data in the table/chart represent tree-related events (circuit interruptions) on SCE's distribution system confirmed by SCE field verification as grow-in, blow-in and fall-in events.

This data highlights a decrease in outages associated with vegetation caused events since the advent of SCE's enhanced clearances. Details about the reported events include confirmed tree-related events (TCCIs) by SCE field verification, and are categorized by Grow-In, Blow-In and Fall-In events. Approximately 100 TCCI "categories" are reduced to 6 primary categories: Grow-In, Blow-In, Fall-In, Human Caused, No Cause/Not tree related, and Uncategorized. Some events initially reported as a TCCI by SCE's outage management system could fall into categories that are not indicative of a TCCI once they are investigated and verified in the field. These include Human Caused, No Cause/Not Tree Related, and Uncategorized (the data below does not include these categories). Legacy data was updated to new data collection standards rolled out in 2021. Complete year-to-year outage data is available from 2015 to present and complete enhanced clearance data is available from 2020 to present. This data reflects distribution related events only, as there are no transmission related events of record. Though SCE has tracked TCCIs since

2015, it has only recently made advancements in its work management system that allows SCE to associate specific outage events with the individual/specific trees in its inventory. Outage data was not associated until 2021. Through this joint study, and over the next few years, SCE expects to find more substantial evidence supporting the positive effectiveness of enhanced clearances and the reduction in tree related events. Please see the Time Series of TCCI Events figure and Average Events Pre & Post Enhanced Clearances table showing early indications that implementing enhanced clearances among other programs has decreased the number of events.

Time Series of TCCI Events

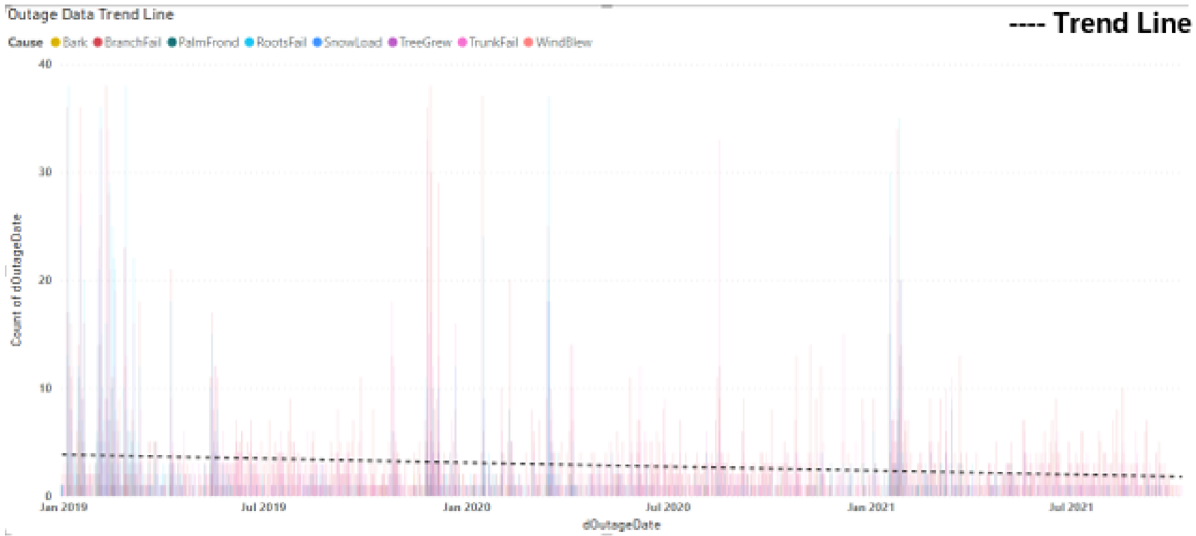


Average Events Pre & Post Enhanced Clearances

Average Events Pre and Post Enhanced Clearances	Pre-Enhanced Clearances	Post Enhanced Clearances	Difference
	2015-2019 Avg TCCIs per Year	2020-2021 Avg TCCIs per Year	
HFTD	148.4	61.5	-59%
Non-HFTD	289.2	136	-53%
All	437.6	197.5	-55%

PG&E

PG&E's Enhanced Vegetation Management (EVM) program began in January of 2019 and the image below illustrates the beginning of enhanced clearances toward the end of 2021, or approximately three years of data, but the outages are representative of the entire service territory. The graph shows outage data confirmed as tree-related events and the distinct causes of the outage (Bark, BranchFail, PalmFrond, RootsFail, TreeGrew, WindBlew). Trend line analysis shows a decrease over the three-year period in outage counts associated with these tree-related causes. This is for Distribution conductor only and outage counts were capped at 40 per day to remove outliers in data. (With outliers still represented, the trend analysis also shows a decrease in tree-related causes, but it is more difficult to read in this particular format.) This data is preliminary and the decreases in tree-related causes cannot be attributed solely to enhanced clearances without further examination.



Summary

The early analysis of each IOU demonstrates that after implementing enhanced clearances the number of vegetation-related outages has decreased.

The IOUs will begin 2022 by initiating a process for soliciting proposals from third-party vendors that can assist with achieving and validating the objectives of the study. Now that each utility's current methods have been reviewed and understood, the process of beginning to standardize data collection and creating a cross-utility database of tree-caused risk events will begin. As preliminary discussions lead to the analysis of vegetation events as the key metric for effectiveness, over the course of this extended study the IOUs may confirm or adjust effectiveness metrics and work towards a more uniform standard for measuring the efficacy of expanded clearances. Part of these discussions included the types of biotic and abiotic factors that can affect the risk of vegetation contact including tree genus/species, tree health, soil composition, storm conditions, Santa Ana winds, etc. The IOUs believe that biotic and abiotic factors can be extracted from existing data sets. Additionally, in partnering with their consultant, the IOUs will begin to examine whether the correlation between enhanced clearances and the lower number of tree-caused outage events may be attributable to other factors beyond clearances, such as the management of hazard trees and the installation of covered conductor. The joint study will look into whether, and to what extent, other mitigations can be effectively parsed out so as to focus in on the effects of enhanced clearances. To that end, additional data may need to be included in the joint data base (such as the presence of a covered circuit segment) to segregate causal factors.

Each IOU will collect the relevant data identified by Energy Safety for the purposes of this study.

9.8.1 Appendix A

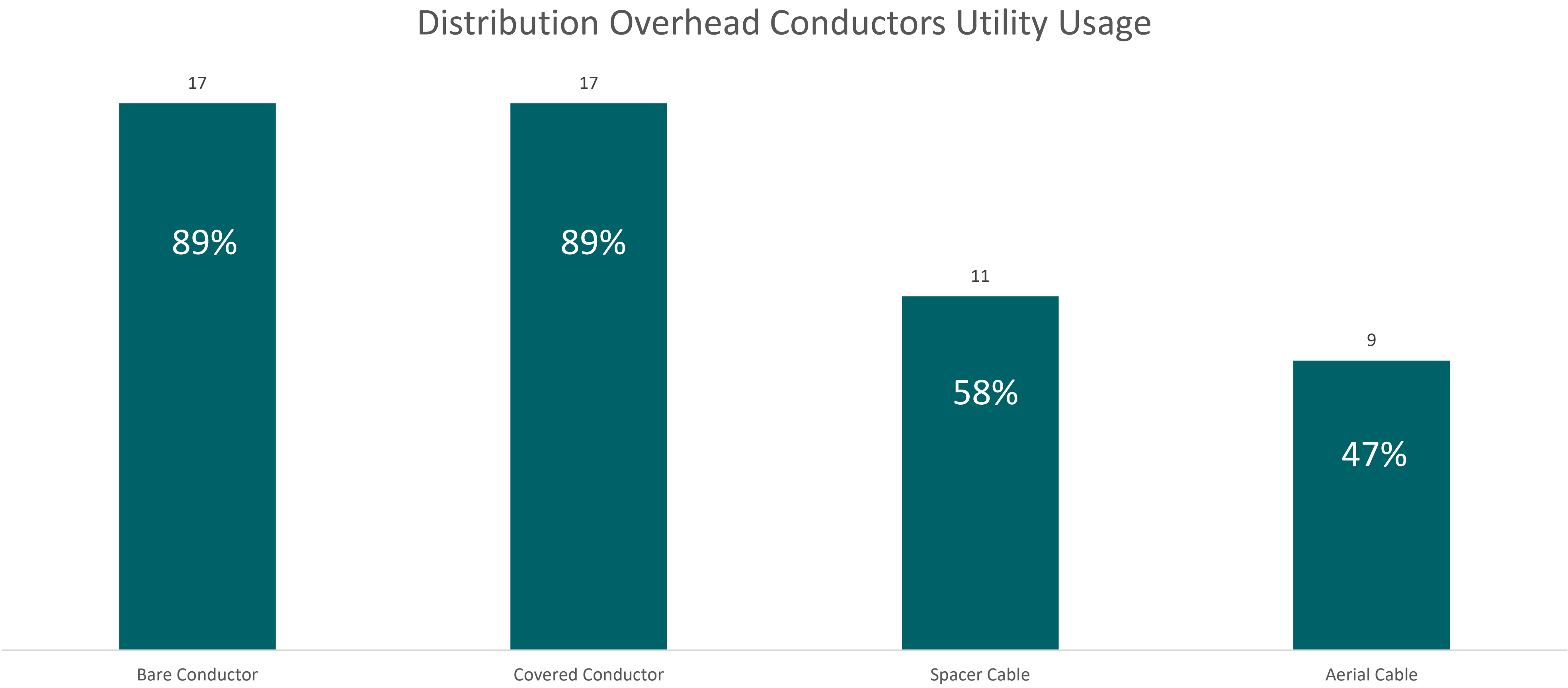
Covered Conductor Benchmarking Survey Results

Joint IOU CC Effectiveness Workstream

Participants

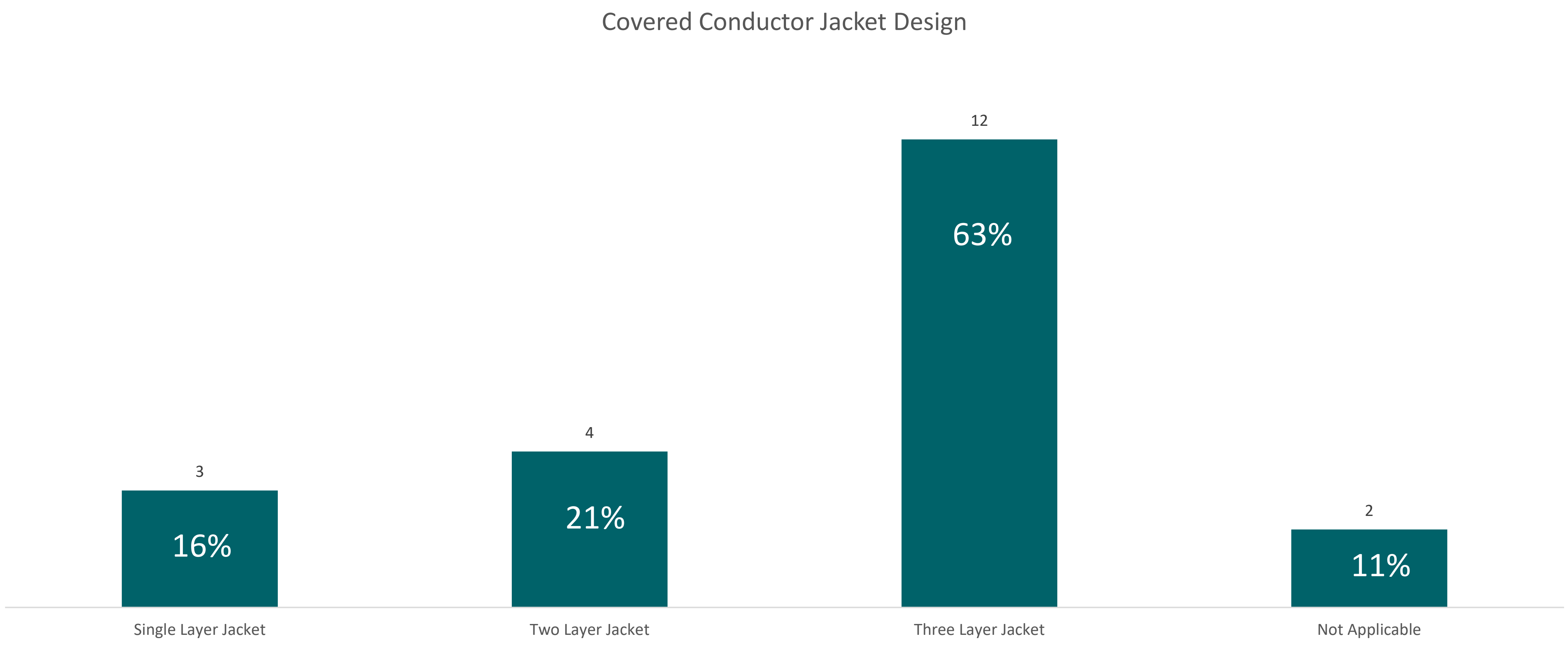
1. American Electric Power
2. Ausnet Services
3. Bear Valley Electric Service, Inc.
4. Duke Energy
5. Essential Energy
6. Eversource Energy (CT)
7. Korean Electric Power Corporation
8. Liberty
9. National Grid
10. Pacific Gas and Electric Company
11. PacifiCorp
12. Portland General
13. Powercor
14. Puget Sound Energy
15. San Diego Gas & Electric
16. Southern California Edison
17. TasNetworks
18. Tokyo Electric Power Company
19. Xcel Energy

What types of overhead conductors does the utility utilize in its distribution system?

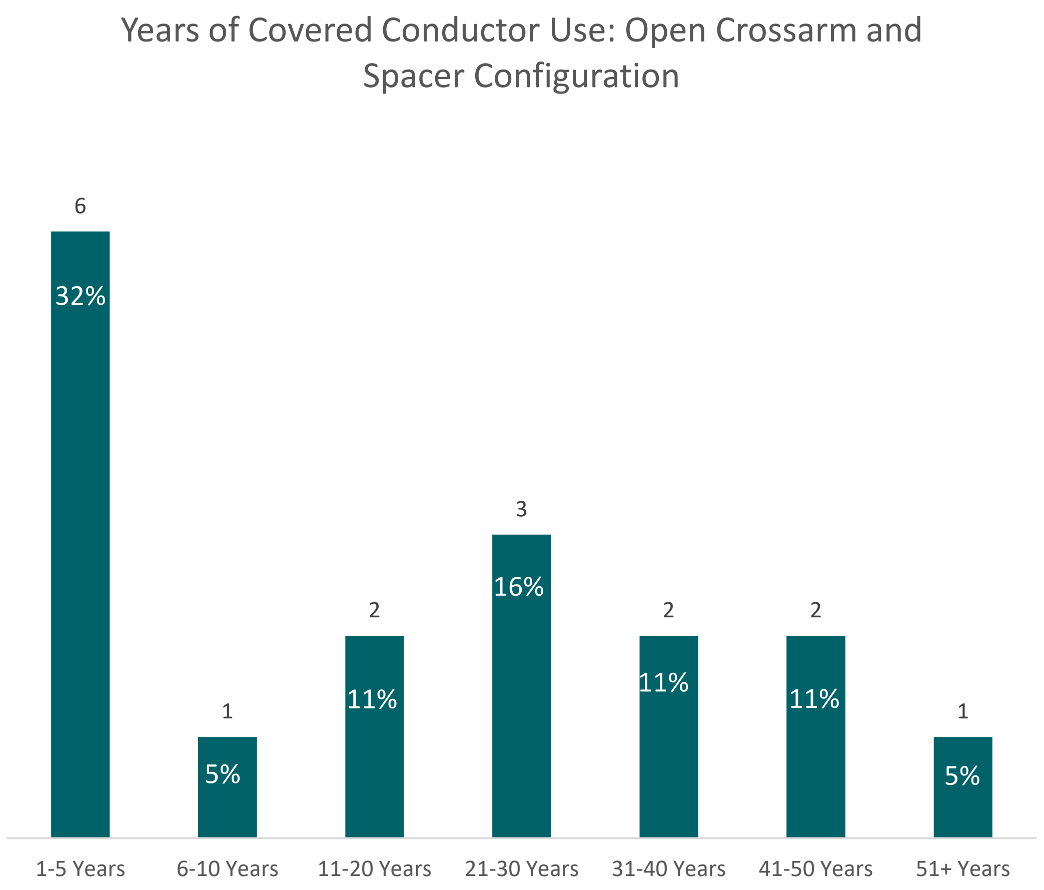


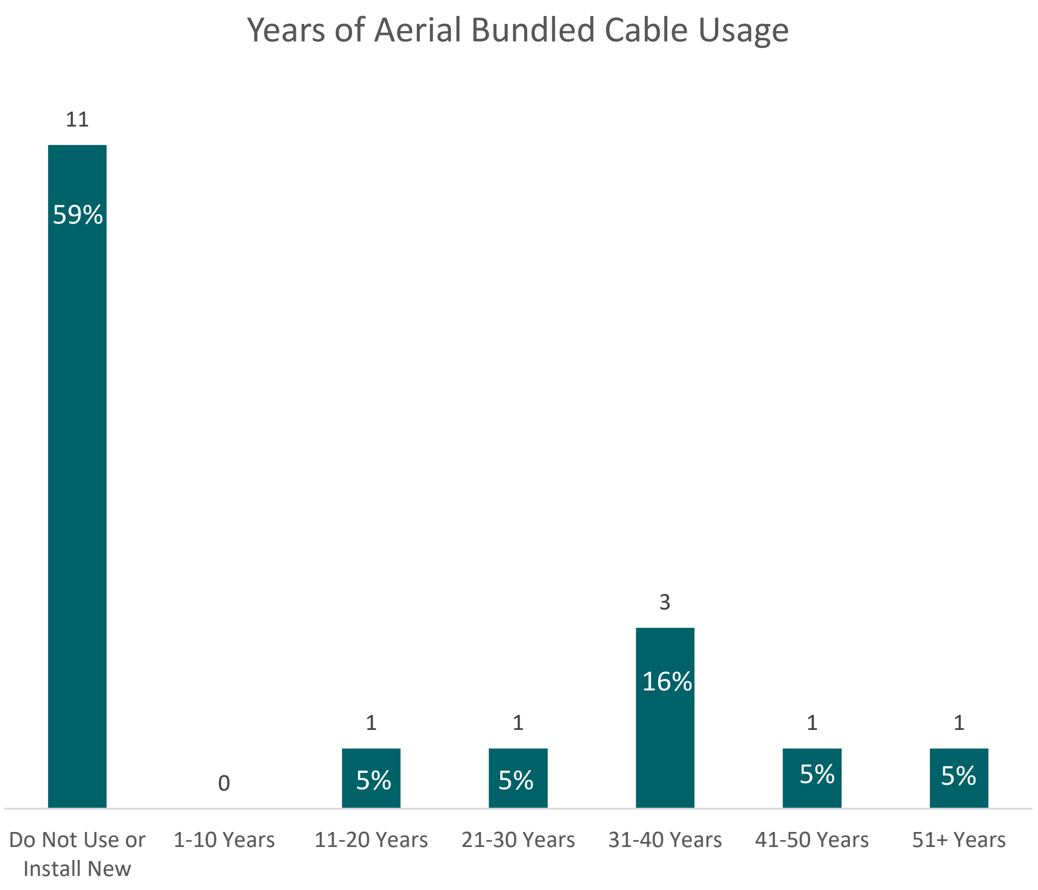
Energy for What's Ahead®

What type of covered conductor design does the utility utilize?



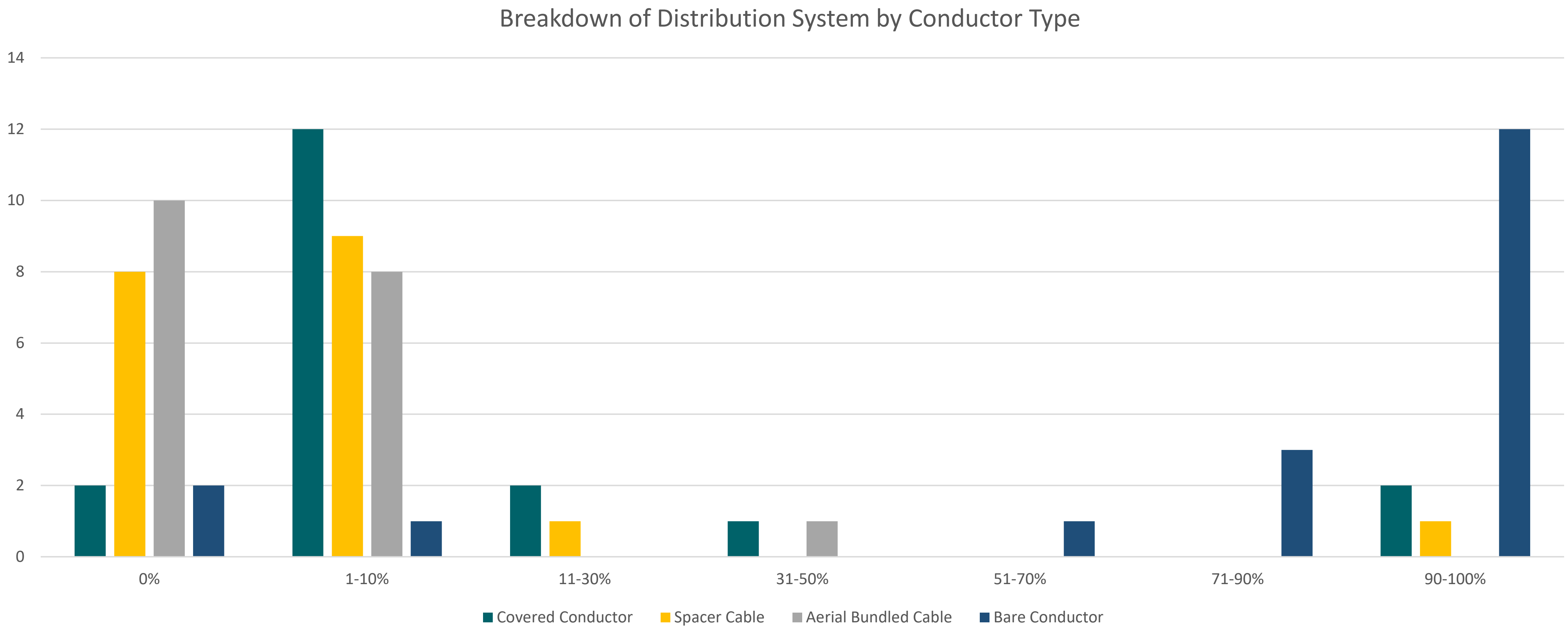
Years of Covered Conductor and Aerial Bundled Cable Usage





Energy for What's Ahead®

What percent of the primary distribution system is covered conductor vs. spacer cable vs. ABC vs. bare conductor?



Energy for What's Ahead®

Circuit Miles of Covered Conductor, Spacer Cable, and ABC Installed

Utility	Covered Conductor Circuit Miles	Spacer Cable Circuit Miles	Aerial Bundled Cable Circuit Miles
American Electric Power	156	137	0
AusNet Services	5	25	125
Bear Valley Electric Service, Inc.	22	0	0
Duke Energy	0	0	0
Essential Energy	2,500	0	1500
Eversource Energy (CT)	8,000	520	200
Korean Electric Power Corporation[1]	120,485		
Liberty	5	2	0
National Grid	4,000	3,000	1,000
Pacific Gas and Electric Company	820	0	3
PacifiCorp	0	60	0
Portland General	243	9	0
Powercor	6	1	60
Puget Sound Energy	1,500	1	0
San Diego Gas & Electric	22	2	0
Southern California Edison	2,187	0	64
TasNetworks	2	0	10
Tokyo Electric Power Company[2]	267,190		16,156
Xcel Energy	0	50	0

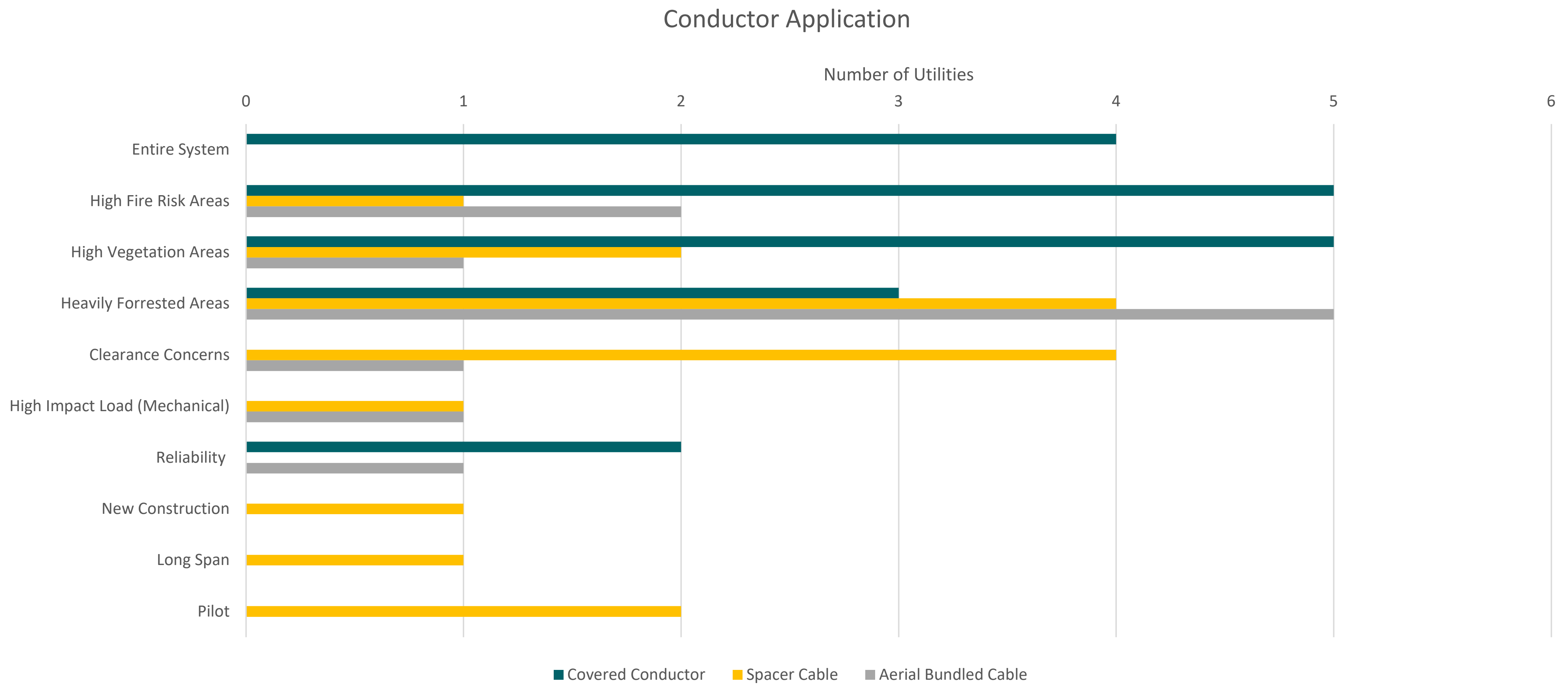
1. Korean Electric Power Corporation uses Covered Conductor and Aerial Bundled Cable. Value represents total circuit miles of Covered Conductor and Aerial Bundled Cable. Circuit mile data is based on information provided from previous benchmarking
2. Tokyo Electric Power Corporation uses Covered Conductor and Spacer Cable. Value represents total circuit miles of Covered Conductor and Spacer Cable.

Outage and Ignition Tracking

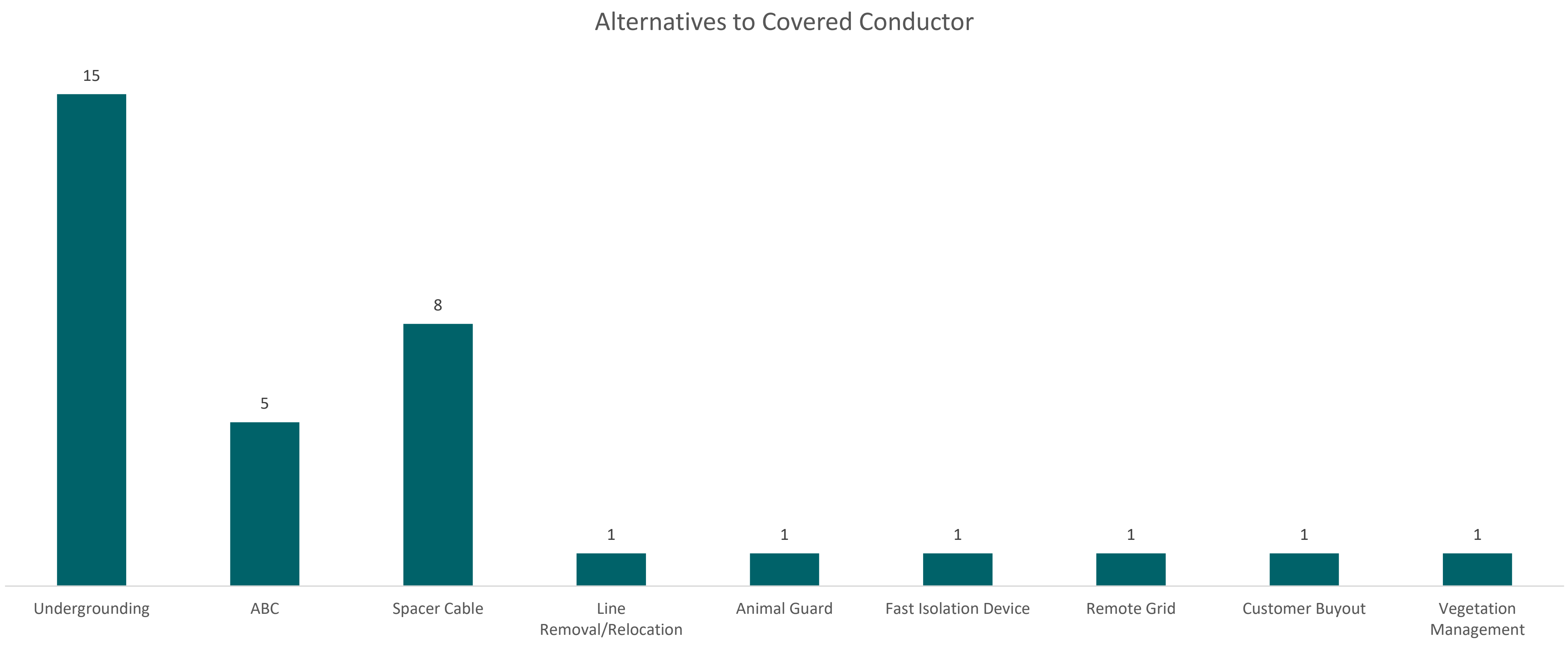
Utility[1]	Track Outage Counts for Bare vs. CC?	Has use of CC, Spacer Cable, or ABC reduced faults?	Track ignition Counts for Bare vs. CC?	Has use of CC, Spacer Cable, or ABC reduced ignitions/ignition drivers?	If no ignition reduction, why?
American Electric Power	No	Yes	No	Yes	
AusNet Services	No	Yes	No	Yes	
Bear Valley Electric Service, Inc.	Yes	Yes	Yes	No	No prior ignitions
Duke Energy	NA	NA	NA	NA	Does not use CC
Essential Energy	Yes	Yes	Yes	Yes	
Eversource Energy (CT)	Yes	Yes	No	No	Data not tracked
Korean Electric Power Corporation	Yes	Yes	No	Yes	
Liberty	No	No	No	No	Data not tracked
National Grid	Yes	Yes	No	No	Data not tracked
Pacific Gas and Electric Company	No	Yes	No	No	Data not tracked
PacifiCorp	Yes	Yes	Yes	Yes	
Portland General	No	Yes	No	No	Data not tracked
Powercor	No	No	No	Yes	
Puget Sound Energy	No	Yes	No	No	Data not tracked
San Diego Gas & Electric	Yes	Yes	Yes	Yes	
Southern California Edison	Yes	Yes	Yes	Yes	
TasNetworks	No	Yes	Yes	Yes	
Tokyo Electric Power Company	No	Yes	No	Yes	
Xcel Energy	No	Yes	No	No	Data not tracked

Measuring Effectiveness of Covered Conductor, Spacer Cable, and ABC

Covered Conductor, Spacer Cable, and Aerial Bundled Cable Application



Alternatives



Protection

- **Existing** fault detection methodologies
  - Overcurrent protection
    - Circuit breaker & Relay
    - Fuses
    - Reclosers
    - TripSavers
  - SCADA connected devices
  - Smart Meters
  - High voltage DC pulse with directional tracking
  - High impedance fault detection
  - Distribution automation system monitoring
  - Distance to fault algorithm

- **Potential** fault detection methodologies
  - Early Fault/Failure Detection
  - Distribution Fault Anticipation
  - Open Phase Detection
  - High impedance fault detection
  - Sensitive Ground Fault
  - Rapid Earth Fault Current Limiter
  - Downed Conductor Detection
  - LR controllers
  - Fault indicators
  - Sensing insulators
  - Zero phase voltage measurement
  - AMI meter loss of voltage detection
  - Working with vendors to develop communication aided protection to detect faulted or broken CC
  - Inspection

Patrol Protocols

- Patrol conductors after storm before energization
  - Require visual observation
  - Same as bare conductor
- Drone usage

Other Comments

Utility	Comment
SDG&E	Primarily using covered conductor, but have the option for spacer cable.
PacifiCorp	Spacer cable has been highly effective
Liberty	Piloting on a case-by-case basis, targeting highest-risk areas, based on Risk-Based Decision model.
Duke Energy	Installed covered conductor and spacer cable on our system in the past. There is a miniscule amount on our system. Our current construction standards do not call for covered or spacer cable installation for the following reasons: 1) Require additional installation procedures and maintenance compared to bare conductors. 2) Require proper Installation to prevent BIL and deterioration failures. 3) Designed to prevent intermittent vegetation contact. Should NOT be used for sustained contact of vegetation. 4) Must coincide with continual Vegetation Maintenance.
Xcel Energy	Using a strengthened neutral shield wire to protect crossarm construction from tree impacts.
TEPCO	• Use of bare wires for MV line is prohibited in Japan. For MV line, covered electric wires are basically used. • Spacer cables used when it is necessary to move the electric wire position away or change routes between utility poles. • Aerial bundled cables are used when connecting the MV line of the third route on the utility pole.
Portland General	• Developing the application strategy to mitigate wildfire in high-risk zones using these conductor types. Until now, these systems were primarily used for reliability purposes.

9.8.2 Appendix B

Effectiveness of Covered Conductors: Failure Mode Identification and Literature Review

Effectiveness of Covered Conductors: Failure Mode Identification and Literature Review

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December 22, 2021

Doc. no. 2103590.000 - 6880

Contents

Executive Summary

Exponent, Inc. (Exponent) was jointly retained by the California investor-owned utilities (IOUs) to assess the effectiveness and reliability of covered conductors (CCs) for overhead distribution system hardening. Our investigation included a literature review, discussions with subject matter experts, a failure mode identification workshop, and a gap analysis comparing expected failure modes to currently available test and field data. Based on our investigation to date, we offer the following conclusions:

1. Covered conductors are a mature technology (in use since the 1970s) and have the potential to mitigate several safety, reliability, and wildfire risks inherent to bare conductors. This is due to the reduced vulnerability to arcing/faults afforded by the multi-layered polymeric insulating sheath material.

2. A subject matter expert workshop, composed of six California IOUs and Exponent, was conducted, and identified hazards and failure modes affecting bare conductors and CCs. Of the 10 hazards that affect bare conductors, CCs have the potential to mitigate six. Mitigated hazards include tree/vegetation contact, wind-induced contact (such as conductor slapping), third-party damage, animal-related damage, public/worker impact, and moisture.

3. The primary failure mode of bare conductors is arcing due to external contact. Laboratory studies and field experience have shown that arcing due to external contact was largely mitigated with CCs. Therefore, a corresponding reduction in ignition potential would be expected.

4. Field experience from around the world, including North America, South America, Europe, Asia, and Australia, consistently report improvements in reliability, decreases in public safety incidents, and decreases in wildfire-related events that correlate with increased conversion to CC.

5. While high-level field experience–based evidence of CC effectiveness is plentiful, relatively few lab-based studies exist that address specific failure modes or quantify risk reduction relative to bare conductors. For some failure modes, further testing is recommended to bolster industry knowledge and to enable more effective risk assessment.

6. Several CC-specific failure modes exist that require operators to consider additional personnel training, augmented installation practices, and adoption of new mitigation strategies (e.g., additional lightning arrestors, conductor washing programs, etc.).

Note that this Executive Summary does not contain all of Exponent's technical evaluations, analyses, conclusions, and recommendations. Hence, the main body of this report is at all times the controlling document.

Motivation and Scope

California investor-owned utilities (IOUs) Pacific Gas & Electric (PG&E), Southern California Edison (SCE), and San Diego Gas & Electric (SDG&E) engaged Exponent to summarize the effectiveness of CCs for hardening of overhead distribution electric lines. During the project, three additional California IOUs joined the effort: Liberty, PacifiCorp, and Bear Valley Electric Service. CCs have gained industry attention due to their potential for mitigating risks associated with public safety, reliability, and wildfire ignition. The current study was undertaken to better understand the advantages, operative failure modes, and current state of knowledge regarding CCs. The objectives of this study were to:

1. Summarize the effectiveness of CCs.
2. Summarize the implementation and design considerations of CCs.
3. Identify gaps in current testing/knowledge and practices/implementation.

To meet these objectives, we performed a comprehensive review of publicly available literature, utility-provided data, and manufacturer information. Additionally, a high-level failure mode identification workshop was conducted with input from technical subject matter experts representing the California IOUs and Exponent. The workshop output was compared against the available literature and test data to identify any gaps between the current state of knowledge and the identified failure modes.

Covered Conductor Technology

History and Motivation for Development

The term “covered conductor” refers to a variety of conductor cable designs that incorporate an external polymer sheath to protect against incidental contact with other conductors or grounded objects such as tree branches. This technology has several advantages over traditional bare conductors, and the key drivers for adoption have been to improve overall system reliability, to enhance public safety in high-population areas, to decrease required right-of-way in densely forested areas, to decrease the scope and frequency of vegetation management, and to reduce the probability of ignition from conductor heating/arcing in fire-prone areas.

Construction and Types

CCs were first adopted in the United States and Europe in the 1970s for medium-voltage distribution lines (35 kV and below) and were later implemented for high-voltage overhead lines in the 1990s [Leskinen 2004]. Early iterations had various technical challenges that led to the development of the modern CC design that will be discussed throughout this report. Modern CCs consist of an all-aluminum conductor (AAC), aluminum conductor with steel reinforcement (ACSR), or copper (CU) conductor, enclosed in a multi-layer polymer sheath. The number of layers and their composition largely depend on the specified voltage rating, as multi-layered variants have a higher impulse strength than the single-layer design and often include a semiconducting conductor shield. This report focuses on CC use in the “medium voltage” range (6–35 kV), though the technology can also be used for higher or lower voltage.

Figure 1 shows a three-layer CC design, which is commonly used for distribution-level voltages. A high-density polyethylene (HDPE) outer jacket provides strength, abrasion resistance, and weather resistance. This layer may be cross-linked to increase its high temperature strength and dimensional stability. A low-density polyethylene (LDPE) inner jacket provides dielectric strength to protect the underlying conductor and may also be cross-linked to enhance high temperature properties. Finally, a semiconducting thermoset “shield” layer is wrapped around the conductor, which equalizes the electric field around the conductor to reduce voltage stress and preserve the insulation [Wareing 2005].

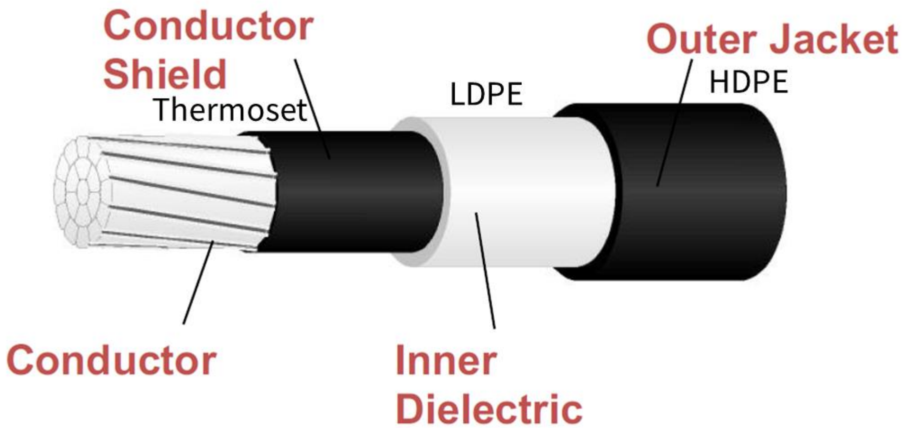

Figure 1. A schematic illustration of a three-layer CC. Diagram modified from Hendrix Aerial Cable Systems [Trager].

Overhead Configurations

One common configuration for CCs used in overhead distribution systems is the standard crossarm-mounted construction. This configuration, sometimes referred to as "tree wire," is often seen where CCs are installed on pre-existing infrastructure designed for bare conductors. This method can leverage legacy hardware, construction and maintenance practices, and pole structures if the weight, diameter, and modified tensioning are considered. Conductors are typically attached to polyethylene pin-type insulators in this configuration. A reduced crossarm structure can also be used in narrow rights-of-way. One disadvantage to this method of installation is that it requires stripping of the conductor sheath at dead-end attachments, creating a length of unprotected bare conductor. Figure 2 shows an example of tree wire construction.

Figure 2. An example of crossarm-mounted CC, or “tree wire,” construction. Photo from Hendrix Aerial Cable Systems [Trager].

CCs are also often constructed in a “spacer cable” configuration. Spacer cable takes advantage of the reduced clearance required of CCs by closely spacing adjacent conductor phases with rigid spacer hardware. This configuration is advantageous in tight corridors where right-of-way may be limited and can reduce wind-related impact on individual conductors [Trager]. No stripping of the conductor sheath is required for this installation method, resulting in a completely covered system except for tap, transformer/capacitor, surge arrester, and protective device locations. A notable feature of spacer cable is that the conductor is not self-supporting, but rather, a steel cable or “messenger cable” is used to support multiple conductors. The messenger cable can also shield the conductors somewhat from fallen branches and lightning strikes. Figure 3 shows an example of spacer cable construction.

Figure 3. An example of spacer cable CC construction. Photo from Hendrix Aerial Cable Systems [Trager].

Field Experience

Finland

Finland started adopting CCs for medium-voltage lines in the 1970s and high-voltage lines in the 1990s to increase reliability. While only 4% of the total medium-voltage network, CCs accounted for 90% of the total average medium-voltage length increase during the early 2000s [Leskinen 2004].

The annual outage rate per 100 km from Finland is shown in Figure 4 and is valid for rural areas. As the figure shows, the number of faults has steadily decreased since the 1970s to around five faults per 100 km. This likely corresponds to the increased number of CC lines in the network [Leskinen 2004].

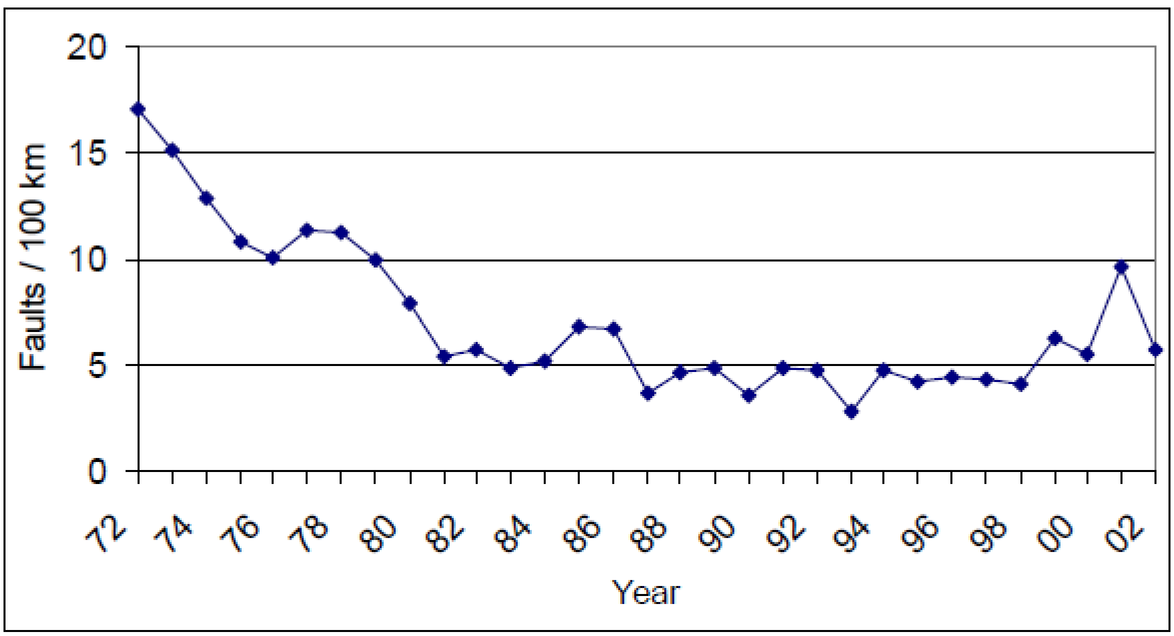

Figure 4. Annual number of faults per 100 km in rural areas of Finland from 1972 to 2002 for medium-voltage lines. Image from [Leskinen 2004].

This study also analyzed previous literature that suggested CC installation also affects the number of high-speed and delayed automatic reclosings. Based on the field data-derived empirical equations from Heine, *et. al*., as shown in Figure 5, the number of high-speed autoreclosings decreases by one third when the percentage of CC lines increases from 10% to 50% [Heine 2003, Leskinen 2004]. The number of autoreclosings is indicative of the number of faults; therefore, these data suggest that the number of faults decreased with increased use of CCs. More recent studies show that the number of permanent faults in CC lines is 20% of the number associated with bare conductor overhead lines and gives an annual fault number of one per 100 km [Leskinen 2004].

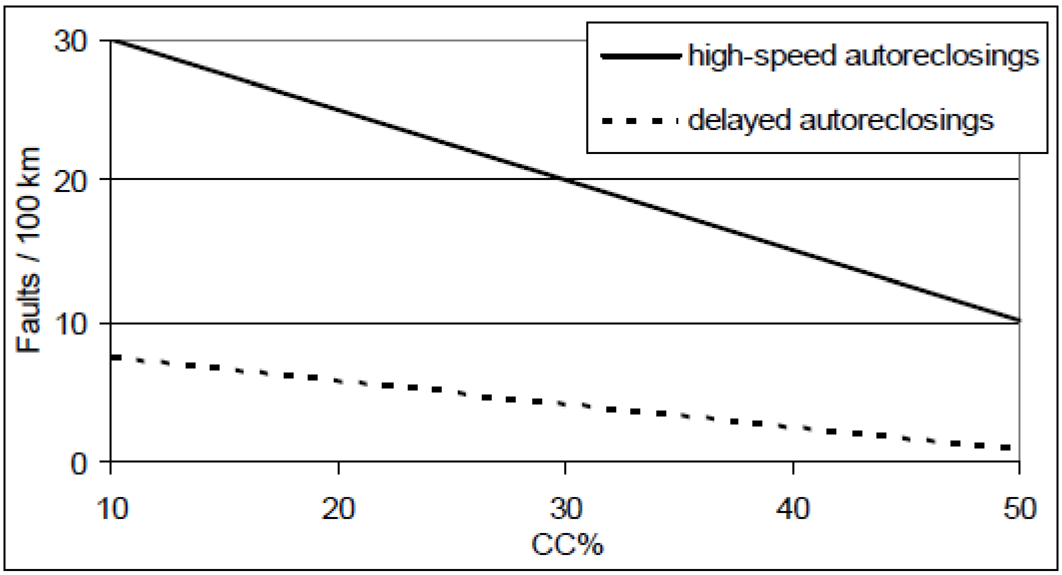

Figure 5. Fault frequency as a function of CC network share in Finland. Image from [Leskinen 2004].

Slovenia

The Slovenian utility Elektro Ljubljana began building CC lines in 1993 to improve reliability, and within ten years CC lines comprised 8% of all Slovenian medium-voltage overhead lines [Leskinen 2004]. The annual medium-voltage outage rate in rural Slovenia was between 15 and 25 per 100 km prior to the introduction of CCs. After the adoption of CC lines and other new technology such as remote-controlled load breakers and shunt circuit breakers, the annual outage rate reduced to less than two faults per 100 km. This rate is nearly double the most recent annual outage rate of Finland, as discussed in the prior section. The higher fault rate in Slovenia compared to Finland has been attributed to the higher level of lightning and a lack of standards [Leskinen 2004].

Taiwan

The Taiwan Power Company invested the equivalent of over $360 million between 1996 and 2000 to replace 11.4 kV overhead lines with 15 kV cross-linked polyethylene (XLPE) weatherproof wires (a type of CC) [Li 2010]. Figure 6 shows the impact of CC lines on the Taiwan Power Company distribution system. (The ratio of covered line length using XLPE weatherproof wire in the distribution system to the total line length of the system is given by the variable r_c.) The distribution system reliability is assessed using the system average interruption frequency index (SAIFI) and the system average interruption duration index (SAIDI). Figure 6 shows the variation of r_c, SAIFI, and SAIDI during 1985 to 2005. Installation of CC lines from 1985 to 2005 resulted in lower fault frequency and interruption duration.

As distribution systems in Taiwan are near highly populated areas, endangered-life indices (ELIs) were used for statistical data with regard to people who experience electric shocks. The following ELI values were used: the annual number of people who receive electric shocks (N_p), the annual number of people injured by electric shocks (N_{pi}), and the annual number of people electrocuted (N_{pe}). The ELI rates and r_c values from 1985 to 2005 are shown in Figure 6. As r_c increased, all ELIs decreased annually from 1995 to 2005 as more CC lines were incorporated into the distribution system.

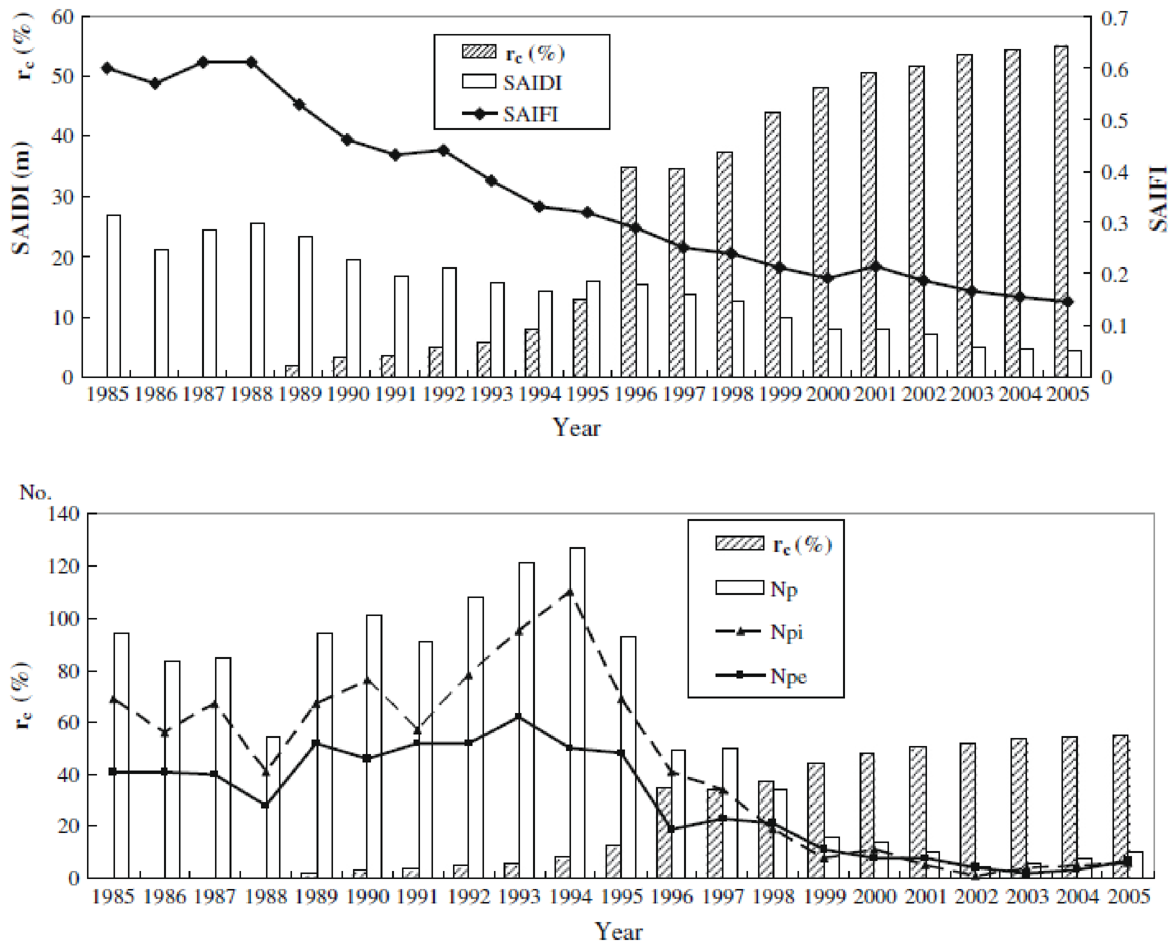

Figure 6. (Top) Taiwan Power Company results from 1985 to 2005 for the ratio of covered line length using XLPE weatherproof wire in a distribution system to the total line length of the system (r_c), system average interruption frequency index (SAIFI), and the system average interruption duration index (SAIDI). (Bottom) Taiwan Power Company results from 1985 to 2005 r_c and endangered-life indices (ELIs). The following ELI values are shown: annual number of people who receive electric shocks (N_p), annual number of people injured by electric shocks (N_{pi}), and annual number of people electrocuted (N_{pe}). Image from [Li 2010].

Australia

CCs have been used in Australia for more than 50 years, primarily motivated by wildfire risk reduction. Early CCs had limited lifetimes due to surface degradation, tracking, radio frequency (RF) emissions, and lightning damage [Wareing 2005]. In the mid-2000s, the Australian Strategic Technology Program determined that technological advancements may help solve historical issues with CCs to allow for their widespread adoption. After the Black Saturday bushfires, the Victorian Bushfires Royal Commission (VBRC) recommended the existing power lines be replaced with aerial bundled cables or other technology that reduced the risk of bushfires. The VBRC estimated a 90% reduction in the likelihood of a bushfire starting by installing CCs [SCE 2019]. Additionally, a study by the Commonwealth Scientific and Industrial Research Organization (CSIRO) found that a 98% reduction in the risk of bush fires due to CCs could be expected [SCE 2019, Electrical Connection 2021]. Although it is unclear how these specific metrics were determined, this shows high confidence by the VBRC and the CSIRO in the effectiveness of CC for wildfire mitigation.

Malaysia

The Tengag Nasional Berhad (TNB) distribution network in Malaysia includes 5,300 km of 33 kV, 22 kV, and 11 kV medium-voltage bare overhead conductor lines and 2,700 km of 33 kV and 11 kV medium-voltage aerial-bundled cables (ABC) lines [Ariffin 2012]. Malaysia has reliability challenges caused by above-average lightning activity, small-animal damage, and vegetation damage, which motivated the use of CCs to improve reliability. TNB started installing medium-voltage ABC lines in the 1990s. Early versions of ABCs had inferior fault rates and failed to deliver on the expected benefits. A redesign was undertaken to change from the single-layer copper screen with HDPE outer sheath to a double-layer copper screen. Additionally, improved construction standards were followed, and compatible accessories were used that resulted in improved performance.

TNB found that the medium-voltage bare conductor lines had a higher number of recorded failures compared with medium-voltage ABC lines from 2001 to 2007. The newly designed medium-voltage ABCs had a failure rate five times lower than that of the original medium-voltage ABCs used in the Malaysian system. In this study, a specific definition for the word “failure” was not provided.

Brazil

CEMIG, one of the four biggest power companies in Brazil, adopted spacer cables in urban areas starting in 1998 to improve reliability [Rocha 2000]. CEMIG's annual work plan was to rebuild the urban distribution system by building 1,400 km of medium-voltage lines and 2,800 km of low-voltage lines using spacer cables. CEMIG completed periodic field inspections during the first nine years of energizing the initial pilot lines. The following observations were made during the field inspections:

- Outages due to atmospheric discharges were observed where the cables had been peeled to create a metallic tie. Changes were made to how ties, polymeric rings, and polymeric anchoring clamps were installed, which resulted in improved performance.
- In areas with permanent tree contact, no signs of electrical tracking were observed.
- Minimal outages were observed in areas with vandalism (insulator breakage) and pole collisions. No outages were recorded on spacer cable lines with vandalism incidents, whereas four to five outages occurred on bare cable lines.
- Outages caused by material failures were practically eliminated.

Overall, CEMIG found a 33% reduction in the average duration and frequency of outages per customer due to the expansion of spacer cable lines [Nishimura 2001].

Failure Modes and Effectiveness

Failure Modes

A high-level failure mode identification workshop was conducted to identify operative failure modes relevant to overhead distribution systems for both bare conductors and CCs. The list of failure modes was developed during a day-long workshop with technical subject matter experts representing Exponent, PG&E, SCE, SDG&E, PacifiCorp, Liberty, and Bear Valley Electric Service. This exercise leveraged the technical knowledge from the seven different organizations and the combined experience and shared operator experiences from the six utilities. This workshop was not a full risk assessment, as other factors such as severity / consequence of an event, likelihood, and ability to detect each failure mode were outside the scope of this exercise.

The output of the failure mode workshop was a list of failure modes applicable to bare conductors and/or CCs and is presented in Table 1. The failure modes are organized into three descriptive categories: external events, human factors, and operations/maintenance. Each line item is further differentiated by the operative hazard within each category. External events primarily include hazards related to weather, vegetation, or fire. Human factors include human-induced hazards such as vehicle/equipment contact, gunshots, and Mylar balloons. The operations/maintenance category encompasses hazards related to the design, installation, and maintenance of overhead distribution lines. Within each hazard, specific scenarios that can result in failure are listed. For example, a phase-to-phase fault (failure mode) resulting from a Mylar balloon (hazard) is differentiated from a phase-to-phase fault (failure mode) resulting from a fallen tree branch (hazard). Failure modes that apply to bare conductors but are largely mitigated by using CCs are marked with a green checkmark.

Table 1. List of failure modes for bare and covered conductors.

Category	Hazard	Scenario	Bare	Covered	#	Failure Mode
External Events	Fire	External fire (wildfire)		X	1	Potential damage to sheath, reducing effectiveness
				X	2	Potential flammability of CC sheath
			X	X	3	Annealing of metal conductor due to fire exposure
External Events	Extreme heat	Extreme temperatures cause sag and clearance issues	X	✓	4	Phase-to-phase or phase-to-ground fault
External Events	UV exposure / solar exposure	Aging / exposure of conductor covering		X	5	Embrittlement and/or cracking of conductor covering
External Events	Sheath contamination	Moisture / salt contamination		X	6	Tracking/insulation failure due to moisture/salt (corona)
		Smoke during fire		X	7	Tracking/insulation failure due to smoke/ash
External Events	Ice/snow	Mechanical loading / stress on conductors	X	X	8	Excessive mechanical loading leading to conductor failure/wire down
		Unloading / dynamic shedding of ice	X	X	9	Dynamic forces leading to conductor failure and wire down
		Combined wind/ice	X	X	10	Galloping (see wind hazard)
External Events	Lightning	Atmospheric lightning	X*	X	11	Arc damage / melting of conductor, possible wire down. Short circuit duty exceeds conductor damage curve.
External Events	Animal	Animal contact		X	12	Phase-to-phase fault due to animal-damaged sheath (chewing)
				X	13	Bird dropping degradation of polymer sheath
			X	✓	14	Large bird contact of multiple conductors (phase-to-phase)

Category	Hazard	Scenario	Bare	Covered	#	Failure Mode
External Events	Moisture	Moisture/salt/ oceanic exposure	X	✓	15	Atmospheric corrosion of span leading to decreased mechanical strength or increased electrical resistance
			X	X	16	Atmospheric corrosion near hardware/dead-end leading to decreased mechanical strength or increased electrical resistance
				X	17	Freeze/thaw cycles leading to sheath damage
			X	X	18	Lack of corrosion inhibitors (on splices) leading to corrosion
				X	19	Migration of water within the sheath layer
			X	✓	20	Stress corrosion cracking of span
			X	X	21	Stress corrosion cracking near hardware/dead-end
External Events	Wind	Winds (within the natural frequency of structure)	X	X	22	Aeolian vibration-induced fatigue cracking
			X	X	23	Mechanical overload of tie wire during galloping (ice/ or lashing of spacer /messenger wires)
			X	X	24	Swinging leading to wear
			X	X	25	Vortex shedding impact / contact of adjacent conductors leading to fatigue of downstream conductors
			X	✓	26	Line slapping (intermittent conductor contact)
		Transmission / distribution line contact	X	✓	27	Differential wind-driven blowout leading to contact of distribution / transmission lines
		Pole damage		X	28	Damage due to potential for increased loading when new covered conductors replace existing bare conductors on the same poles / crossarms / guys

Category	Hazard	Scenario	Bare	Covered	#	Failure Mode
External Events	Tree damage	Tree falls, breaks conductor	X	✓	29	Conductor failure / wire down resulting in loss of service, potential for ignition (along the entire length of bare conductor or exposed section of CC)
			X	X	30	Live conductor down with no outage
		Tree branch bridges various lines (conductors do not break)	X	✓	31	Phase-to-phase fault, potential ignition
			X	X	32	Delayed fault due to long-term contact (dielectric breakdown / reduction in dielectric strength), potential phase-to-phase fault
				X	33	Abrasion of sheath
				X	34	Cracking of CC sheath
				X	35	Heating damage to sheath
				X	36	Corrosion of conductor due to compromised sheath
		Tree falls and pulls entire system to ground	X	X	37	Surrounding structure fails (broken conductor)
			X	X	38	Surrounding structure fails (conductor intact)
Human Factors	Public/worker impact	Agricultural equipment / third-party workers / under-build workers (cable/telephone)	X	✓	39	Potential for shock or electrocution
		Vehicle impact to pole / guy wire	X	✓	40	Potential for guy wire whip to create contact to conductor
			X	✓	41	Phase-to-phase contact
			X	✓	42	Phase-to-ground contact
		Gunshots	X	X	43	Conductor damage

Category	Hazard	Scenario	Bare	Covered	#	Failure Mode
Human Factors	Third-party damage	Tarps under high wind conditions	X	✓	44	Phase-to-phase contact
		Balloons	X	✓	45	Phase-to-phase contact
		Kites	X	✓	46	Phase-to-phase contact
		Palm fronds	X	✓	47	Phase-to-phase contact
Operations & Maintenance	Maintenance / Installation	Conductor damage due to incorrect hardware tool or incorrect stripping		X	48	Mechanical damage to sheath (dent/gouge)
		Poor splicing or poor connection	X	X	49	Poor contact leading to localized heating and connection failure
		Over-tensioning	X	X	50	Incorrect tensioning leading to conductor failure (due to vibration, increased stress)
		Under-tensioning	X	X	51	Increased sway leading to wear
			X	✓	52	Clearance issues due to increased sway
		Excessive angles	X	X	53	Insulator breaks off due to mechanical overload (for excessive angles). Conductor may break off or float, contacting pole.
		Broken tie wires	X	X	54	Poorly installed tie wires could break, leading to conductors separating from insulators and contacting pole.
		Improper installation	X	X	55	Bird caging—conductor strands separate

* Direct lightning strikes resulting in concentrated heating of the bare conductor and a wire down event are relatively infrequent.

Effectiveness of Covered Conductors

Failure Mode Discussion

In total, 58 unique failure mode / hazard scenario combinations were identified through the failure mode workshop. These failure modes can be categorized into three basic types:

1. Failure modes that affect both bare *and* CCs.

   Example: Aeolian vibration-induced fatigue cracking of the metal conductor (Table 1, No. 23).
2. Failure modes that affect bare conductors but are reduced or effectively eliminated by CCs.

   Example: Phase-to-phase fault due to tree branch bridging conductor phases (Table 1, No. 32).
3. Failure modes that are unique to CCs that do *not* affect bare conductors.

   Example: Lightning-induced melting of conductor sheath (Table 1, No. 12).

Failure modes that apply to bare and covered conductors

Failure modes that apply to both bare and covered conductors are well known due to historic use of bare conductors and are generally expected to be effectively managed through existing mitigations and controls. However, there are instances in which these failure modes may be *more* prevalent with CCs than with bare conductors. For instance, some wind-related phenomena such as Aeolian vibration may, in certain circumstances, be exacerbated with CCs due to their smooth surface, increased weight, and larger overall diameter [Leskinen 2004]. For similar reasons, CCs may also be more prone to ice loading than bare conductors. Ice loading may result in mechanical overload of the conductor, or increased susceptibility to galloping. A full list of failure modes that apply to both bare and covered conductors derived from the failure mode workshop is given in Table 2.

Table 2. Failure modes that affect both bare and covered conductors.

Hazard	#	Failure Mode	**Potential** risk relative to bare
Fire	3	Annealing of metal conductor due to fire exposure	Reduced
Ice/snow	8	Excessive mechanical loading leading to conductor failure / wire down	Increased
	9	Dynamic forces (ice shedding) leading to conductor failure and wire down	Needs study
	10	Galloping damage (see wind scenario)	Needs study
Lightning	11	Arc damage / melting of conductor, possible wire down	Increased
Moisture	16	Atmospheric corrosion near hardware/dead-end leading to decreased mechanical strength or increased electrical resistance	Comparable
	18	Lack of corrosion inhibitors (on splices) leading to corrosion	Comparable
	21	Stress corrosion cracking near hardware/dead-end	Comparable
Wind	22	Aeolian vibration induced fatigue cracking	Needs study
	23	Mechanical overload of tie wire during galloping (ice/ or lashing of spacer /messenger wires)	Needs study
	24	Swinging leading to wear	Increased
	25	Vortex shedding impact / contact of adjacent conductors leading to fatigue of downstream conductors	Needs study
Tree damage	30	Live conductor down with no outage	Increased
	32	Delayed fault due to long-term contact	Reduced
	37	Surrounding structure fails (broken conductor)	Needs study
	38	Surrounding structure fails (conductor intact)	Needs study
Third-party damage	43	Conductor damage from gunshot	Comparable
Maintenance/ installation	49	Poor contact leading to localized heating and connection failure	Comparable
	50	Incorrect tensioning leading to conductor failure (due to vibration, increased stress)	Comparable
	51	Increased sway leading to increased wear	Needs study
	53	Insulator breaks off due to mechanical overload (for excessive angles). Conductor may break off or float contacting pole.	Comparable
	54	Poorly installed tie wires could break, leading to conductors separating from insulators and contacting pole.	Comparable
	55	Bird caging—conductor strands separate	Comparable

These failure modes that can affect both bare and covered conductors are of particular importance to operators, as risk assessments may need to be updated to reflect the increased likelihood of certain events when switching to CCs. Since no studies were found that directly compared the frequency or severity of these failure modes between covered and bare conductors, the impact on mitigation and maintenance practices has not been quantified.

Despite the dearth of test data on the likelihood and severity of these failure modes for CCs relative to bare conductors, insight can be gained from a first-principles analysis of these failure modes. For example, the vulnerability to fatigue from Aeolian vibration is expected to be different for CCs for several reasons. The Aeolian vortex shedding frequency is inversely proportional to transverse wind speed, and therefore the shedding frequency will be lower for CCs because of the increase in conductor diameter due to the insulation. However, this lower cycle count could be offset by differences in the wind power input of self-damping, which define the vibration amplitude. In addition, Aeolian fatigue failure typically manifests at attachments (clamps), and it is not known whether typical CC connectors are more susceptible to the strain concentrations that lead to failure. Similarly, ice gravity loading and dynamic loads from ice and snow shedding can be expected to differ due to different conductor diameter, surface roughness, weight, and surface temperature. Additional analysis is required to better understand these failure modes.

Failure modes mitigated by covered conductors

The next group of failure modes are those that are largely mitigated by the use of covered conductors. These failure modes are the primary drivers for adoption of CCs, as they represent the risk reduction potential compared to traditional bare conductors. A total of 17 failure modes largely mitigated through the use of CC were identified through the workshop exercise, and are marked with a green checkmark in Table 1. The common theme among these failure modes is that they are created through contact with third-party objects, vegetation, or other conductors that create phase-to-ground or phase-to-phase faults. The available literature, industry testing, and field experiences from utilities around the world suggest that modern CCs can prevent arcing in the medium-voltage range over short time scales, thereby increasing system reliability and public safety, and reducing the potential for wildfire ignition. A full list of failure modes addressed by CCs derived from the failure mode workshop is given in Table 3.

Table 3. Failure modes that affect bare conductors but are largely mitigated by covered conductors.

Hazard	#	Failure Mode
Extreme heat	4	Fault due to sag/clearance issues
Animal	14	Large bird contact of multiple conductors (phase-to-phase contact)
Moisture	15	Atmospheric corrosion of span leading to decreased mechanical strength or increased electrical resistance
	20	Stress corrosion cracking of span
Wind	26	Line slapping (intermittent conductor contact)
	27	Differential wind driven blowout leading to contact of distribution / transmission lines
Tree damage	29	Conductor failure/wire down resulting in loss of service, potential for ignition (along the entire length of bare conductor or exposed section of CC)
	31	Phase-to-phase fault. Potential ignition.
Public/worker impact	39	Potential for shock or electrocution
	40	Potential for guy wire whip to create contact to conductor
	41	Phase-to-phase contact (vehicle)
	42	Phase-to-ground contact (vehicle)
Third-party damage	44	Phase-to-phase contact (tarp)
	45	Phase-to-phase contact (balloon)
	46	Phase-to-phase contact (kite)
	47	Phase-to-phase contact (palm frond)
Maintenance/ Installation	52	Clearance issues due to increased sway

As stated above, these failure modes generally consist of arcing between phases or objects. The primary and secondary effects of these failure modes have implications for system reliability, public safety, and wildfire prevention. For example, arcing between phases due to conductor slapping can create sparks, conductor melting, and/or a possible wire-down scenario. This not only creates an outage risk but also creates potential for a wildfire ignition if dry brush exists below the lines. As will be discussed, available literature indicates that CCs prevent arcing during line slap, such that sparks and melting never occur. In another example, windstorms can blow debris and vegetation into the conductors. While this may not result in a wire-down event, it can create arcing between phases, and the vegetation (e.g., palm fronds) can ignite and fall to the ground. CCs prevent arcing when vegetation is blown into the lines and, therefore, ignition cannot occur.

The extent to which existing information supports the effectiveness of CCs to address these failure modes was considered. For example, it is generally accepted that CCs largely eliminate the risk of vegetation-caused phase-to-phase faults. However, the literature and existing data were analyzed to understand the extent to which this has been proved and whether there are situations that have not been studied. Testing performed by SCE found that CCs prevented phase-to-phase and phase-to-ground faults in field tests that simulated common scenarios such as branch contact, Mylar balloon contact, and conductor slapping (simulating sustained contact) when energized at 12 kV [SCE 2019]. This is relevant and useful testing, though similar laboratory studies to further bolster these conclusions were not found in the available literature.

Most of the available literature consists of high-level observations that correlate system reliability and safety metrics to increases in CC line installation [Leskinen 2004, Li 2010, SCE 2019, Electrical Connection 2021, Ariffin 2012, Rocha 2000, Nishimura 2001]. These studies suggest that the purported benefits of CCs are effective. However, the benefits are not attributed to specific failure modes, but rather overall system reliability and safety metrics. Further, the true technical limits, i.e., to what extent, and over what time scale arcing is mitigated, still lack concrete data. Few publicly available studies were found that directly test the arcing characteristics of CCs. While the SCE testing provides systematic fault testing of CCs, one limitation of the testing performed by SCE is that it was focused on short-term incidental contact and did not test long-term effects such as a tree branch growing into conductor spans. Second, while the success of these tests at 12 kV provides useful data for many distribution-level applications, an effective steady-state breakdown voltage (upper limit) at which arcing eventually occurs was not identified.

Failure modes unique to covered conductors

Failure modes unique to CCs primarily involve damage or degradation to the insulating polymer sheath. These may not be addressed by mitigations that currently exist under asset management plans geared toward bare conductor use. Therefore, Exponent recommends to better understand these failure modes through available literature and targeted testing. When addressing CC-specific failure modes, it is important to consider that some failure modes may simply reduce the benefits of the covering (i.e., return to bare conductor risk level) while others may create a situation that has a unique and independent risk profile relative to a typical bare conductor installation. These factors will be the focus of the Covered Conductor Risks section below. As will be shown later in the report, some of these failure modes have been largely addressed by advances in technology (e.g., UV stabilizers that reduce embrittlement of conductor covering) or are unlikely to occur (e.g., animal chewing the same spot on two adjacent phases). A full list of the CC-specific failure modes derived from the failure mode workshop is given in Table 4.

Table 4. Failure modes that affect *only* covered conductors.

Hazard	#	Failure Mode
Fire	1	Potential damage to sheath, reducing effectiveness
	2	Potential flammability of CC sheath
UV exposure / solar exposure	5	Embrittlement and/or cracking of conductor covering
Contamination	6	Tracking/insulation failure due to moisture/salt (corona)
	7	Tracking/insulation failure due to smoke/ash
Animal	12	Phase-to-phase fault due to animal-damaged sheath (chewing)
	13	Bird dropping degradation of polymer sheath
Ice/snow	17	Freeze/thaw cycles leading to sheath damage
	19	Migration of water within the sheath layer
Wind	28	Damage due to potential for increased loading when new covered conductors replace existing bare conductors on the same poles / crossarms / guys
Tree damage	33	Abrasion of sheath
	34	Cracking of CC sheaths
	35	Heating damage to sheath
	36	Corrosion of conductor due to compromised sheath

Hazard	#	Failure Mode
Maintenance / installation	48	Mechanical damage to sheath (dent/gouge)

Few published studies were found that analyze specific CC-specific failure modes. However, some data have been obtained from CC manufacturers that assists in understanding the limitations of the technology. Hendrix Wire & Cable has performed several tests on the properties and durability of its CC products. These tests include tracking resistance, ultraviolet (UV) resistance, environmental stress cracking, hot creep tests, and performance of CCs in high-contamination environments [Hendrix 2019, Trager 2006]. These test results suggest that modern CC sheathing is resistant to many forms of environmental degradation. However, since these tests were designed to isolate individual variables in a controlled environment, they do not account for all possible variables in a real-world scenario. The failure modes addressed by the Hendrix testing are likely to reduce the effectiveness of covered conductors but, in most circumstances, would not result in a new, higher-risk profile.

Another consideration that is not represented in the failure mode table is the possibility of undetected wire-down events. The CC sheath provides protection from immediate phase-to-ground faults, and therefore may not trigger fault detection systems. This may lead to high-impedance faults and delay necessary field repairs. Downed bare conductors can also result in high-impedance faults, but the situation will be different for CCs since there will be reduced conductor contact with the ground. The potential for these high-impedance fault events that evade detection is the subject of current research, and new early fault detection systems are in development. Operators transitioning to covered conductors may benefit from further research into early fault detection solutions [SCE 2019, Kistler 2019]. These CC-specific failure modes will be the focus of the Covered Conductor Risks section below.

The failure modes discussed thus far are important for understanding the benefits and tradeoffs of implementing CC technology. The next sections will focus on three broad categories of system performance: reliability, public safety, and wildfire ignition. These sections are structured as such because of the available literature, much of which is not specific to individual failure modes but is broader in nature. Available knowledge in these areas from field experience and lab testing will be highlighted, as well as any deficiencies that may warrant further study.

System Reliability

Industry experience has demonstrated an improvement in system reliability when using CCs [EPRI 2014, Leskinen 2004, Li 2010, Nishimura 2001, Rocha 2000, Ariffin 2012]. The primary driver of this improvement in reliability was the decreased probability of fault events, which resulted in fewer system outages. Finland saw a steady decrease in recorded faults in rural areas in the years after 1972, which corresponded to an expansion of CC use. Finland also found that the number of automatic reclosing events decreased to one third as the percentage of CC lines increased from 10% to 50% [Leskinen 2004]. A Taiwanese study similarly found that SAIFI was reduced by approximately 75% and SAIDI was reduced by approximately 86% as the percentage of CCs was increased from 0% to ~55% [Li 2010]. The Electric Power Research Institute (EPRI) also stated that CCs have the potential to reduce tree-caused outages by 40% based on an analysis of data from Duke Energy and Xcel Energy [EPRI 2015].

Public Safety

Public safety is a driver of CC adoption in high population density areas. The Taiwan Power Company observed a ~92% decrease in the number of people experiencing an electric shock from overhead powerlines from 1994 to 2005, when CCs became nearly 60% of their total distribution network [Li 2010]. Operators in Japan observed a similar correlation between accidents and CC installation, noting a factor of 50% reduction in accidents per year from 1965 to 1984 after converting their entire 74 km 6.6 kV network to CCs [Kyushu 1997]. The National Electric Energy Testing, Research and Applications Center (NEETRAC) at Georgia Tech performed a study on the touch current characteristics of CCs vs. bare conductors [NEETRAC 2018]. Both laboratory testing and computer simulations were performed to investigate the results of human bare-hand contact on a two-mile 12 kV distribution system. These tests demonstrated that the contact current for bare conductor was as high as 7 amperes (A), while the maximum contact current for CCs was in the micro-ampere (μA) range. The increased protection against electric shock incidents is significant. However, damage to the conductor sheath or intentional stripping at hardware or dead-end connections will predictably negate or reduce these benefits.

Wildfire Ignition

Utilities in dry climates such as Australia and the western United States are subject to increased risk of wildfire ignition from powerline failures. The reduced propensity for arcing events with CCs is a distinct advantage for minimizing this risk. The Powerline Bushfire Safety Program of the Victoria, Australia, government commissioned a study that examined the fire performance of CCs in "wire down" ignition tests [Marxsen 2015]. Both covered and bare conductors were tested in "wire on ground" faults under severe fire risk conditions. The authors concluded that intact CCs effectively mitigate ignition risk, stating that "the leakage current through the outer plastic covering with the conductor lying on the ground is not sufficient to create thermal runaway so it does not create fire risk."

However, tests on damaged CCs, i.e., conductors with existing through-thickness coating loss, found that the probability of ignition for CCs can be higher than with bare conductors due to the concentration of arcing at the damage location. On flat ground with uniform dry grass coverage, the estimated probability of fire ignition for a damaged CC was 67% vs. only 37% for bare conductor [Marxsen 2015]. An important limitation of this test is that it assumes direct contact of the fuel source with the bare portion of the damaged conductor. The probability of fire would likely be much lower in areas with non-uniform vegetation cover or uneven ground, reducing the likelihood that coating holidays or stripped connection points would contact dry brush. Further, the study investigated the effects of through-thickness coating holidays but did not address the potential negative effects of partial coating loss from sources such as abrasion.

Summary of Covered Conductor Effectiveness

The prior sections outline field experience and laboratory studies that suggest a significant risk reduction with CC use. Although not all bare conductor failure modes are addressed by specific laboratory studies in controlled environments, sufficient high-level evidence exists to suggest that selected hazards affecting bare conductor are addressed by CC use. As shown in Table 5, there are six hazards that are largely mitigated by CC use, including animal, moisture, wind, tree/vegetation, public/ worker impact, and third-party damage. However, as discussed in the prior sections, this does not suggest that additional work is not required to address these hazards. In many cases, specific test scenarios may still add value to better understand CC use. Such tests scenarios are discussed in the Recommendations section of this report.

Table 5. Hazards that are largely addressed by use of covered conductors are shown in green.

	Hazard	Potential to Mitigate Failures		
		Bare Conductor	**Covered Conductor**	**Sources**
Primary Hazards	Tree/vegetation		Reduced risk of tree/veg contact-induced fault	Li 2010; Leskinen 2004; Ariffin 2012
	Wind		Reduced risk of phase-to-phase faulting from slapping or blowout	Leskinen 2004
	Third-party damage		Reduced risk of phase-to-phase faults from contact with kites, balloons, palm fronds, etc.	SCE 2019
	Animal		Reduced risk of animal contact-induced fault	Ariffin 2012
	Public/worker impact		Reduced risk of faults from worker contact or vehicle impact	Li 2010
Secondary Hazards	Moisture		Provides environmental protection except near hardware/dead-ends	
	Ice/snow			
	Fire			
	Extreme heat			
	Maintenance/ installation			
	UV exposure	N/A		
	Contamination	N/A		
	Lightning	N/A		

Comparison to Underground Cabling

The above-referenced literature and case studies demonstrate the advantages of CCs relative to bare conductors. The insulating polymer sheath mitigates several failure modes related to phase-to-phase and phase-to-ground faulting such as conductor slapping, animal contact, tree contact, and downed-conductor scenarios. While these benefits are critical to distribution system reliability and safety, there are additional hazards associated with overhead line constructions that cannot be reduced or eliminated by CCs. For example, CCs are exposed to ice/snow loading, contamination from salt, industrial pollutants, wildfire smoke, and conductor burndown from lightning strikes.

The third option typically considered for distribution system hardening is underground cabling. This method of construction has the potential to mitigate the same failure modes as CCs while also mitigating failure modes related to several other hazards, as shown in Table 6. By routing distribution lines underground, the conductors are protected from weather, fire, and other above-ground hazards that affect both bare and covered overhead conductors.

While there are benefits of underground distribution lines, there are also several economic and logistical challenges associated with their implementation. While economic considerations were largely out of scope for this work, a study conducted by SCE found that the cost per mile for undergrounding an existing overhead line ($3 million per mile) is roughly an order of magnitude more expensive than reconductoring with CCs ($430,000 per mile) [SCE 2019]. Underground conversions also may not be possible in all circumstances due to limitations of the terrain and local geology. For example, underground lines may not be practical or possible in mountainous areas or regions with high earthquake risk. Another consideration is the time required for implementation. Underground conversions are time-intensive projects, so a system hardening program based on undergrounding will take more time to realize any tangible benefits to system reliability/safety. Repairs to underground lines are more expensive and time-consuming due to access difficulties. Finally, there are environmental impacts from underground conversion that do not exist for reconductoring of existing infrastructure. These challenges are not reflected in Table 6 but require consideration in any mitigation implementation strategy.

Table 6. Mitigation potential of distribution line constructions.

	Hazard	Potential to Mitigate Failures		
		Bare Conductor	Covered Conductor	Underground
Primary Hazards	Tree/vegetation			
	Wind			
	Third-party damage			
	Animal			
	Public/worker impact			
Secondary Hazards	Moisture			
	Ice/snow			
	Fire			
	Extreme heat			
	Maintenance/installation			
	UV exposure	N/A		
	Contamination	N/A		
	Lightning	N/A		

Covered Conductor Risks

To understand all potential implications of implementing CCs, failure modes unique to CCs were assessed relative to available literature and testing information. The goal of this comparison was to understand the extent to which the identified CC-specific failure modes represent risks to operators that implement CCs. CC-specific failure modes fall into one of two categories: failure modes that may reduce the effectiveness of the insulating sheath, and failure modes that have a unique and independent risk profile relative to bare conductors (i.e., there is a potential for the risk to be higher than for bare conductors). Table 7 presents the potential consequence of the failure mode relative to bare conductors. The consequences for each failure mode were assigned based on whether the CC failure mode, should it occur, would be likely to decrease, increase, or have comparable risk relative to bare conductors, based on literature review and industry best practices. For example, contamination from salt may result in tracking on the surface of the insulation and may significantly reduce the insulating capacity of the sheath. In this scenario, the CC would have reduced effectiveness relative to a new CC but would still not exhibit a risk profile that is comparable or higher than that of a bare conductor. Complete failure of the CC insulation was considered in this analysis. For simplicity, localized (holiday) or partial failure was not considered. A detailed description of the rationale for each status can be found in the body of this section. Table 7 also lists literature sources and recommendations on whether additional testing is recommended for a given failure mode. As shown in Table 7, several effective mitigations were identified in literature for the CC-specific failure modes. However, there are still failure modes without known or proven mitigations that likely require further testing, research, and/or analysis.

Table 7. Risk of covered conductors relative to bare conductors and knowledge gaps.

Hazard	Scenario	Failure Mode	Consequence of Failure	Mitigation Notes	Selected Literature/ Testing	More Investigation Recommended
Fire	External fire	Potential damage to sheath, reducing effectiveness	Reduced effectiveness of CC	No mitigation effective against extreme temps	No testing or field experience found*	Yes
	Wildfire	Potential flammability of CC sheath	Reduced effectiveness of CC	No mitigation effective against extreme temps	SCE 2019	Yes
UV exposure / solar exposure	Aging / exposure of conductor covering	Embrittlement and/or cracking of conductor covering	Reduced effectiveness of CC	UV inhibitors commonly used to prolong polymer lifetime	Hendrix 2010; Ariffin 2012	No
Contamination	Moisture/ salt	Tracking insulation failure due moisture/salt (corona)	Reduced effectiveness of CC	Tracking and erosion issues are documented for 1-, 2-, and 3-layer CC under polluted conditions	Yousuf 2019: Cardoso 2011; Espino-Cortes 2014	No
	Smoke during fire	Tracking/insulation failure due to smoke/ash	Reduced effectiveness of CC	Tracking and erosion issues are documented for 1-, 2-, and 3-layer systems under polluted conditions	Yousuf 2019: Cardoso 2011; Espino-Cortes 2014	No
Animal	Animal contact	Phase-to-phase fault due to animal-damaged sheath (chewing)	Potentially higher consequence than bare	Redesign of coating to include a two-layer copper screen and use non-HDPE as the sheath material**	Ariffin 2012	No

Hazard	Scenario	Failure Mode	Consequence of Failure	Mitigation Notes	Selected Literature/ Testing	More Investigation Recommended
		Bird dropping degradation of polymer sheath	Reduced effectiveness of CC	Washing conductors may be effective to prevent degradation	No testing or field experience found*	Yes
Moisture	Moisture/salt/ oceanic exposure	Freeze/thaw cycles leading to sheath damage if CC is not co-extruded	Reduced effectiveness of CC	No mitigation identified in literature	No testing or field experience found*	Yes
		Migration of water within the sheath layer	Reduced effectiveness of CC	Proper installation hardware and procedures needed	No testing or field experience found*	Yes
Wind	Pole damage	Increased potential for pole damage (due to heavier conductor and larger wind area)	Potentially higher consequence than bare	Proper standards and procedures needed when retrofitting	Leskinen 2004	Yes
Tree damage	Tree falls, breaks conductor	Live conductor down with no outage	Reduced effectiveness of CC	Literature shows fewer ELIs as CC were introduced into system (see Taiwan section)	Li 2010	Yes
	Tree branch bridges various lines (conductors do not break)	Abrasion of sheath	Reduced effectiveness of CC	Literature shows CC reduced outages due to tree contact	Li 2010; Leskinen 2004; Ariffin 2012	Yes
		Cracking of CC sheaths	Reduced effectiveness of CC	Literature shows CC reduced outages due to tree contact	Li 2010; Leskinen 2004; Ariffin 2012	Yes

Hazard	Scenario	Failure Mode	Consequence of Failure	Mitigation Notes	Selected Literature/ Testing	More Investigation Recommended
		Heating damage to sheath following coating damage	Reduced effectiveness of CC	Literature shows CC reduced outages due to tree contact	Li 2010; Leskinen 2004; Ariffin 2012	Yes
		Corrosion of conductor due to compromised sheath	Reduced effectiveness of CC	Literature shows CC reduced outages due to tree contact	Li 2010; Leskinen 2004; Ariffin 2012	Yes
Maintenance / installation	Sheath damage due to incorrect hardware tool or incorrect stripping	Mechanical damage to sheath (dent/gouge)	Potentially higher consequence than bare	Proper standards and procedures needed	Rocha 2000	No

* Based on a thorough literature review. However, sources may exist that were not found through this effort.

** HDPE may be beneficial for other failure modes.

Risk Discussion

In total, 24 failure modes that are unique to CCs were assessed for their risk relative to bare conductors. The failure modes presented in Table 7 were identified through the joint IOU workshop. However, the frequency of these events (as well as consequence) was not within scope for this effort, and, as such, not all failure modes may present measurable risks to operators. Further, only a portion of these failure modes may result in an elevated risk profile relative to bare conductors, whereas others may only reduce the effectiveness of the covering. The following section discusses special cases from Table 7 in more detail.

Two fire-related failure modes were identified, including damage to, and flammability of, the sheath. In a "worst-case" scenario, if the sheath becomes damaged by fire or heat from a nearby fire, only the metallic conductor will remain. In this case, the effectiveness of CCs is greatly reduced, but no elevated risk relative to bare conductor would result. If, however, the sheath was only damaged in a localized area (versus extensive damage across the entire sheath), then a fault event could have the potential to concentrate heat and arcing in the area of the coating damage in a more severe manner than a bare conductor. In this case, a new, unique risk profile may exist beyond a simple reduction in CC effectiveness. In both cases, no mitigation, testing, or field experience was found in the literature reviewed. For this reason, further research, and possibly testing of these failure modes is recommended to determine the effect of sheath damage due to fire.

UV or solar exposure may accelerate the conductor sheath aging by causing embrittlement and/or cracking. Damage to the sheath may reduce the effectiveness of the CC. UV inhibitors are commonly incorporated in the conductor coating to prolong polymer lifetime [Hendrix 2010, Ariffin 2012].

Contamination from moisture/salt and smoke during fires was considered, as tracking could reduce the effectiveness of the insulation. Tracking of single-, dual-, and triple-layer CCs in heavily polluted areas and coastal areas is well documented in literature [Cardoso 2011, Yousuf

2019, Espino-Cortes 2014]. Similar to the fire hazard discussed above, if the insulation or sheath experiences significant tracking, then the CC effectiveness will be reduced.

Lightning may cause arc damage or melting of the CC that results in a down wire. Reports in the literature indicate CCs help to reduce the number of outages due to lightning, though the mechanism for failure prevention is unclear [Ariffin 2012, Leskinen 2004]. However, the presence of the CC insulation may create an increased risk during a lightning strike. For bare conductors during a lightning event, the electrical arc is more easily dissipated across the metallic surface. In the case of CCs, the insulation may concentrate the electrical arc at a single point during a lightning event, which may cause burndown [Lima 2016, Leal 2021]. Pinholes in the CC insulation may also result in a small reduction of the breakdown voltage. Although lightning arrestors help to mitigate this failure mode, additional testing or research could still be helpful in better understanding the effects of lightning strikes on CCs.

Animal chewing on the conductor coating may cause a localized area of damage such that arcing/heating may be concentrated during a fault. Therefore, this type of damage may present an elevated risk profile relative to bare conductors. Literature sources recommend use of a two-layer copper screen and non-HDPE as the sheath material to deter animals from chewing on the conductors. However, using non-HDPE coatings for the sheath material must be weighed against the benefits of using HDPE materials, especially in areas where animal chewing may not pose a significant risk. No further testing is recommended at this point, as this mitigation is well documented in literature [Ariffin 2012].

Moisture may result in sheath damage due to freeze/thaw cycles or water migration. In the case of water migration, sealing the ends of the conductor may help prevent damage. Few literature sources were found that addressed this specific failure mode or potential mitigation strategies. Additional research, analysis, or testing is recommended to address moisture ingress that could change the breakdown voltage potential of CCs.

Wind damage to poles due to the heavier weight of CCs and larger wind sway is potentially an increased risk compared to bare conductors. This risk can be mitigated by using proper standards and procedures, especially when retrofitting CCs onto existing structures. Additional analysis is recommended to understand potential pole damage due to CC weight.

Tree damage may result in multiple failure modes, as shown in Table 7. On a high level, field experience shows that the number of outages caused by tree contact is reduced when CCs are used [Leskinen 2004, Li 2010, Ariffin 2012, Rocha 2000]. CCs likely decrease the risk of tree-related failure modes. However, the literature studies reviewed do not detail the specific failure modes that are mitigated. Additional research and testing may be needed to determine the extent to which CCs reduce the risk of certain failure modes. Testing focused on long-term tree contact and mechanical testing of the polymer sheath is recommended.

Maintenance and installation considerations are different for CCs compared with bare conductors. Due to the CC sheath, care should be taken while installing CCs to minimize damage from incorrect hardware, stripping, or installation. Additionally, the span sag levels must be adjusted due to increased weight of CCs. Specialized training, standards, and procedures must be followed to account for the additional considerations for CC installation and maintenance. These standards and procedures should help minimize the CC risks and make them comparable to those of bare conductors. However, the additional training, standards, and procedures introduce the potential to increase the risk of CCs compared to bare conductors if not properly followed. No further testing is recommended at this time for this hazard, as long as proper procedures and standards are established for maintenance and installation.

Implementation and Design Considerations

In addition to new failure modes and risks that may be introduced by CCs, there also exist several special considerations for effective design and implementation of CC systems.

Hardware specific to CCs is recommended to ensure consistent and safe installation and reduce the risk of damaging the conductor insulation. This hardware may include insulation-piercing connectors (IPCs), spacers, tangent brackets, and messenger cable. If IPCs are not used, manual stripping of conductor insulation is required at hardware connection points. This creates a risk for local arcing/faults as well as the potential for conductor sheath damage and environmental ingress if not properly executed.

Replacement of bare conductors with equivalent CCs can potentially cause increased sag and can overload the poles, crossarms, or guys because they can increase both gravity and wind loads. The capacity of existing structures needs to be checked before reconductoring is considered. The span length for new lines is typically shorter than bare conductors due to the heavier weight of CCs. However, this can be overcome if a larger messenger wire with greater ultimate tensile strength is used [Cardoso 2011]. Span lengths of 40 meters are common for distribution systems but can be increased up to 400 meters with proper installation [Cardoso 2011].

Installation and maintenance procedures are necessary for CCs due to the special requirements listed above. Proper handling of CCs and considerations when retrofitting CCs onto existing infrastructure is needed. This includes but is not limited to minimizing the amount of coating stripped or removed, covering any exposed conductor, increasing line sag to account for the additional CC weight, and installing proper accessories for lighting arrestors, dead-end covers, composite poles, and crossarms [EPRI 2009 Crudele]. This requires additional personnel training to address unique aspects of CC care, special equipment requirements, and handling during installation and maintenance.

Recommendations

1. Line Tension Study

Several failure modes that affect both bare and covered conductors have the potential to be exacerbated with CCs relative to bare conductors. These are primarily related to the physical differences between the conductors such as diameter, weight, and surface characteristics, leading to potential differences in susceptibility to Aeolian vibrations, galloping, line sway, mechanical overload due to ice accretion, and others (Table 2). Therefore, a thorough understanding of these differences from an analytical perspective is recommended. Specifically, a study investigating the most appropriate line tension considering the size and weight of covered conductor is recommended, which would aid in mitigation of the identified failure modes.

2. Additional Arc Testing

The available literature was found to be promising and suggests that many of the identified failure modes are largely addressed by use of CCs. However, a few key scenarios have yet to be addressed. Further arc testing is recommended to investigate the effects of long-term contact with vegetation, ground, or other objects to better understand delayed high-impedance fault behavior. The effects of wet vs. dry conditions on arcing behavior also warrants further investigation.

3. Covered Conductor–Specific Failure Mode Testing

An understanding of CC-specific failure modes is critical to effective asset management. While implementing CCs will mitigate some risks associated with bare conductor use, there are new failure modes introduced through the use of CCs. The available literature focuses on the benefits of CCs and is relatively lacking with respect to these failure modes. Further research (and potentially testing) is recommended to better understand the following phenomena:

a. Sheath damage and flammability due to nearby fire
b. Tracking due to contamination from salt or smoke
c. Moisture ingress
d. CC sway behavior and the potential for pole damage

4. Early Fault Detection Research

Due to the insulation provided by CCs, a fallen intact conductor may be difficult to quickly detect with existing fault protection systems. Early fault detection schemes are a subject of current research, and additional investigation of this technology is recommended.

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Limitations

At the request of PG&E, SCE, and SDG&E, Exponent has conducted an investigation into the effectiveness of covered conductors for overhead distribution system hardening. Exponent investigated specific issues relevant to this technology, as requested by PG&E, SCE, and SDG&E. The scope of services performed during this investigation may not adequately address the needs of other users of this report, and any reuse of this report or its findings, conclusions, or recommendations presented herein is at the sole risk of the user. The opinions and comments formulated during this assessment are based on observations and information available at the time of the investigation. No guarantee or warranty as to future life or performance of any reviewed condition is expressed or implied.

The findings presented herein are made to a reasonable degree of engineering certainty. We have made every effort to accurately and completely investigate all areas of concern identified during our investigation. Exponent may supplement this report should new data become available.

9.9 DATA TABLES (1-12)

Utility	Southern California Edison Company
Table No.	1
Date Modified	2/18/2022

Notes:
Transmission lines refer to all lines at or above 65kV, and distribution lines refer to all lines below 65kV.

Note: These columns are placeholders for future QR submissions.

Table 1: Recent performance on progress metrics

Metric type	#	Progress metric name	2015	2016	2017	2018	2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021	Q1 2022	Q2 2022	Q3 2022	Q4 2022	Unit(s)	Comments
1. Grid condition findings from inspection - Distribution lines in HFTD	1.a.	Number of circuit miles inspected from patrol inspections in HFTD - Distribution lines	9,718	9,723	9,724	9,729	9,730	1,594	6,934	1,235	235	3,707	5,895	955	1					# circuit miles	SCE tracks completed inspections by tracking the counts of assets inspected instead of tracking by circuit miles. In order to present completed inspections in the requested format, SCE used a calculated average span length multiplied by the number of structures inspected.
	1.b.	Number of circuit miles inspected from detailed inspections in HFTD - Distribution lines	1,869	2,324	1,984	2,425	14,349	4,137	4,537	4,232	3,495	3,831	5,471	2,762	97					# circuit miles	This row is the sum of the four detailed inspection programs found in the submetrics at the bottom of this table. 2021 year-end data is going through final quality assurance review and if any changes are needed, they will be updated in the next quarterly submission.
	1.c.	Number of circuit miles inspected from other inspections (list types of "other" inspections in comments) in HFTD - Distribution lines	NA	NA	NA	12,605	5,663	1,382	1,382	1,382	1,382	2,548	2,183	258	339					# circuit miles	This row is the sum of the two programs below that are considered as "other" and found in the submetrics at the bottom of this table
	1.d.	Level 1 findings in HFTD for patrol inspections - Distribution lines	0	0	3	1	17	0	18	0	1	5	3	0	0					# findings	
	1.e.	Level 1 findings in HFTD for detailed inspections - Distribution lines	2,167	3,152	3,111	2,827	4,147	792	717	710	735	772	647	577	689					# findings	
	1.f.	Level 1 findings in HFTD for other inspections (list types of "other" inspections in comments) - Distribution lines	246	770	326	168	616	90	115	306	261	87	53	41	56					# findings	
	1.g.	Level 2 findings in HFTD for patrol inspections - Distribution lines	6,348	5,106	3,753	3,704	6,491	1,024	1,470	1,222	1,054	1,517	994	853	636					# findings	
	1.h.	Level 2 findings in HFTD for detailed inspections - Distribution lines	7,541	8,113	6,281	16,458	58,595	10,006	9,073	5,645	3,774	8,965	13,959	4,375	1,197					# findings	
	1.i.	Level 2 findings in HFTD for other inspections (list types of "other" inspections in comments) - Distribution lines	4,432	4,145	3,798	3,507	18,212	1,448	1,744	530	1,866	1,169	665	592	803					# findings	
	1.j.	Level 3 findings in HFTD for patrol inspections - Distribution lines	40	10	29	51	227	119	6	0	2	26	90	28	0					# findings	
	1.k.	Level 3 findings in HFTD for detailed inspections - Distribution lines	14,086	17,813	12,548	12,865	31,820	8,767	9,240	7,008	804	13,857	8,949	1,913	555					# findings	
	1.l.	Level 3 findings in HFTD for other inspections (list types of "other" inspections in comments) - Distribution lines	241	124	186	878	77,369	1,263	1,134	3,135	297	472	319	128	196					# findings	
1. Grid condition findings from inspection - Distribution lines total	1.a.ii.	Number of total circuit miles inspected from patrol inspections - Distribution lines	40,194	40,199	40,198	40,206	40,207	3,045	24,160	10,753	2,719	5,417	14,645	16,238	4,318					# circuit miles	SCE tracks completed inspections by tracking the counts of assets inspected instead of tracking by circuit miles. In order to present completed inspections in the requested format, SCE used a calculated average span length multiplied by the number of structures inspected.
	1.b.ii.	Number of total circuit miles inspected from detailed inspections - Distribution lines	7,950	8,034	7,865	9,069	24,059	4,477	5,540	5,938	6,604	4,328	6,673	5,118	2,379					# circuit miles	This row is the sum of the four detailed inspection programs found in the submetrics at the bottom of this table.
	1.c.ii.	Number of total circuit miles inspected from other inspections (list types of "other" inspections in comments) - Distribution lines	4,320	4,509	4,093	29,902	8,887	2,106	2,106	2,106	2,106	3,458	2,986	1,092	876					# circuit miles	This row is the sum of the two programs below that are considered as "other" and found in the submetrics at the bottom of this table
	1.d.ii.	Level 1 findings for patrol inspections - Distribution lines	2	2	4	5	25	1	76	0	19	15	11	1	0					# findings	
	1.e.ii.	Level 1 findings for detailed inspections - Distribution lines	17,777	19,676	21,787	19,493	21,964	4,446	4,954	6,345	5,036	4,882	4,617	4,897	5,203					# findings	
	1.f.ii.	Level 1 findings for other inspections (list types of "other" inspections in comments) - Distribution lines	1,779	2,684	1,806	1,501	2,039	405	556	637	569	370	317	264	299					# findings	
	1.g.ii.	Level 2 findings for patrol inspections - Distribution lines	26,390	17,642	15,534	15,147	18,308	4,321	4,328	4,799	3,642	4,542	4,452	3,376	2,764					# findings	
	1.h.ii.	Level 2 findings for detailed inspections - Distribution lines	51,260	48,850	42,281	55,981	105,785	15,259	16,569	15,534	17,033	13,509	25,967	27,300	29,830					# findings	
	1.i.ii.	Level 2 findings for other inspections (list types of "other" inspections in comments) - Distribution lines	14,748	13,519	11,997	11,990	25,280	3,645	3,718	2,004	3,945	3,278	2,106	1,874	2,045					# findings	
	1.j.ii.	Level 3 findings for patrol inspections - Distribution lines	326	57	112	80	520	126	10	5	17	26	94	33	0					# findings	
	1.k.ii.	Level 3 findings for detailed inspections - Distribution lines	83,586	73,546	62,968	69,597	96,715	12,364	17,489	19,045	20,134	17,607	18,746	20,337	19,598					# findings	
	1.l.ii.	Level 3 findings for other inspections (list types of "other" inspections in comments) - Distribution lines	1,091	697	936	2,616	90,914	1,546	1,524	4,761	595	660	382	637	221					# findings	
1. Grid condition findings from inspection - Transmission lines in HFTD	1.a.iii.	Number of circuit miles inspected from patrol inspections in HFTD - Transmission lines	4,438	4,438	4,438	4,438	4,438	1,109	1,109	1,109	1,109	456	1,090	1,246	879					# circuit miles	SCE tracks completed inspections by tracking the counts of assets inspected instead of tracking by circuit miles. In order to present completed inspections in the requested format, SCE used a calculated average span length multiplied by the number of structures inspected.
	1.b.iii.	Number of circuit miles inspected from detailed inspections in HFTD - Transmission lines	NA	NA	NA	1,479	11,057	2,077	3,887	1,642	1,630	1,434	3,272	1,588	452					# circuit miles	This row is the sum of the three detailed inspection programs and found in the submetrics section at the bottom of this table.
	1.c.iii.	Number of circuit miles inspected from other inspections (list types of "other" inspections in comments) in HFTD - Transmission lines	NA	NA	NA	103	5,003	284	284	284	284	43	121	406	658					# circuit miles	This row is the sum of the two programs below that are considered as "other" and found in the submetrics at the bottom of this table
	1.d.iii.	Level 1 findings in HFTD for patrol inspections - Transmission lines	49	81	41	31	70	11	6	15	25	12	17	22	6					# findings	
	1.e.iii.	Level 1 findings in HFTD for detailed inspections - Transmission lines	0	0	0	1	37	7	15	39	38	18	42	23	1					# findings	
	1.f.iii.	Level 1 findings in HFTD for other inspections (list types of "other" inspections in	0	0	0	0	6	0	0	0	0	0	0	1	14					# findings	
	1.g.iii.	Level 2 findings in HFTD for patrol inspections - Transmission lines	693	823	851	892	933	497	1,971	533	141	339	744	544	148					# findings	
	1.h.iii.	Level 2 findings in HFTD for detailed inspections - Transmission lines	15	62	134	346	14,199	1,331	4,832	1,529	911	520	1,406	369	31					# findings	
	1.i.iii.	Level 2 findings in HFTD for other inspections (list types of "other" inspections in	277	127	393	413	433	16	47	45	79	21	34	29	89					# findings	
	1.j.iii.	Level 3 findings in HFTD for patrol inspections - Transmission lines	908	681	690	261	515	136	387	176	49	613	265	166	40					# findings	
	1.k.iii.	Level 3 findings in HFTD for detailed inspections - Transmission lines	6	41	5	93	2,020	44	399	505	218	203	549	83	2					# findings	
	1.l.iii.	Level 3 findings in HFTD for other inspections (list types of "other" inspections in	0	0	0	0	41	5	1	2	4	0	1	2	0					# findings	
1. Grid condition findings from inspection - Transmission lines total	1.a.iv.	Number of total circuit miles inspected from patrol inspections - Transmission lines	13,068	13,068	13,068	13,068	13,068	3,267	3,267	3,267	3,267	1,757	2,202	2,836	2,502					# circuit miles	For 2015-2017, patrol inspections doubled as detailed inspections being completed on every transmission asset in the service territory. Beginning in 2018, the recorded inspection

	1.b.iv.	Number of total circuit miles inspected from detailed inspections - Transmission lines	NA	NA	NA	4,210	10,818	2,447	4,749	2,545	2,287	1,957	3,939	1,955	897	# circuit miles	This row is the sum of the three detailed inspection found in the submetrics section at the bottom of this table.
	1.c.iv.	Number of total circuit miles inspected from other inspections (list types of "other" inspections in comments) - Transmission lines	6,460	4,592	6,226	7,309	5,529	1,637	1,637	1,637	1,637	267	2,066	562	767	# circuit miles	This row is the sum of the two programs below that are considered as "other" and found in the submetrics at the bottom of this table
	1.d.iv.	Level 1 findings for patrol inspections - Transmission lines	241	252	211	178	235	50	33	64	61	49	66	49	14	# findings	
	1.e.iv.	Level 1 findings for detailed inspections - Transmission lines	0	1	0	1	59	8	18	43	47	19	42	24	1	# findings	
	1.f.iv.	Level 1 findings for other inspections (list types of "other" inspections in comments) -	1	2	2	1	11	0	0	1	0	0	0	1	63	# findings	
	1.g.iv.	Level 2 findings for patrol inspections - Transmission lines	3,897	4,555	5,259	5,118	4,359	1,712	2,956	1,177	797	1,521	1,567	1,165	652	# findings	
	1.h.iv.	Level 2 findings for detailed inspections - Transmission lines	33	87	165	767	17,570	1,430	4,936	1,586	1,005	535	1,415	378	42	# findings	
	1.i.iv.	Level 2 findings for other inspections (list types of "other" inspections in comments) -	1,424	577	987	1,133	958	101	135	232	360	124	90	129	181	# findings	
	1.j.iv.	Level 3 findings for patrol inspections - Transmission lines	7,009	3,299	3,059	1,600	2,717	732	836	479	378	842	520	305	362	# findings	
	1.k.iv.	Level 3 findings for detailed inspections - Transmission lines	9	44	6	100	2,281	47	403	523	241	206	551	87	2	# findings	
	1.l.iv.	Level 3 findings for other inspections (list types of "other" inspections in comments) -	1	2	4	3	71	5	2	2	4	0	1	2	0	# findings	
2. Vegetation clearance findings from inspection - total	2.a.i	Number of spans insepcted where at least some vegetation was found in non-compliant condition - total	NA	NA	NA	NA	2,645	132	568	1,511	924	403	444	550	389	# of spans inspected with noncompliant clearance	Prior to July 2019, SCE's work management system did not track the reason why a tree was trimmed, just that trimming was
	2.a.ii	Number of spans insepcted for vegetation compliance - total	NA	NA	NA	NA	130,934	37,783	58,595	69,975	73,341	67,137	60,876	75,316	48,662	# of spans inspected for	SCE tracks completed vegetation compliance inspections by
2. Vegetation clearance findings from inspection - in HFTD	2.b.i	Number of spans insepcted where at least some vegetation was found in non-compliant condition in HFTD	NA	NA	NA	NA	1,446	88	368	835	659	282	324	343	256	# of spans inspected with noncompliant clearance	SCE tracks findings by count and does not record specific data that associate the findings to a specific span. Therefore SCE is
	2.b.ii	Number of spans insepcted for vegetation compliance in HFTD	NA	NA	NA	NA	69,496	24,536	35,702	35,104	49,555	41,422	39,056	41,354	26,145	# of spans inspected for	SCE tracks completed vegetation compliance inspections by
3. Community outreach metrics	3.a.	# Customers in an evacuation zone for utility-ignited wildfire	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	# customers (if customer was in an evacuation zone	SCE has no jurisdiction over evacuation orders. SCE diligently requested and followed up with local governments and law
	3.b.	# Customers notified of evacuation orders	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	# customers (count customer multiple times	SCE has no jurisdiction over evacuation orders. SCE diligently requested and followed up with local governments and law
	3.c.	% of customers notified of evacuation in evacuation zone of a utility-ignited wildfire	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Percentage of customers	SCE has no jurisdiction over evacuation orders. SCE diligently

Table 1 Sub Metrics:

1. Grid condition findings from inspection - Distribution lines in HFTD	1.b.	Number of circuit miles inspected from detailed inspections in HFTD - Distribution lines (Subtotals)															
		Overhead Detailed Inspections	1,869	2,324	1,984	1,566	1,846	515	1,348	48	3	649	289	45	12		completed in circuit miles. Starting in 2020, the numbers represent completed compliance-due detailed inspections by circuit miles. SCE tracks completed inspections by tracking the counts of assets inspected instead of
		Enhanced Overhead Inspections	NA	NA	NA	859	8,642	NA	NA	NA	NA	NA	NA	NA	NA		SCE tracks completed inspections by tracking the counts of assets inspected instead of tracking by circuit miles. In order to present completed inspections in the requested format, SCE used a
		High Fire Risk Informed Inspections	NA	NA	NA	NA	NA	1,195	762	1,757	1,065	2,967	1,835	316	7		SCE tracks completed inspections by tracking the counts of assets inspected instead of tracking by circuit miles. In order to present completed inspections in the requested format, SCE used a
		Aerial Inspections	NA	NA	NA	NA	3,861	2,427	2,427	2,427	2,427	215	3,347	2,401	78		SCE tracks completed inspections by tracking the counts of assets inspected instead of tracking by circuit miles. In order to present completed inspections in the requested format, SCE used a
	1.c.	Number of circuit miles inspected from other inspections (list types of "other" inspections in comments) in HFTD - Distribution lines (Subtotals)															
		Infrared Scan	NA	NA	NA	11,775	4,962	1,112	1,112	1,112	1,112	2,465	1,945	0	0		For 2020, SCE tracks the completed asset inspected by year and in order to represent the 2020 completed asset inspection by quarter, SCE evenly distributed the completed inspections to
		Intrusive Pole Inspections	1,080	1,127	1,023	830	701	271	271	271	271	83	238	258	339		SCE tracks completed inspections by tracking the counts of assets inspected instead of tracking by circuit miles. In order to present completed inspections in the requested format, SCE used a
1. Grid condition findings from inspection - Distribution lines total	1.b.ii.	Number of total circuit miles inspected from detailed inspections - Distribution lines (Subtotals)															
		Overhead Detailed Inspections	7,950	8,034	7,865	7,851	7,956	851	2,343	1,743	3,104	912	1,359	2,309	2,284		completed in circuit miles. Starting in 2020, the numbers represent completed compliance-due detailed inspections by circuit miles. SCE tracks completed inspections by tracking the counts of assets inspected instead of
		Enhanced Overhead Inspections	NA	NA	NA	1,218	12,242	NA	NA	NA	NA	NA	NA	NA	NA		SCE tracks completed inspections by tracking the counts of assets inspected instead of tracking by circuit miles. In order to present completed inspections in the requested format, SCE used a
		High fire Risk Informed Inspections	NA	NA	NA	NA	NA	1,199	770	1,768	1,073	3,201	1,967	408	17		SCE tracks completed inspections by tracking the counts of assets inspected instead of tracking by circuit miles. In order to present completed inspections in the requested format, SCE used a
		Aerial Inspections	NA	NA	NA	NA	3,861	2,427	2,427	2,427	2,427	215	3,347	2,401	78		SCE tracks completed inspections by tracking the counts of assets inspected instead of tracking by circuit miles. In order to present completed inspections in the requested format, SCE used a
	1.c.ii.	Number of total circuit miles inspected from other inspections (list types of "other" inspections in comments) - Distribution lines															
		Infrared Scan	NA	NA	NA	26,055	4,962	1,112	1,112	1,112	1,112	2,465	1,945	0	0		For 2020, SCE tracks the completed asset inspected by the year and in order to represent the 2020 completed asset inspection by quarter, SCE just evenly distributed the completed inspections
		Intrusive Pole Inspections	4,320	4,509	4,093	3,847	3,925	995	995	995	995	993	1,041	1,092	876		SCE tracks completed inspections by tracking the counts of assets inspected instead of tracking by circuit miles. In order to present completed inspections in the requested format, SCE used a
1. Grid condition findings from inspection - Transmission lines in HFTD	1.b.iii.	Number of circuit miles inspected from detailed inspections in HFTD - Transmission lines															
		Detailed Inspections	NA	NA	NA	1,479	1,479	370	370	370	370	311	323	734	423		For 2015-2017, patrol inspections doubled as detailed inspections being completed on every transmission asset in the service territory. Beginning in 2018 the recorded inspection
		High Fire Inspections	NA	NA	NA	NA	4,948	839	2,649	404	392	577	1,439	497	0		SCE tracks completed inspections by tracking the counts of assets inspected instead of tracking by circuit miles. In order to present completed inspections in the requested format, SCE used a
		Aerial Inspections	NA	NA	NA	NA	4,630	868	868	868	868	546	1,509	357	29		SCE tracks completed inspections by tracking the counts of assets inspected instead of tracking by circuit miles. In order to present completed inspections in the requested format, SCE used a

	1.c.iii	Number of total circuit miles inspected from other inspections (list types of "other" inspections in comments) - Transmission lines (SubTotals)													
		IR Corona	NA	NA	NA	NA	4,901	251	251	251	251	0	73	380	594	For 2020, SCE tracked the completed inspections by the year. In order to represent the 2020 completed inspection by quarter, SCE evenly distributed the completed inspections to each of the
		Intrusive Pole Inspections	NA	NA	NA	103	102	32	32	32	32	43	49	26	64	SCE tracks completed inspections by tracking the counts of assets inspected instead of tracking by circuit miles. In order to present completed inspections in the requested format, SCE used a
1. Grid condition findings from inspection - Transmission lines total	1.b.iv.	Number of total circuit miles inspected from detailed inspections - Transmission lines													
		Detailed Inspections	NA	NA	NA	4,210	4,760	697	1,188	1,229	983	834	990	1,101	868	For 2015-2017, patrol inspections doubled as detailed inspections being completed on every transmission asset in the service territory. Beginning in 2018 the recorded inspection
		High Fire Inspections	NA	NA	NA	NA	4,948	839	2,649	404	392	577	1,439	497	0	SCE tracks completed inspections by tracking the counts of assets inspected instead of tracking by circuit miles. In order to present completed inspections in the requested format, SCE used a
		Aerial Inspections	NA	NA	NA	NA	1,109	911	911	911	911	546	1,509	357	29	SCE tracks completed inspections by tracking the counts of assets inspected instead of tracking by circuit miles. In order to present completed inspections in the requested format, SCE used a
	1.c.iv.	Number of total circuit miles inspected from other inspections (list types of "other" inspections in comments) - Transmission lines													
		IR Corona	0	0	0	0	0	43	43	43	43	0	73	380	594	For 2020, SCE tracked the completed inspections by the year. In order to represent the 2020 completed inspection by quarter, SCE evenly distributed the completed inspections to each of the
		Intrusive Pole Inspections	6,460	4,592	6,226	7,309	5,529	1,594	1,594	1,594	1,594	267	1,993	182	173	SCE tracks completed inspections by tracking the counts of assets inspected instead of tracking by circuit miles. In order to present completed inspections in the requested format, SCE used a

Utility	Southern California Edison Company	
Table No.	2	
Date Modified	2/18/2022	

Notes:
Transmission lines refer to all lines at or above 65kV, and distribution lines refer to all lines below 65kV.
HWW = High wind warning
RFW = Red flag warning

Note: These columns are placeholders for future QR submissions.

Table 2: Recent performance on outcome metrics

Metric type	#	Outcome metric name	Wind Warning Status	HFTD Tier	2015	2016	2017	2018	2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021	Q1 2022	Q2 2022	Q3 2022	Q4 2022	Unit(s)	Comments
1. Risk Events	1.a.	Number of all events with probability of ignition, including wires down, contacts with	All	1	0	0	0	0	1	0	0	0	0	0	0	0	0					Number per year	
		Number of all events with probability of ignition, including wires down, contacts with	RFW	1	0	0	0	0	0	0	0	0	0	0	0	0	0						
		Number of all events with probability of ignition, including wires down, contacts with	HWW	1	0	0	0	0	0	0	0	0	0	0	0	0	0						
		Number of all events with probability of ignition, including wires down, contacts with	HWW & RFW	1	0	0	0	0	0	0	0	0	0	0	0	0	0						
		Number of all events with probability of ignition, including wires down, contacts with	HWW & not RFW	1	0	0	0	0	0	0	0	0	0	0	0	0	0						
		Number of all events with probability of ignition, including wires down, contacts with	All	2	886	1047	1196	1116	1783	322	321	414	292	303	286	283	291						
		Number of all events with probability of ignition, including wires down, contacts with	RFW	2	6	27	67	53	15	0	5	24	48	26	6	0	6						
		Number of all events with probability of ignition, including wires down, contacts with	HWW	2	53	51	86	32	64	36	7	0	32	36	2	0	12						
		Number of all events with probability of ignition, including wires down, contacts with	HWW & RFW	2	0	7	30	16	1	0	0	0	32	15	2	0	4						
		Number of all events with probability of ignition, including wires down, contacts with	HWW & not RFW	2	53	46	64	18	64	40	8	0	5	24	0	0	8						
		Number of all events with probability of ignition, including wires down, contacts with	All	3	1342	1676	1779	1691	2972	381	467	556	469	466	329	388	456						
		Number of all events with probability of ignition, including wires down, contacts with	RFW	3	4	74	169	141	86	0	7	24	89	62	2	0	16						
		Number of all events with probability of ignition, including wires down, contacts with	HWW	3	59	91	156	47	81	43	7	0	39	86	1	0	11						
		Number of all events with probability of ignition, including wires down, contacts with	HWW & RFW	3	0	17	87	32	26	0	1	0	40	54	0	0	4						
		Number of all events with probability of ignition, including wires down, contacts with	HWW & not RFW	3	59	74	69	17	55	43	6	0	0	32	1	0	7						
		Number of all events with probability of ignition, including wires down, contacts with	All	Non- HFTD	9872	11602	12410	13166	13154	2498	3036	4545	2932	2862	3025	3130	3192						
		Number of all events with probability of ignition, including wires down, contacts with	RFW	Non- HFTD	35	235	598	479	240	0	28	167	463	189	18	0	224						
		Number of all events with probability of ignition, including wires down, contacts with	HWW	Non- HFTD	128	352	653	311	268	122	19	0	292	297	14	0	187						
		Number of all events with probability of ignition, including wires down, contacts with	HWW & RFW	Non- HFTD	0	68	198	183	70	0	4	0	294	118	12	0	116						
		Number of all events with probability of ignition, including wires down, contacts with	HWW & not RFW	Non- HFTD	128	283	459	127	198	122	15	0	0	179	2	0	71						
1. Risk Events	1.b.	Number of wires down	All	1	0	0	0	0	0	0	0	0	0	0	0	0	0					Number of wires down per year	
		Number of wires down	RFW	1	0	0	0	0	0	0	0	0	0	0	0	0	0						
		Number of wires down	HWW	1	0	0	0	0	0	0	0	0	0	0	0	0	0						
		Number of wires down	HWW & RFW	1	0	0	0	0	0	0	0	0	0	0	0	0	0						
		Number of wires down	HWW & not RFW	1	0	0	0	0	0	0	0	0	0	0	0	0	0						
		Number of wires down	All	2	104	168	194	117	155	28	29	21	34	46	30	29	38						
		Number of wires down	RFW	2	0	1	6	3	0	0	0	2	7	2	0	0	0						
		Number of wires down	HWW	2	10	5	10	1	4	5	2	0	3	3	0	0	0						
		Number of wires down	HWW & RFW	2	0	0	3	0	0	0	0	0	3	1	0	0	0						
		Number of wires down	HWW & not RFW	2	10	5	7	1	4	5	2	0	0	2	0	0	0						
		Number of wires down	All	3	173	328	377	221	254	49	69	60	58	96	33	35	91						
		Number of wires down	RFW	3	0	17	25	15	16	0	1	4	19	17	0	0	3						

		Number of wires down	HWW	3	10	17	29	6	8	4	4	0	7	18	0	0	1	
		Number of wires down	HWW & RFW	3	0	4	12	2	2	0	0	0	7	13	0	0	1	
		Number of wires down	HWW & not RFW	3	10	13	17	4	6	4	4	0	0	5	0	0	0	
		Number of wires down	All	Non- HFTD	1252	1888	2006	1415	1376	318	441	444	515	487	425	339	407	
		Number of wires down	RFW	Non- HFTD	3	50	87	47	26	0	5	15	83	41	3	0	35	
		Number of wires down	HWW	Non- HFTD	25	68	105	33	26	18	3	0	54	45	3	0	22	
		Number of wires down	HWW & RFW	Non- HFTD	0	16	31	20	8	0	1	0	54	24	2	0	16	
		Number of wires down	HWW & not RFW	Non- HFTD	25	52	74	13	18	18	2	0	0	21	1	0	6	
1. Risk Events	1.c.	Number of outage events not caused by contact with vegetation	All	1	0	0	0	0	1	0	0	0	0	0	0	0	0	Number of outage events per year
		Number of outage events not caused by contact with vegetation	RFW	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Number of outage events not caused by contact with vegetation	HWW	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Number of outage events not caused by contact with vegetation	HWW & RFW	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Number of outage events not caused by contact with vegetation	HWW & not RFW	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Number of outage events not caused by contact with vegetation	All	2	733	807	918	938	1564	277	279	384	247	245	241	247	241	
		Number of outage events not caused by contact with vegetation	RFW	2	6	25	57	41	14	0	5	22	34	21	6	0	6	
		Number of outage events not caused by contact with vegetation	HWW	2	39	46	76	31	60	31	5	0	29	33	2	0	12	
		Number of outage events not caused by contact with vegetation	HWW & RFW	2	0	7	25	14	1	0	0	0	24	12	2	0	4	
		Number of outage events not caused by contact with vegetation	HWW & not RFW	2	39	39	51	17	59	31	5	0	5	21	0	0	8	
		Number of outage events not caused by contact with vegetation	All	3	1076	1207	1257	1388	2557	303	366	482	385	349	283	337	327	
		Number of outage events not caused by contact with vegetation	RFW	3	4	51	115	116	64	0	5	20	61	41	2	0	11	
		Number of outage events not caused by contact with vegetation	HWW	3	42	62	99	37	62	26	2	0	29	62	1	0	10	
		Number of outage events not caused by contact with vegetation	HWW & RFW	3	0	13	58	27	22	0	1	0	29	37	0	0	3	
		Number of outage events not caused by contact with vegetation	HWW & not RFW	3	42	49	41	10	40	26	1	0	0	25	1	0	7	
		Number of outage events not caused by contact with vegetation	All	Non- HFTD	8254	9274	9910	11374	11361	2106	2513	4058	2312	2286	2541	2724	2647	
		Number of outage events not caused by contact with vegetation	RFW	Non- HFTD	31	176	468	366	190	0	19	150	343	141	15	0	166	
		Number of outage events not caused by contact with vegetation	HWW	Non- HFTD	85	267	467	246	222	97	10	0	209	248	11	0	147	
		Number of outage events not caused by contact with vegetation	HWW & RFW	Non- HFTD	0	47	143	134	49	0	2	0	209	93	10	0	82	
		Number of outage events not caused by contact with vegetation	HWW & not RFW	Non- HFTD	85	220	329	112	173	97	8	0	0	155	1	0	65	
1. Risk Events	1.d.	Number of outage events caused by contact with vegetation	All	1	0	0	0	0	0	0	0	0	0	0	0	0	0	Number of outage events per year
		Number of outage events caused by contact with vegetation	RFW	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Number of outage events caused by contact with vegetation	HWW	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Number of outage events caused by contact with vegetation	HWW & RFW	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Number of outage events caused by contact with vegetation	HWW & not RFW	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Number of outage events caused by contact with vegetation	All	2	35	60	72	45	49	16	6	4	9	11	3	4	9	
		Number of outage events caused by contact with vegetation	RFW	2	0	1	4	8	1	0	0	0	7	3	0	0	0	

		Number of outage events caused by contact with vegetation	HWW	2	4	2	8	1	1	4	1	0	5	3	0	0	0	
		Number of outage events caused by contact with vegetation	HWW & RFW	2	0	0	2	1	0	0	0	0	5	2	0	0	0	
		Number of outage events caused by contact with vegetation	HWW & not RFW	2	4	2	6	0	1	4	1	0	0	1	0	0	0	
		Number of outage events caused by contact with vegetation	All	3	61	112	122	61	138	27	17	3	19	15	2	5	37	
		Number of outage events caused by contact with vegetation	RFW	3	0	4	27	9	6	0	0	0	9	4	0	0	2	
		Number of outage events caused by contact with vegetation	HWW	3	7	12	28	4	11	13	1	0	3	6	0	0	0	
		Number of outage events caused by contact with vegetation	HWW & RFW	3	0	0	17	1	2	0	0	0	3	4	0	0	0	
		Number of outage events caused by contact with vegetation	HWW & not RFW	3	7	12	11	3	9	13	1	0	0	2	0	0	0	
		Number of outage events caused by contact with vegetation	All	Non- HFTD	305	385	424	305	331	61	46	15	83	66	16	23	123	
		Number of outage events caused by contact with vegetation	RFW	Non- HFTD	0	9	43	63	22	0	4	1	36	7	0	0	23	
		Number of outage events caused by contact with vegetation	HWW	Non- HFTD	18	16	80	31	20	7	6	0	29	4	0	0	18	
		Number of outage events caused by contact with vegetation	HWW & RFW	Non- HFTD	0	5	24	29	13	0	1	0	29	1	0	0	18	
		Number of outage events caused by contact with vegetation	HWW & not RFW	Non- HFTD	18	11	56	2	7	7	5	0	0	3	0	0	0	
2. Utility inspection findings - Distribution	2.a.	Number of Level 1 findings (distribution)	N/A	1	15	12	16	12	6	0	2	0	2	2	1	0	2	
		Number of Level 1 findings (distribution)	N/A	2	929	1,082	1,175	976	1,632	374	312	291	335	344	289	217	235	
		Number of Level 1 findings (distribution)	N/A	3	1,469	2,828	2,249	2,008	3,142	508	536	725	660	518	413	401	508	
		Number of Level 1 findings (distribution)	N/A	Non- HFTD	17,145	18,440	20,157	18,003	19,248	3,970	4,736	5,966	4,627	4,403	4,242	4,544	4,757	
	2.b.	Number of Level 2 findings (distribution)	N/A	1	121	107	96	52	35	8	6	1	1	1	0	2	1	
		Number of Level 2 findings (distribution)	N/A	2	5,721	5,262	3,827	6,733	29,877	4,024	4,294	2,215	1,570	5,167	6,178	1,349	1,100	
		Number of Level 2 findings (distribution)	N/A	3	12,479	11,995	9,909	16,884	53,386	8,446	7,987	5,181	5,123	6,483	9,440	4,469	1,535	
		Number of Level 2 findings (distribution)	N/A	Non- HFTD	74,077	62,647	55,980	59,449	66,075	10,747	12,328	14,940	17,926	9,678	16,907	26,730	32,003	
	2.c.	Number of Level 3 findings (distribution)	N/A	1	29	24	7	19	22	2	1	2	0	0	0	3	0	
		Number of Level 3 findings (distribution)	N/A	2	4,866	7,847	5,092	5,211	43,687	3,404	4,122	3,307	393	7,342	3,849	461	446	
		Number of Level 3 findings (distribution)	N/A	3	9,472	10,076	7,664	8,564	65,707	6,743	6,257	6,834	710	7,013	5,509	1,605	305	
		Number of Level 3 findings (distribution)	N/A	Non- HFTD	70,636	56,353	51,253	58,499	78,733	3,887	8,643	13,668	19,643	3,938	9,864	18,938	19,068	
	2.d.	Number of distribution circuit miles inspected	N/A	1	36	37	33	809	298	115	116	114	114	83	166	80	13	2021 year-end data is going through final quality assurance review and if any changes are needed, they will be updated in the next quarterly submission.
		Number of distribution circuit miles inspected	N/A	2	4,824	5,303	4,951	13,193	10,819	2,127	4,890	2,265	1,510	4,016	4,651	979	143	2021 year-end data is going through final quality assurance review and if any changes are needed, they will be updated in the next quarterly submission.
		Number of distribution circuit miles inspected	N/A	3	7,808	7,835	7,748	25,038	18,626	4,872	7,848	4,471	3,487	5,988	8,732	2,915	281	2021 year-end data is going through final quality assurance review and if any changes are needed, they will be updated in the next quarterly submission.
		Number of distribution circuit miles inspected	N/A	Non- HFTD	39,797	39,567	39,424	40,137	43,410	2,516	18,954	11,947	6,318	3,117	10,755	18,474	7,137	2021 year-end data is going through final quality assurance review and if any changes are needed, they will be updated in the next quarterly submission.
2. Utility inspection findings - Transmission	2.a.ii	Number of Level 1 findings (transmission)	N/A	1	2	0	2	0	0	0	0	0	0	0	0	1	4	
		Number of Level 1 findings (transmission)	N/A	2	27	22	24	12	80	8	13	31	42	15	29	17	9	
		Number of Level 1 findings (transmission)	N/A	3	20	59	15	20	33	10	8	23	21	15	30	28	8	
		Number of Level 1 findings (transmission)	N/A	Non- HFTD	193	174	172	148	192	40	30	54	45	38	49	28	57	
	2.b.ii	Number of Level 2 findings (transmission)	N/A	1	1	1	447	0	4	1	2	3	1	0	0	3	0	

		Number of Level 2 findings (transmission)	N/A	2	595	566	929	1,091	9,705	1025	3283	1126	470	391	881	362	108
		Number of Level 2 findings (transmission)	N/A	3	389	445	2	560	5856	818	3565	978	660	489	1303	577	160
		Number of Level 2 findings (transmission)	N/A	Non- HFTD	4,369	4,207	5,033	5,367	7,322	1399	1177	888	1031	1,300	888	730	607
	2.c.ii	Number of Level 3 findings (transmission)	N/A	1	3	0	372	0	0	0	0	0	0	0	0	0	0
		Number of Level 3 findings (transmission)	N/A	2	641	550	323	178	1,507	109	371	297	96	417	377	123	21
		Number of Level 3 findings (transmission)	N/A	3	270	172	0	176	1069	76	416	386	175	399	438	128	21
		Number of Level 3 findings (transmission)	N/A	Non- HFTD	6,105	2,623	2,374	1,349	2,493	599	454	321	352	232	257	143	322
	2.d.ii	Number of transmission circuit miles inspected	N/A	1	194	138	187	219	1,346	76	76	76	76	24	107	28	24
		Number of transmission circuit miles inspected	N/A	2	2,459	1,861	2,384	2,857	4,500	1,489	2,406	1,110	1,032	603	2,053	665	355
		Number of transmission circuit miles inspected	N/A	3	4,852	3,638	4,700	5,615	7,035	2,098	3,035	2,125	2,170	882	3,150	1,066	684
		Number of transmission circuit miles inspected	N/A	Non- HFTD	12,023	12,023	12,023	15,896	16,533	3,688	4,134	4,137	3,910	2,472	2,896	3,594	3,103
	3.a.	Fatalities due to utility-related ignitions (total)	N/A	N/A	0	0	2	3	1	0	0	0	0	0	0	0	0
	3.b.	Injuries due to utility-related igntions (total)	N/A	N/A	0	3	2	3	3	0	0	6	2	0	0	0	0
4. Value of assets destroyed by utility-related ignitions,	4.a.	Value of assets destroyed by utility-related ignitions (total)	N/A	N/A	########	########	########	########	#########	$150,400	$300,800	########	########	$188,000	$451,200	########	$338,400
5. Structures damaged or destroyed by utility-related	5.a.	Number of structures destroyed by utility-related ignitions (total)	N/A	N/A	45	290	1,072	1,667	26	0	0	47	13	0	0	0	0
	5.b.	Critical infrastructure damaged/destroyed by utility-rleated ignitions (total)	N/A	N/A	NA	NA	36	31	NA	NA	NA	NA	NA	NA	NA	NA	NA
6. Acreage burned by utility-related ignitions	6.a.	Acreage burned by utility-rleated ignitions	N/A	N/A	15,711	82,897	292,051	97,240	22,784	4	574	115,871	12,863	12	513	30	41
7. Number of utility-related ignitions	7.a.	Number of ignitions (total) according to existing ignition data reporting requirement	N/A	N/A	107	96	105	109	124	16	58	44	31	29	66	58	18
	7.b.	Number of ignitions	All	1	0	0	0	0	0	0	0	0	0	0	0	0	0
		Number of ignitions	RFW	1	0	0	0	0	0	0	0	0	0	0	0	0	0
		Number of ignitions	HWW	1	0	0	0	0	0	0	0	0	0	0	0	0	0
		Number of ignitions	HWW & RFW	1	0	0	0	0	0	0	0	0	0	0	0	0	0
		Number of ignitions	HWW & not RFW	1	0	0	0	0	0	0	0	0	0	0	0	0	0
		Number of ignitions	All	2	14	12	12	16	15	1	7	5	2	1	12	3	3
		Number of ignitions	RFW	2	0	0	0	1	0	0	0	0	0	0	0	0	0
		Number of ignitions	HWW	2	0	0	0	0	0	0	0	0	0	0	0	0	0
		Number of ignitions	HWW & RFW	2	0	0	0	1	0	0	0	0	0	0	0	0	0
		Number of ignitions	HWW & not RFW	2	0	0	0	0	0	0	0	0	0	0	0	0	0
		Number of ignitions	All	3	32	29	23	21	23	2	15	11	7	6	11	11	1
		Number of ignitions	RFW	3	0	2	2	1	0	0	1	0	0	0	0	0	0
		Number of ignitions	HWW	3	0	0	0	0	0	0	0	0	0	0	0	0	0
		Number of ignitions	HWW & RFW	3	0	0	0	2	0	0	0	0	1	0	0	0	0
		Number of ignitions	HWW & not RFW	3	0	0	0	0	0	0	0	0	0	0	0	0	0
		Number of ignitions	All	Non- HFTD	61	55	70	72	86	13	36	28	22	23	43	44	15
		Number of ignitions	RFW	Non- HFTD	1	0	0	3	2	0	0	1	1	0	0	0	0

		Number of ignitions	HWW	Non- HFTD	0	1	1	1	0	0	0	0	0	0	0	0	0
		Number of ignitions	HWW & RFW	Non- HFTD	0	0	0	0	0	0	0	0	2	0	0	0	0
		Number of ignitions	HWW & not RFW	Non- HFTD	0	0	0	0	0	0	0	0	0	0	0	0	0
8. Fatalities resulting from utility wildfire mitigation	8.a.	Fatalities due to utility wildfire mitigation activities (total) - "activities" defined as all	N/A	N/A	0	0	0	0	0	1	0	0	0	0	0	0	0
9. OSHA-reportable injuries from utility wildfire mitigation initiatives	9.a.	OSHA-reportable injuries due to utility wildfire mitigation activities (total) - "activities" defined as all activities accounted for in the 2020 WMP proposed WMP spend	N/A	N/A	0	0	0	0	1	0	1	3	0	0	1	0	0

Table 2 Sub Metrics:

1. Risk Events	1.b.	Number of wires down	Unknown	1	0	0	0	0	0	0	0	0	0	0	0	0	0
		Number of wires down	Unknown	2	9	35	25	13	13	0	0	1	1	3	2	0	2
		Number of wires down	Unknown	3	8	70	71	34	18	3	6	2	1	3	2	5	3
		Number of wires down	Unknown	Non- HFTD	33	285	183	98	59	4	6	11	12	20	25	28	10
		Number of wires down	Unknown	Unknown	3	30	40	7	5	1	0	0	2	0	0	1	0
1. Risk Events	1.c.	Number of outage events not caused by contact with vegetation	Unknown	Unknown	1824	511	482	504	747	113	142	124	114	119	124	108	165
1. Risk Events	1.d.	Number of outage events caused by contact with vegetation	Unknown	Unknown	9	16	4	14	17	0	1	4	5	3	0	1	6

Utility	Southern California Edison Company
Table No.	3
Date Modified	2/18/2022

Table 3: List and description of additional metrics

Note: These columns are placeholders for future QR submissions.

Metric	Definition	Purpose	Assumptions made to connect metric to purpose	Third-party validation (if any)	2015	2016	2017	2018	2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021	Q1 2022	Q2 2022	Q3 2022	Q4 2022	Unit(s)	Comments
CPUC reportable ignitions in High Fire Risk Areas (HFRA)	Events meeting reportable ignition status per Decision 14-02-015 and falling within BL322, HFTD Zone 1 HFTD Tier 2 and 200 ft. Outer Buffer, and HFTD Tier 3 and 200 ft. Outer Buffer areas	To measure changes in rate of ignitions between years	Factors outside of SCE's control (e.g., wind, live fuel moisture) have a significant effect on CPUC reportable ignition counts in HFRA.	Annual submission of CPUC reportable ignition totals to CPUC	46	41	35	37	38	3	22	16	9	7	22	9	4					Number of reportable ignitions in HFRA	HFRA includes HFTD Tier 3, HFTD Tier 2, HFTD Zone 1, and BL322 (non-CPUC HFRA)
Faults in HFRA	Events in which electrical current deviates from the anticpated path via SCE facilities within BL322, HFTD Zone 1 HFTD Tier 2 and 200 ft. Outer Buffer, and HFTD Tier 3 and 200 ft. Outer Buffer areas	To measure changes in rate of fault events which are a pre-cursor both ignition and safety events	Number of faults in HFRA based on cause. These metrics may help to provide insight on controllable and uncontrollable risks or help plan future activities to focus on a particular type of fault or outage that may be of wildfire risk.	Deep-dive audits of select portions of utility grid	1,905	2,186	2,369	2,432	4,309	623	668	873	660	620	529	593	614					Number of faults in HFRA	HFRA includes HFTD Tier 3, HFTD Tier 2, HFTD Zone 1, and BL322 (non-CPUC HFRA). Note: SCE is incorporating additional Transmission outage data as an improvement to its outage reporting. Historical reporting has been revised to reflect the additional Transmission outage data.
Wire Down Incidents in HFRA	Events in which SCE overhead conductors (energized or de-energized) fall within 8ft above ground or lower, within BL322, HFTD Tier 2 and 200 ft. Outer Buffer, and HFTD Tier 3 and 200 ft. Outer Buffer areas	To measure changes in rate of wire down events which are a pre-cursor both ignition and safety events	Number of wire down incidents in HFRA based on cause. These metrics may help to provide insight on controllable and uncontrollable risks or help plan future activities to focus on a particular type of fault or outage that may be of wildfire risk.	Deep-dive audits of select portions of utility grid	277	496	571	338	409	77	98	81	92	142	63	64	129					Number of wire downs per year in HFRA	HFRA includes HFTD Tier 3, HFTD Tier 2, HFTD Zone 1, and BL322 (non-CPUC HFRA)
Number of customers and average duration of Public Safety Power Shutoff (PSPS) events																							
Total # of customers de-energized	Count of customers de-energized, with duplicates, per year	To measure the scale of impact of outages due to PSPS to customers, with duplicates	Not Applicable	Not Applicable	Refer to Table 11, # 4.a.	Refer to Table 11, # 4.a.	Refer to Table 11, # 4.a.	Refer to Table 11, # 4.a.	Refer to Table 11, # 4.a.	Refer to Table 11, # 4.a.	Refer to Table 11, # 4.a.	Refer to Table 11, # 4.a.	Refer to Table 11, # 4.a.	Refer to Table 11, # 4.a.	Refer to Table 11, # 4.a.	Refer to Table 11, # 4.a.	Refer to Table 11, # 4.a.					Number of customers	None
Average duration of de-energization across all customers.	Average outage duration (hours per customer) experienced by PSPS de-energization per customer de-energized	Of the customers de-energized due to PSPS, to measure the magnitude of the effect of the PSPS de-energization	Not Applicable	Not Applicable	N/A	N/A	30.3	23.2	27	N/A	N/A	2.2	18.3	23.9	2.9	9.8	25.0					Hours	Applies to each instance of a customer being de-energized due to PSPS
Timeliness and accuracy of PSPS notifications																							
% of customers notified prior to a PSPS event impacting them	# of customers notified prior to initiation of PSPS event who were impacted by PSPS/ # of customers impacted by PSPS (if multiple PSPS events impact the same customer, count each event as a separate customer)	To measure success rate of notification for the customers who were impacted by de-energization	Not Applicable	Not Applicable	Refer to Table 11, # 4.e.	Refer to Table 11, # 4.e.	Refer to Table 11, # 4.e.	Refer to Table 11, # 4.e.	Refer to Table 11, # 4.e.	Refer to Table 11, # 4.e.	Refer to Table 11, # 4.e.	Refer to Table 11, # 4.e.	Refer to Table 11, # 4.e.	Refer to Table 11, # 4.e.	Refer to Table 11, # 4.e.	Refer to Table 11, # 4.e.	Refer to Table 11, # 4.e.					Percentage	None
% of customers notified prior to a PSPS event that did not impact them	% of customers notified of potential de-energization that were not de-energized for that PSPS event (on a total customer basis) 1 - (# of total customers de-energized / # of imminent de-energization notifications sent)	To measure the occurrence of PSPS notifications and de-energizations	Not Applicable	Not Applicable	N/A	N/A	N/A	N/A	N/A	N/A	100%	39%	61%	65%	87%	0%	25%					% of customers notified of imminent potential de-energization that were not de-energized for that PSPS event (on a total customer basis)	This data was not recorded prior to 2020.

Utility	Southern California Edison Company
Table No.	4
Date Modified	2/18/2022

Note: These columns are placeholders for future QR submissions.

Table 4: Fatalities due to utility wildfire mitigation initiatives

Metric type	#	Outcome metric name	2015	2016	2017	2018	2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021	Q1 2022	Q2 2022	Q3 2022	Q4 2022	Unit(s)	Comments
1. Fatalities - Full-time Employee	1.a.	Fatalities due to utility inspection - Full-time employee	0	0	0	0	0	0	0	0	0	0	0	0	0					# fatalities	
	1.b.	Fatalities due to vegetation management - Full-time employee	0	0	0	0	0	0	0	0	0	0	0	0	0					# fatalities	
	1.c.	Fatalities due to utility fuel management - Full-time employee	0	0	0	0	0	0	0	0	0	0	0	0	0					# fatalities	
	1.d.	Fatalities due to grid hardening - Full-time employee	0	0	0	0	0	0	0	0	0	0	0	0	0					# fatalities	
	1.e.	Fatalities due to other - Full-time employee	0	0	0	0	0	0	0	0	0	0	0	0	0					# fatalities	
2. Fatalities - Contractor	2.a.	Fatalities due to utility inspection - Contractor	0	0	0	0	0	0	0	0	0	0	0	0	0					# fatalities	
	2.b.	Fatalities due to vegetation management - Contractor	0	0	0	0	0	1	0	0	0	0	0	0	0					# fatalities	By providing this data, SCE is not admitting: 1) any responsibility or liability for any incident reported herein or 2) that a wildfire mitigation activity caused a fatality.
	2.c.	Fatalities due to utility fuel management - Contractor	0	0	0	0	0	0	0	0	0	0	0	0	0					# fatalities	
	2.d.	Fatalities due to grid hardening - Contractor	0	0	0	0	0	0	0	0	0	0	0	0	0					# fatalities	
	2.e.	Fatalities due to other - Contractor	0	0	0	0	0	0	0	0	0	0	0	0	0					# fatalities	
3. Fatalities - Member of public	3.a.	Fatalities due to utility inspection - Public	0	0	0	0	0	0	0	0	0	0	0	0	0					# fatalities	
	3.b.	Fatalities due to vegetation management - Public	0	0	0	0	0	0	0	0	0	0	0	0	0					# fatalities	
	3.c.	Fatalities due to utility fuel management - Public	0	0	0	0	0	0	0	0	0	0	0	0	0					# fatalities	
	3.d.	Fatalities due to grid hardening - Public	0	0	0	0	0	0	0	0	0	0	0	0	0					# fatalities	
	3.e.	Fatalities due to other - Public	0	0	0	0	0	0	0	0	0	0	0	0	0					# fatalities	

Utility	Southern California Edison Company
Table No.	5
Date Modified	2/18/2022

Note: These columns are placeholders for future QR submissions.

Table 5: OSHA-reportable injuries due to utility wildfire mitigation initiatives

Metric type	#	Outcome metric name	2015	2016	2017	2018	2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021	Q1 2022	Q2 2022	Q3 2022	Q4 2022	- Unit(s)	Comments
1. OSHA injuries - Full-time Employee	1.a.	OSHA injuries due to utility inspection - Full-time employee	0	0	0	0	1	0	0	0	0	0	0	0	0					# OSHA-reportable injuries	By providing this data, SCE is not admitting that 1) any responsibility or liability for any incident reported herein or 2) that a wildfire mitigation activity caused an injury.
	1.b.	OSHA injuries due to vegetation management - Full-time employee	0	0	0	0	0	0	0	0	0	0	0	0	0					# OSHA-reportable injuries	
	1.c.	OSHA injuries due to utility fuel management - Full-time employee	0	0	0	0	0	0	0	0	0	0	0	0	0					# OSHA-reportable injuries	
	1.d.	OSHA injuries due to grid hardening - Full-time employee	0	0	0	0	0	0	0	0	0	0	0	0	0					# OSHA-reportable injuries	By providing this data, SCE is not admitting that 1) any responsibility or liability for any incident reported herein or 2) that a wildfire mitigation activity caused an injury.
	1.e.	OSHA injuries due to other - Full-time employee	0	0	0	0	0	0	0	0	0	0	0	0	0					# OSHA-reportable injuries	
2. OSHA injuries - Contractor	2.a.	OSHA injuries due to utility inspection - Contractor	0	0	0	0	0	0	0	0	0	0	0	0	0					# OSHA-reportable injuries	
	2.b.	OSHA injuries due to vegetation management - Contractor	0	0	0	0	0	0	1	0	0	0	1	0	0					# OSHA-reportable injuries	By providing this data, SCE is not admitting that 1) any responsibility or liability for any incident reported herein or 2) that a wildfire mitigation activity caused an injury.
	2.c.	OSHA injuries due to utility fuel management - Contractor	0	0	0	0	0	0	0	0	0	0	0	0	0					# OSHA-reportable injuries	
	2.d.	OSHA injuries due to grid hardening - Contractor	0	0	0	0	0	0	0	3	0	0	0	0	0					# OSHA-reportable injuries	By providing this data, SCE is not admitting that 1) any responsibility or liability for any incident reported herein or 2) that a wildfire mitigation activity caused an injury.
	2.e.	OSHA injuries due to other - Contractor	0	0	0	0	0	0	0	0	0	0	0	0	0					# OSHA-reportable injuries	
3. OSHA injuries - Member of public	3.a.	OSHA injuries due to utility inspection - Public	0	0	0	0	0	0	0	0	0	0	0	0	0					# OSHA-reportable injuries	
	3.b.	OSHA injuries due to vegetation management - Public	0	0	0	0	0	0	0	0	0	0	0	0	0					# OSHA-reportable injuries	
	3.c.	OSHA injuries due to utility fuel management - Public	0	0	0	0	0	0	0	0	0	0	0	0	0					# OSHA-reportable injuries	
	3.d.	OSHA injuries due to grid hardening - Public	0	0	0	0	0	0	0	0	0	0	0	0	0					# OSHA-reportable injuries	
	3.e.	OSHA injuries due to other - Public	0	0	0	0	0	0	0	0	0	0	0	0	0					# OSHA-reportable injuries	

Utility	Southern California Edison Company
Table No.	6
Date Modified	2/18/2022

Note: These columns are placeholders for future QR submissions.

Table 6: Weather patterns

Metric type	#	Outcome metric name	2015	2016	2017	2018	2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021	Q1 2022	Q2 2022	Q3 2022	Q4 2022	Unit(s)	Comments
1. Red Flag Warning Overhead circuit mile Days	1.a.	Red Flag Warning Overhead circuit mile days - entire utility territory	80,504	286,327	476,404	283,806	201,423	0	24,845	62,241	162,422	58,515	16,825	5,765	107,567					Sum of overhead circuit miles of utility grid subject to Red Flag Warning each day within a given time period, calculated as the number of overhead circuit miles that were under an RFW multiplied by the number of days those circuit miles were under said RFW. For example, if 100 overhead circuit miles were under an RFW for 1 day, and 10 of those miles were under RFW for an additional day, then the total RFW OH circuit mile days would be 110.	GIS systems are used in order to overlay the locational information of each red flag warning. GIS models are updated frequently with changes within SCE's service territroy and does not have the ability to analyze and calculate information in previous years. As such, the overhead lengths of distribution and transmission circuits are based on 2020 circuit mile information for the calculation of historical years 2015-2019. Additionally, this overall number may be slightly different than the 2020 WMP filing due to the use of the 2020 GIS information. Historical information was re-calculated as high fire threat district break outs are new requirements in the 2021 WMP.
	1.b.	Red Flag Warning Overhead circuit mile days - HFTD Zone 1	1	8	4	3	2	0	0	1	2	1	0	0	0					Red Flag Warning Overhead circuit mile days, see above for definition	GIS systems are used in order to overlay the locational information of each red flag warning. GIS models are updated frequently with changes within SCE's service territroy and does not have the ability to analyze and calculate information in previous years. As such, the overhead lengths of distribution and transmission circuits are based on 2020 circuit mile information for the calculation of historical years 2015-2019. Additionally, this overall number may be slightly different than the 2020 WMP filing due to the use of the 2020 GIS information. Historical information was re-calculated as high fire threat district break outs are new requirements in the 2021 WMP.
	1.c.	Red Flag Warning Overhead circuit mile days - HFTD Tier 2	9,214	31,921	50,039	31,295	21,598	0	4,391	10,011	17,964	7,003	3,074	2,860	10,163					Red Flag Warning Overhead circuit mile days, see above for definition	GIS systems are used in order to overlay the locational information of each red flag warning. GIS models are updated frequently with changes within SCE's service territroy and does not have the ability to analyze and calculate information in previous years. As such, the overhead lengths of distribution and transmission circuits are based on 2020 circuit mile information for the calculation of historical years 2015-2019. Additionally, this overall number may be slightly different than the 2020 WMP filing due to the use of the 2020 GIS information. Historical information was re-calculated as high fire threat district break outs are new requirements in the 2021 WMP.
	1.d.	Red Flag Warning Overhead circuit mile days - HFTD Tier 3	25,523	88,117	127,005	82,216	57,321	0	4,031	13,920	36,805	17,404	1,214	2,029	25,933					Red Flag Warning Overhead circuit mile days, see above for definition	GIS systems are used in order to overlay the locational information of each red flag warning. GIS models are updated frequently with changes within SCE's service territroy and does not have the ability to analyze and calculate information in previous years. As such, the overhead lengths of distribution and transmission circuits are based on 2020 circuit mile information for the calculation of historical years 2015-2019. Additionally, this overall number may be slightly different than the 2020 WMP filing due to the use of the 2020 GIS information. Historical information was re-calculated as high fire threat district break outs are new requirements in the 2021 WMP.
	1.e.	Red Flag Warning Overhead circuit mile days - Non-HFTD	45,766	166,281	299,356	170,293	122,502	0	16,423	38,309	107,651	34,108	12,537	876	71,471					Red Flag Warning Overhead circuit mile days, see above for definition	GIS systems are used in order to overlay the locational information of each red flag warning. GIS models are updated frequently with changes within SCE's service territroy and does not have the ability to analyze and calculate information in previous years. As such, the overhead lengths of distribution and transmission circuits are based on 2020 circuit mile information for the calculation of historical years 2015-2019. Additionally, this overall number may be slightly different than the 2020 WMP filing due to the use of the 2020 GIS information. Historical information was re-calculated as high fire threat district break outs are new requirements in the 2021 WMP.
2. Wind conditions	2.a.	High wind warning overhead circuit mile days	78,965	116,378	144,820	133,880	95,208	61,545	9,235	62	57,072	78,101	10,503	0	28,926					Sum of overhead circuit miles of utility grid subject to High Wind Warnings (HWW, as defined by the National Weather Service) each day within a given time period, calculated as the number of overhead circuit miles that were under an HWW multiplied by the number of days those miles were under said HWW. For example, if 100 overhead circuit miles were under an HWW for 1 day, and 10 of those miles were under HWW for an additional day, then the total HWW OH circuit mile days would be 110.	GIS systems are used in order to overlay the locational information of each red flag warning. GIS models are updated frequently with changes within SCE's service territroy and does not have the ability to analyze and calculate information in previous years. As such, the overhead lengths of distribution and transmission circuits are based on 2020 circuit mile information for the calculation of historical years 2015-2019. Additionally, this overall number may be slightly different than the 2020 WMP filing due to the use of the 2020 GIS information. Historical information was re-calculated as high fire threat district break outs are new requirements in the 2021 WMP.
3. Other	3.a.	Other relevant weather pattern metrics tracked (add additional rows as needed)																			

Utility	Southern California Edison Company	**Notes:**
Table No.	7.1	Transmission lines refer to all lines at or above 65kV, and distribution lines refer to all lines below 65kV.
Date Modified	2/18/2022	Data from 2015 - 2021 Q4 should be actual numbers. 2022 Q1 - 2024 should be projected. In future submissions update projected numbers with actuals

Table 7.1: Key recent and projected drivers of risk events

Risk Event category	Cause category	#	Sub-cause category	Are risk events tracked fo	Number of risk events 2015	2016	2017	2018	2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021	Projected risk events Q1 2022	Q2 2022	Q3 2022	Q4 2022	Q1 2023	Q2 2023	Q3 2023	Q4 2023	Unit(s)	Comments
Wire down event - Distribution	1. Contact from object - Distribution	1.a.	Veg. contact- Distribution	Yes	279	404	382	158	308	86	103	80	150	113	68	57	133	86	60	61	93	84	59	60	91	# risk events (excluding ignitions)	
		1.b.	Animal contact- Distribution	Yes	74	59	53	48	38	10	19	28	11	11	13	11	14	13	13	13	14	13	13	13	14	# risk events (excluding ignitions)	
		1.c.	Balloon contact- Distribution	Yes	115	113	115	134	98	22	47	27	12	24	48	21	13	24	47	23	14	24	47	23	14	# risk events (excluding ignitions)	
		1.d.	Vehicle contact- Distribution	Yes	227	374	248	267	269	78	121	89	97	80	120	104	100	90	102	99	97	89	101	97	96	# risk events (excluding ignitions)	
		1.e.	Other contact from object - Distribution	Yes	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
	2. Equipment / facility failure - Distribution	2.a.	Connector damage or failure- Distribution	Yes	84	112	81	75	68	25	34	37	19	24	17	22	15	21	20	21	19	21	20	21	19	# risk events (excluding ignitions)	
		2.b.	Splice damage or failure — Distribution	Yes	35	28	24	24	28	3	10	10	6	11	3	5	6	8	6	6	6	8	6	6	6	# risk events (excluding ignitions)	
		2.c.	Crossarm damage or failure - Distribution	Yes	31	29	26	25	35	10	10	5	9	15	3	3	11	13	5	4	11	13	5	4	11	# risk events (excluding ignitions)	
		2.d.	Insulator damage or failure- Distribution	No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
		2.e.	Lightning arrestor damage or failure- Distribution	Yes	0	0	2	0	2	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
		2.f.	Tap damage or failure - Distribution	Yes	0	0	4	5	12	4	3	2	2	5	0	1	2	3	1	2	2	3	1	2	2	# risk events (excluding ignitions)	
		2.g.	Tie wire damage or failure - Distribution	No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
		2.h.	Other - Distribution	Yes	105	120	141	151	231	53	127	160	144	111	110	97	141	132	132	130	142	132	132	130	142	# risk events (excluding ignitions)	
	3. Wire-to-wire contact - Distribution	3.a.	Wire-to-wire contact / contamination- Distribution	Yes	0	0	1	2	1	0	4	2	1	4	0	0	0	1	0	0	0	1	0	0	0	# risk events (excluding ignitions)	
	4. Contamination - Distribution	4.a.	Contamination - Distribution	No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
	5. Utility work / Operation	5.a.	Utility work / Operation	No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
	6. Vandalism / Theft - Distribution	6.a.	Vandalism / Theft - Distribution	No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
	7. Other- Distribution	7.a.	All Other- Distribution	Yes	580	1154	1530	863	678	101	58	82	154	231	104	79	99	138	94	87	92	138	94	87	92	# risk events (excluding ignitions)	
	8. Unknown- Distribution	8.a.	Unknown - Distribution	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
Wire down event - Transmission	9. Contact from object - Transmission	9.a.	Veg. contact- Transmission	Yes	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
		9.b.	Animal contact- Transmission	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
		9.c.	Balloon contact- Transmission	Yes	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
		9.d.	Vehicle contact- Transmission	Yes	0	3	2	2	8	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
		9.e.	Other contact from object - Transmission	Yes	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
	10. Equipment / facility failure - Transmission	10.a.	Connector damage or failure- Transmission	Yes	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
		10.b.	Splice damage or failure — Transmission	Yes	0	0	1	3	2	2	0	0	0	0	0	2	1	0	0	1	0	0	0	1	0	# risk events (excluding ignitions)	
		10.c.	Crossarm damage or failure - Transmission	Yes	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
		10.d.	Insulator damage or failure- Transmission	Yes	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
		10.e.	Lightning arrestor damage or failure- Transmission	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
		10.f.	Tap damage or failure - Transmission	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
		10.g.	Tie wire damage or failure - Transmission	No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
		10.h.	Other - Transmission	Yes	0	8	2	1	6	0	2	2	1	0	1	1	0	0	1	0	0	0	1	0	0	# risk events (excluding ignitions)	
	11. Wire-to-wire contact - Transmission	11.a.	Wire-to-wire contact / contamination- Transmission	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
	12. Contamination - Transmission	12.a.	Contamination - Transmission	No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
	13. Utility work / Operation	13.a.	Utility work / Operation	No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
	14. Vandalism / Theft - Transmission	14.a.	Vandalism / Theft - Transmission	Yes	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
	15. Other- Transmission	15.a.	All Other- Transmission	Yes	1	6	4	0	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
	16. Unknown- Transmission	16.a.	Unknown - Transmission	Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
Outage - Distribution	17. Contact from object - Distribution	17.a.	Veg. contact- Distribution	Yes	395	557	609	416	527	104	70	25	111	93	20	33	174	108	2	28	93	95	0	26	73	# risk events (excluding ignitions)	
		17.b.	Animal contact- Distribution	Yes	655	598	622	648	686	122	202	169	163	78	169	143	103	61	159	126	97	58	156	115	93	# risk events (excluding ignitions)	
		17.c.	Balloon contact- Distribution	Yes	758	785	911	975	776	178	348	272	191	245	436	246	166	235	375	232	172	232	360	225	168	# risk events (excluding ignitions)	
		17.d.	Vehicle contact- Distribution	Yes	508	586	528	647	517	116	113	153	132	144	128	146	142	141	132	135	135	138	130	130	132	# risk events (excluding ignitions)	
		17.e.	Other contact from object - Distribution	Yes	869	393	289	369	449	44	28	35	42	66	75	115	129	108	86	109	113	108	85	108	112	# risk events (excluding ignitions)	
	18. Equipment / facility failure - Distribution	18.a.	Capacitor bank damage or failure- Distribution	Yes	280	275	372	337	426	126	159	72	46	110	98	124	80	96	96	102	90	96	96	102	90	# risk events (excluding ignitions)	
		18.b.	Conductor damage or failure — Distribution	Yes	463	594	654	713	1116	206	144	211	252	276	109	133	319	304	235	209	296	294	229	204	288	# risk events (excluding ignitions)	
		18.c.	Fuse damage or failure - Distribution	Yes	232	195	245	508	1245	169	176	317	167	179	132	201	183	181	158	156	178	181	158	156	178	# risk events (excluding ignitions)	
		18.d.	Lightning arrestor damage or failure- Distribution	Yes	105	127	99	106	216	27	21	26	25	12	21	18	22	24	26	24	27	24	26	24	27	# risk events (excluding ignitions)	
		18.e.	Switch damage or failure- Distribution	Yes	51	46	45	67	78	17	11	16	19	14	10	18	22	15	13	16	19	15	13	16	19	# risk events (excluding ignitions)	
		18.f.	Pole damage or failure - Distribution	Yes	98	126	130	207	541	57	36	31	40	32	22	21	60	52	47	43	56	52	47	43	56	# risk events (excluding ignitions)	
		18.g.	Insulator and brushing damage or failure - Distribution	Yes	42	75	79	123	121	28	14	11	43	30	13	22	45	27	15	21	37	27	15	21	37	# risk events (excluding ignitions)	
		18.h.	Crossarm damage or failure - Distribution	Yes	127	143	138	354	834	98	45	29	45	39	17	17	61	56	46	36	63	56	46	36	62	# risk events (excluding ignitions)	
		18.i.	Voltage regulator / booster damage or failure - Distribution	Yes	1	2	1	2	4	0	0	1	1	0	1	2	0	0	1	1	0	0	1	1	0	# risk events (excluding ignitions)	
		18.j.	Recloser damage or failure - Distribution	No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
		18.k.	Anchor / guy damage or failure - Distribution	Yes	17	20	18	17	20	3	3	3	4	3	1	3	5	4	2	3	5	4	2	3	5	# risk events (excluding ignitions)	
		18.l.	Sectionalizer damage or failure - Distribution	No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
		18.m.	Connection device damage or failure - Distribution	Yes	386	490	406	501	500	123	111	86	97	165	108	66	145	131	100	84	113	128	90	79	109	# risk events (excluding ignitions)	
		18.n.	Transformer damage or failure - Distribution	Yes	1889	1649	1978	2594	2489	416	559	1890	536	403	547	724	501	524	613	1053	556	522	603	1029	537	# risk events (excluding ignitions)	
		18.o.	Other - Distribution	Yes	97	150	117	178	320	38	50	64	66	50	60	50	64	56	59	55	60	56	59	55	60	# risk events (excluding ignitions)	
	19. Wire-to-wire contact - Distribution	19.a.	Wire-to-wire contact / contamination- Distribution	Yes	46	78	64	41	13	6	5	8	7	3	2	11	21	15	15	18	21	15	15	17	21	# risk events (excluding ignitions)	
	20. Contamination - Distribution	20.a.	Contamination - Distribution	No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
	21. Utility work / Operation	21.a.	Utility work / Operation	Yes	152	128	110	98	67	32	15	18	10	14	10	12	14	14	12	13	14	14	12	13	14	# risk events (excluding ignitions)	
	22. Vandalism / Theft - Distribution	22.a.	Vandalism / Theft - Distribution	Yes	78	80	78	102	103	23	21	21	15	9	16	21	17	16	19	21	19	16	19	21	19	# risk events (excluding ignitions)	
	23. Other- Distribution	23.a.	All Other- Distribution	Yes	2006	2237	2346	3137	3099	482	574	965	445	374	526	700	524	383	522	743	495	383	522	743	495	# risk events (excluding ignitions)	
	24. Unknown- Distribution	24.a.	Unknown - Distribution	Yes	2142	2141	2408	1741	1879	361	460	508	538	603	509	483	570	546	514	501	517	546	513	501	517	# risk events (excluding ignitions)	
Outage - Transmission	25. Contact from object - Transmission	25.a.	Veg. contact- Transmission	Yes	15	16	13	9	8	0	0	1	5	2	1	0	1	2	2	2	2	2	2	2	2	# risk events (excluding ignitions)	
		25.b.	Animal contact- Transmission	Yes	79	75	67	70	33	8	20	5	12	6	14	10	6	7	10	9	8	7	10	9	8	# risk events (excluding ignitions)	
		25.c.	Balloon contact- Transmission	Yes	23	39	56	50	24	3	14	7	8	10	14	4	8	11	10	7	8	11	10	7	8	# risk events (excluding ignitions)	
		25.d.	Vehicle contact- Transmission	Yes	36	39	39	38	18	3	5	6	4	8	6	3	5	6	5	4	5	6	5	4	5	# risk events (excluding ignitions)	
		25.e.	Other contact from object - Transmission	Yes	77	36	36	45	28	7	4	5	3	1	2	4	9	3	4	4	6	3	4	4	6	# risk events (excluding ignitions)	
	26. Equipment / facility failure - Transmission	26.a.	Capacitor bank damage or failure- Transmission	Yes	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
		26.b.	Conductor damage or failure — Transmission	Yes	23	16	91	47	38	6	3	13	7	9	5	6	20	9	8	8	13	9	8	8	13	# risk events (excluding ignitions)	
		26.c.	Fuse damage or failure - Transmission	Yes	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
		26.d.	Lightning arrestor damage or failure- Transmission	Yes	2	5	2	4	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
		26.e.	Switch damage or failure- Transmission	Yes	5	3	4	5	2	3	2	0	0	0	1	0	1	1	1	1	1	1	1	1	1	# risk events (excluding ignitions)	
		26.f.	Pole damage or failure - Transmission	Yes	13	13	18	10	14	3	0	3	3	3	8	3	3	3	5	3	3	3	5	3	3	# risk events (excluding ignitions)	
		26.g.	Insulator and brushing damage or failure - Transmission	Yes	10	13	20	4	9	2	3	1	2	0	1	0	3	2	2	2	3	2	2	2	3	# risk events (excluding ignitions)	
		26.h.	Crossarm damage or failure - Transmission	Yes	11	7	8	7	8	2	1	2	0	0	1	0	4	1	1	1	2	1	1	1	2	# risk events (excluding ignitions)	
		26.i.	Voltage regulator / booster damage or failure - Transmission	Yes	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
		26.j.	Recloser damage or failure - Transmission	No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
		26.k.	Anchor / guy damage or failure - Transmission	Yes	3	8	8	1	4	0	1	2	4	0	1	0	1	1	1	1	1	1	1	1	1	# risk events (excluding ignitions)	
		26.l.	Sectionalizer damage or failure - Transmission	No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
		26.m.	Connection device damage or failure - Transmission	Yes	1	1	3	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
		26.n.	Transformer damage or failure - Transmission	Yes	0	1	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
		26.o.	Other - Transmission	Yes	14	26	10	25	41	3	8	9	10	10	5	5	6	7	5	5	6	7	5	5	6	# risk events (excluding ignitions)	
	27. Wire-to-wire contact - Transmission	27.a.	Wire-to-wire contact / contamination- Transmission	Yes	14	20	17	29	42	10	10	1	3	1	9	4	2	2	7	4	3	2	7	4	3	# risk events (excluding ignitions)	
	28. Contamination - Transmission	28.a.	Contamination - Transmission	No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# risk events (excluding ignitions)	
	29. Utility work / Operation	29.a.	Utility work / Operation	Yes	11	25	12	9	11	1	1	1	1	2	2	3	0	2	2	2	1	2	2	2	1	# risk events (excluding ignitions)	
	30. Vandalism / Theft - Transmission	30.a.	Vandalism / Theft - Transmission	Yes	4	7	3	10	2	0	0	1	2	0	0	1	0	1	1	1	1	1	1	1	1	# risk events (excluding ignitions)	
	31. Other- Transmission	31.a.	All Other- Transmission	Yes	189	212	224	244	187	38	63	47	55	47	54	48	53	50	53	50	53	50	53	50	53	# risk events (excluding ignitions)	
	32. Unknown- Transmission	32.a.	Unknown - Transmission	Yes	369	335	311	134	267	38	70	36	59	53	55	48	66	60	60	58	64	60	60	58	64	# risk events (excluding ignitions)	

Utility	Southern California Edison Company	**Notes:**
Table No.	7.2	Transmission lines refer to all lines at or above 65kV, and distribution lines refer to all lines below 65kV.
Date Modified	2/18/2022	Data from 2015 - 2021 should be actual numbers. 2022 and 2023 should be projected. In future submissions update projected numbers with actuals

Table 7.2: Key recent and projected drivers of ignitions

						Number of ignitions							Projected ignitions			
Metric type	**#**	**Ignition driver**	**Line Type**	**HFTD tier**	**Are ignitions tracked for ignition driv**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**Unit(s)**	**Comments**
1. Contact from object	1.a.i	Veg. contact	Distribution	Non-HFTD	Yes	7	7	10	10	10	8	12	12	12	# ignitions	
	1.a.ii	Veg. contact	Distribution	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions	
	1.a.iii	Veg. contact	Distribution	HFTD Tier 2	Yes	2	1	1	4	2	2	3	2	1	# ignitions	
	1.a.iv	Veg. contact	Distribution	HFTD Tier 3	Yes	4	4	5	1	1	1	5	3	2	# ignitions	
	1.a.v	Veg. contact	Distribution	System	Yes	13	12	16	15	13	11	20	16	15	# ignitions	
	1.a.vi	Veg. contact	Transmission	Non-HFTD	Yes	0	0	0	0	1	0	0	0	0	# ignitions	
	1.a.vii	Veg. contact	Transmission	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions	
	1.a.viii	Veg. contact	Transmission	HFTD Tier 2	Yes	0	0	0	0	0	0	0	0	0	# ignitions	
	1.a.ix	Veg. contact	Transmission	HFTD Tier 3	Yes	1	2	0	0	2	0	0	0	0	# ignitions	
	1.a.x	Veg. contact	Transmission	System	Yes	1	2	0	0	3	0	0	0	0	# ignitions	
	1.b.i	Animal contact	Distribution	Non-HFTD	Yes	2	4	3	8	14	15	10	10	10	# ignitions	
	1.b.ii	Animal contact	Distribution	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions	
	1.b.iii	Animal contact	Distribution	HFTD Tier 2	Yes	1	2	1	3	2	2	0	1	1	# ignitions	
	1.b.iv	Animal contact	Distribution	HFTD Tier 3	Yes	6	2	2	1	2	5	3	3	2	# ignitions	
	1.b.v	Animal contact	Distribution	System	Yes	9	8	6	12	18	22	13	14	13	# ignitions	
	1.b.vi	Animal contact	Transmission	Non-HFTD	Yes	0	0	3	0	0	2	0	0	0	# ignitions	
	1.b.vii	Animal contact	Transmission	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions	
	1.b.viii	Animal contact	Transmission	HFTD Tier 2	Yes	2	0	0	0	0	0	2	1	1	# ignitions	
	1.b.ix	Animal contact	Transmission	HFTD Tier 3	Yes	0	1	0	0	0	2	0	1	1	# ignitions	
	1.b.x	Animal contact	Transmission	System	Yes	2	1	3	0	0	4	2	2	2	# ignitions	
	1.c.i	Balloon contact	Distribution	Non-HFTD	Yes	10	7	11	24	10	10	18	15	15	# ignitions	
	1.c.ii	Balloon contact	Distribution	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions	
	1.c.iii	Balloon contact	Distribution	HFTD Tier 2	Yes	0	0	3	1	2	2	1	1	1	# ignitions	
	1.c.iv	Balloon contact	Distribution	HFTD Tier 3	Yes	2	3	4	5	3	5	2	2	2	# ignitions	
	1.c.v	Balloon contact	Distribution	System	Yes	12	10	18	30	15	17	21	19	18	# ignitions	
	1.c.vi	Balloon contact	Transmission	Non-HFTD	Yes	0	0	1	0	1	1	0	0	0	# ignitions	
	1.c.vii	Balloon contact	Transmission	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions	
	1.c.viii	Balloon contact	Transmission	HFTD Tier 2	Yes	1	0	1	0	0	0	0	0	0	# ignitions	
	1.c.ix	Balloon contact	Transmission	HFTD Tier 3	Yes	0	1	0	0	0	0	1	0	0	# ignitions	
	1.c.x	Balloon contact	Transmission	System	Yes	1	1	2	0	1	1	1	1	1	# ignitions	
	1.d.i	Vehicle contact	Distribution	Non-HFTD	Yes	7	4	4	4	8	3	7	6	6	# ignitions	
	1.d.ii	Vehicle contact	Distribution	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions	
	1.d.iii	Vehicle contact	Distribution	HFTD Tier 2	Yes	0	0	1	4	2	1	1	1	1	# ignitions	
	1.d.iv	Vehicle contact	Distribution	HFTD Tier 3	Yes	4	2	1	5	0	2	0	2	2	# ignitions	
	1.d.v	Vehicle contact	Distribution	System	Yes	11	6	6	13	10	6	8	9	9	# ignitions	
	1.d.vi	Vehicle contact	Transmission	Non-HFTD	Yes	0	0	0	0	0	0	0	0	0	# ignitions	
	1.d.vii	Vehicle contact	Transmission	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions	
	1.d.viii	Vehicle contact	Transmission	HFTD Tier 2	Yes	0	0	0	0	0	0	0	0	0	# ignitions	
	1.d.ix	Vehicle contact	Transmission	HFTD Tier 3	Yes	1	1	0	0	0	0	1	1	1	# ignitions	
	1.d.x	Vehicle contact	Transmission	System	Yes	1	1	0	0	0	0	1	1	1	# ignitions	
	1.e.i	Other contact from object	Distribution	Non-HFTD	Yes	2	3	3	0	4	4	10	8	8	# ignitions	
	1.e.ii	Other contact from object	Distribution	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions	
	1.e.iii	Other contact from object	Distribution	HFTD Tier 2	Yes	1	1	1	0	0	1	0	0	0	# ignitions	
	1.e.iv	Other contact from object	Distribution	HFTD Tier 3	Yes	1	2	1	0	2	0	2	1	1	# ignitions	
	1.e.v	Other contact from object	Distribution	System	Yes	4	6	5	0	6	5	12	9	9	# ignitions	
	1.e.vi	Other contact from object	Transmission	Non-HFTD	Yes	0	1	0	0	0	0	0	0	0	# ignitions	
	1.e.vii	Other contact from object	Transmission	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions	
	1.e.viii	Other contact from object	Transmission	HFTD Tier 2	Yes	1	0	0	0	0	0	0	0	0	# ignitions	
	1.e.ix	Other contact from object	Transmission	HFTD Tier 3	Yes	0	0	0	0	0	1	1	0	0	# ignitions	
	1.e.x	Other contact from object	Transmission	System	Yes	1	1	0	0	0	1	1	1	1	# ignitions	
2. Equipment / facility failure	2.a.i	Capacitor bank damage or failure	Distribution	Non-HFTD	Yes	0	0	1	0	1	0	0	0	0	# ignitions	
	2.a.ii	Capacitor bank damage or failure	Distribution	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions	
	2.a.iii	Capacitor bank damage or failure	Distribution	HFTD Tier 2	Yes	0	0	0	0	0	0	0	0	0	# ignitions	
	2.a.iv	Capacitor bank damage or failure	Distribution	HFTD Tier 3	Yes	0	1	0	0	0	0	0	0	0	# ignitions	
	2.a.v	Capacitor bank damage or failure	Distribution	System	Yes	0	1	1	0	1	0	0	0	0	# ignitions	
	2.a.vi	Capacitor bank damage or failure	Transmission	Non-HFTD	Yes	0	0	0	0	0	0	0	0	0	# ignitions	
	2.a.vii	Capacitor bank damage or failure	Transmission	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions	
	2.a.viii	Capacitor bank damage or failure	Transmission	HFTD Tier 2	Yes	0	0	0	0	0	0	0	0	0	# ignitions	
	2.a.ix	Capacitor bank damage or failure	Transmission	HFTD Tier 3	Yes	0	0	0	0	0	0	0	0	0	# ignitions	
	2.a.x	Capacitor bank damage or failure	Transmission	System	Yes	0	0	0	0	0	0	0	0	0	# ignitions	
	2.b.i	Conductor damage or failure	Distribution	Non-HFTD	Yes	1	14	14	1	6	11	21	18	18	# ignitions	
	2.b.ii	Conductor damage or failure	Distribution	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions	
	2.b.iii	Conductor damage or failure	Distribution	HFTD Tier 2	Yes	1	2	0	1	2	2	2	2	2	# ignitions	
	2.b.iv	Conductor damage or failure	Distribution	HFTD Tier 3	Yes	0	3	1	3	3	12	5	3	2	# ignitions	
	2.b.v	Conductor damage or failure	Distribution	System	Yes	2	19	15	5	11	25	28	22	22	# ignitions	
	2.b.vi	Conductor damage or failure	Transmission	Non-HFTD	Yes	0	0	0	0	0	0	0	0	0	# ignitions	
	2.b.vii	Conductor damage or failure	Transmission	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions	

2.b.viii	Conductor damage or failure	Transmission	HFTD Tier 2	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.b.ix	Conductor damage or failure	Transmission	HFTD Tier 3	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.b.x	Conductor damage or failure	Transmission	System	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.c.i	Fuse damage or failure	Distribution	Non-HFTD	Yes	1	0	1	0	2	1	1	1	1	# ignitions
2.c.ii	Fuse damage or failure	Distribution	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.c.iii	Fuse damage or failure	Distribution	HFTD Tier 2	Yes	0	0	0	0	0	0	1	0	0	# ignitions
2.c.iv	Fuse damage or failure	Distribution	HFTD Tier 3	Yes	0	1	0	0	0	0	0	0	0	# ignitions
2.c.v	Fuse damage or failure	Distribution	System	Yes	1	1	1	0	2	1	2	1	1	# ignitions
2.c.vi	Fuse damage or failure	Transmission	Non-HFTD	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.c.vii	Fuse damage or failure	Transmission	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.c.viii	Fuse damage or failure	Transmission	HFTD Tier 2	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.c.ix	Fuse damage or failure	Transmission	HFTD Tier 3	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.c.x	Fuse damage or failure	Transmission	System	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.d.i	Lightning arrestor damage or failure	Distribution	Non-HFTD	Yes	2	0	2	0	1	2	3	2	2	# ignitions
2.d.ii	Lightning arrestor damage or failure	Distribution	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.d.iii	Lightning arrestor damage or failure	Distribution	HFTD Tier 2	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.d.iv	Lightning arrestor damage or failure	Distribution	HFTD Tier 3	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.d.v	Lightning arrestor damage or failure	Distribution	System	Yes	2	0	2	0	1	2	3	2	2	# ignitions
2.d.vi	Lightning arrestor damage or failure	Transmission	Non-HFTD	Yes	0	0	0	0	1	0	0	0	0	# ignitions
2.d.vii	Lightning arrestor damage or failure	Transmission	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.d.viii	Lightning arrestor damage or failure	Transmission	HFTD Tier 2	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.d.ix	Lightning arrestor damage or failure	Transmission	HFTD Tier 3	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.d.x	Lightning arrestor damage or failure	Transmission	System	Yes	0	0	0	0	1	0	0	0	0	# ignitions
2.e.i	Switch damage or failure	Distribution	Non-HFTD	Yes	0	0	0	1	2	5	3	3	3	# ignitions
2.e.ii	Switch damage or failure	Distribution	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.e.iii	Switch damage or failure	Distribution	HFTD Tier 2	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.e.iv	Switch damage or failure	Distribution	HFTD Tier 3	Yes	0	0	0	0	0	0	1	0	0	# ignitions
2.e.v	Switch damage or failure	Distribution	System	Yes	0	0	0	1	2	5	4	4	4	# ignitions
2.e.vi	Switch damage or failure	Transmission	Non-HFTD	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.e.vii	Switch damage or failure	Transmission	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.e.viii	Switch damage or failure	Transmission	HFTD Tier 2	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.e.ix	Switch damage or failure	Transmission	HFTD Tier 3	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.e.x	Switch damage or failure	Transmission	System	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.f.i	Pole damage or failure	Distribution	Non-HFTD	Yes	1	2	1	0	0	2	0	1	1	# ignitions
2.f.ii	Pole damage or failure	Distribution	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.f.iii	Pole damage or failure	Distribution	HFTD Tier 2	Yes	0	0	0	0	0	1	0	0	0	# ignitions
2.f.iv	Pole damage or failure	Distribution	HFTD Tier 3	Yes	0	0	0	0	1	0	0	0	0	# ignitions
2.f.v	Pole damage or failure	Distribution	System	Yes	1	2	1	0	1	3	0	1	1	# ignitions
2.f.vi	Pole damage or failure	Transmission	Non-HFTD	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.f.vii	Pole damage or failure	Transmission	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.f.viii	Pole damage or failure	Transmission	HFTD Tier 2	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.f.ix	Pole damage or failure	Transmission	HFTD Tier 3	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.f.x	Pole damage or failure	Transmission	System	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.g.i	Insulator and brushing damage or failure	Distribution	Non-HFTD	Yes	0	0	0	0	2	5	1	2	2	# ignitions
2.g.ii	Insulator and brushing damage or failure	Distribution	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.g.iii	Insulator and brushing damage or failure	Distribution	HFTD Tier 2	Yes	1	2	0	0	0	1	0	0	0	# ignitions
2.g.iv	Insulator and brushing damage or failure	Distribution	HFTD Tier 3	Yes	0	0	2	1	0	1	0	0	0	# ignitions
2.g.v	Insulator and brushing damage or failure	Distribution	System	Yes	1	2	2	1	2	7	1	2	2	# ignitions
2.g.vi	Insulator and brushing damage or failure	Transmission	Non-HFTD	Yes	0	0	0	0	1	0	0	0	0	# ignitions
2.g.vii	Insulator and brushing damage or failure	Transmission	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.g.viii	Insulator and brushing damage or failure	Transmission	HFTD Tier 2	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.g.ix	Insulator and brushing damage or failure	Transmission	HFTD Tier 3	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.g.x	Insulator and brushing damage or failure	Transmission	System	Yes	0	0	0	0	1	0	0	0	0	# ignitions
2.h.i	Crossarm damage or failure	Distribution	Non-HFTD	Yes	1	2	1	1	0	0	0	0	0	# ignitions
2.h.ii	Crossarm damage or failure	Distribution	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.h.iii	Crossarm damage or failure	Distribution	HFTD Tier 2	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.h.iv	Crossarm damage or failure	Distribution	HFTD Tier 3	Yes	0	0	0	0	1	0	0	0	0	# ignitions
2.h.v	Crossarm damage or failure	Distribution	System	Yes	1	2	1	1	1	0	0	0	0	# ignitions
2.h.vi	Crossarm damage or failure	Transmission	Non-HFTD	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.h.vii	Crossarm damage or failure	Transmission	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.h.viii	Crossarm damage or failure	Transmission	HFTD Tier 2	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.h.ix	Crossarm damage or failure	Transmission	HFTD Tier 3	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.h.x	Crossarm damage or failure	Transmission	System	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.i.i	Voltage regulator / booster damage or failure	Distribution	Non-HFTD	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.i.ii	Voltage regulator / booster damage or failure	Distribution	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.i.iii	Voltage regulator / booster damage or failure	Distribution	HFTD Tier 2	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.i.iv	Voltage regulator / booster damage or failure	Distribution	HFTD Tier 3	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.i.v	Voltage regulator / booster damage or failure	Distribution	System	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.i.vi	Voltage regulator / booster damage or failure	Transmission	Non-HFTD	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.i.vii	Voltage regulator / booster damage or failure	Transmission	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.i.viii	Voltage regulator / booster damage or failure	Transmission	HFTD Tier 2	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.i.ix	Voltage regulator / booster damage or failure	Transmission	HFTD Tier 3	Yes	0	0	0	0	0	0	0	0	0	# ignitions
2.i.x	Voltage regulator / booster damage or failure	Transmission	System	Yes	0	0	0	0	0	0	0	0	0	# ignitions

	2.j.i	Recloser damage or failure	Distribution	Non-HFTD	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.j.ii	Recloser damage or failure	Distribution	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.j.iii	Recloser damage or failure	Distribution	HFTD Tier 2	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.j.iv	Recloser damage or failure	Distribution	HFTD Tier 3	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.j.v	Recloser damage or failure	Distribution	System	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.j.vi	Recloser damage or failure	Transmission	Non-HFTD	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.j.vii	Recloser damage or failure	Transmission	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.j.viii	Recloser damage or failure	Transmission	HFTD Tier 2	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.j.ix	Recloser damage or failure	Transmission	HFTD Tier 3	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.j.x	Recloser damage or failure	Transmission	System	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.k.i	Anchor / guy damage or failure	Distribution	Non-HFTD	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.k.ii	Anchor / guy damage or failure	Distribution	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.k.iii	Anchor / guy damage or failure	Distribution	HFTD Tier 2	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.k.iv	Anchor / guy damage or failure	Distribution	HFTD Tier 3	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.k.v	Anchor / guy damage or failure	Distribution	System	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.k.vi	Anchor / guy damage or failure	Transmission	Non-HFTD	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.k.vii	Anchor / guy damage or failure	Transmission	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.k.viii	Anchor / guy damage or failure	Transmission	HFTD Tier 2	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.k.ix	Anchor / guy damage or failure	Transmission	HFTD Tier 3	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.k.x	Anchor / guy damage or failure	Transmission	System	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.l.i	Sectionalizer damage or failure	Distribution	Non-HFTD	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.l.ii	Sectionalizer damage or failure	Distribution	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.l.iii	Sectionalizer damage or failure	Distribution	HFTD Tier 2	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.l.iv	Sectionalizer damage or failure	Distribution	HFTD Tier 3	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.l.v	Sectionalizer damage or failure	Distribution	System	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.l.vi	Sectionalizer damage or failure	Transmission	Non-HFTD	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.l.vii	Sectionalizer damage or failure	Transmission	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.l.viii	Sectionalizer damage or failure	Transmission	HFTD Tier 2	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.l.ix	Sectionalizer damage or failure	Transmission	HFTD Tier 3	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.l.x	Sectionalizer damage or failure	Transmission	System	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.m.i	Connection device damage or failure	Distribution	Non-HFTD	Yes	1	1	2	0	4	3	7	4	4	# ignitions
	2.m.ii	Connection device damage or failure	Distribution	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.m.iii	Connection device damage or failure	Distribution	HFTD Tier 2	Yes	1	2	0	0	1	0	4	2	2	# ignitions
	2.m.iv	Connection device damage or failure	Distribution	HFTD Tier 3	Yes	2	1	1	1	2	0	2	3	3	# ignitions
	2.m.v	Connection device damage or failure	Distribution	System	Yes	4	4	3	1	7	3	13	10	9	# ignitions
	2.m.vi	Connection device damage or failure	Transmission	Non-HFTD	Yes	0	0	0	1	1	0	0	0	0	# ignitions
	2.m.vii	Connection device damage or failure	Transmission	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.m.viii	Connection device damage or failure	Transmission	HFTD Tier 2	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.m.ix	Connection device damage or failure	Transmission	HFTD Tier 3	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.m.x	Connection device damage or failure	Transmission	System	Yes	0	0	0	1	1	0	0	0	0	# ignitions
	2.n.i	Transformer damage or failure	Distribution	Non-HFTD	Yes	2	1	1	8	2	8	8	4	4	# ignitions
	2.n.ii	Transformer damage or failure	Distribution	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.n.iii	Transformer damage or failure	Distribution	HFTD Tier 2	Yes	0	1	0	0	0	1	1	0	0	# ignitions
	2.n.iv	Transformer damage or failure	Distribution	HFTD Tier 3	Yes	1	0	1	2	1	1	2	1	1	# ignitions
	2.n.v	Transformer damage or failure	Distribution	System	Yes	3	2	2	10	3	10	11	6	6	# ignitions
	2.n.vi	Transformer damage or failure	Transmission	Non-HFTD	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.n.vii	Transformer damage or failure	Transmission	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.n.viii	Transformer damage or failure	Transmission	HFTD Tier 2	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.n.ix	Transformer damage or failure	Transmission	HFTD Tier 3	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.n.x	Transformer damage or failure	Transmission	System	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.o.i	Other	Distribution	Non-HFTD	Yes	4	4	0	6	2	2	7	6	6	# ignitions
	2.o.ii	Other	Distribution	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.o.iii	Other	Distribution	HFTD Tier 2	Yes	0	0	0	0	0	1	1	1	1	# ignitions
	2.o.iv	Other	Distribution	HFTD Tier 3	Yes	2	3	1	1	0	1	2	2	2	# ignitions
	2.o.v	Other	Distribution	System	Yes	6	7	1	7	2	4	10	8	8	# ignitions
	2.o.vi	Other	Transmission	Non-HFTD	Yes	0	0	1	0	0	0	0	0	0	# ignitions
	2.o.vii	Other	Transmission	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.o.viii	Other	Transmission	HFTD Tier 2	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	2.o.ix	Other	Transmission	HFTD Tier 3	Yes	0	0	0	1	0	0	0	0	0	# ignitions
	2.o.x	Other	Transmission	System	Yes	0	0	1	1	0	0	0	0	0	# ignitions
3. Wire-to-wire contact	3.a.i	Wire-to-wire contact / contamination	Distribution	Non-HFTD	Yes	0	1	2	1	6	4	5	5	5	# ignitions
	3.a.ii	Wire-to-wire contact / contamination	Distribution	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	3.a.iii	Wire-to-wire contact / contamination	Distribution	HFTD Tier 2	Yes	0	0	0	2	1	0	1	1	1	# ignitions
	3.a.iv	Wire-to-wire contact / contamination	Distribution	HFTD Tier 3	Yes	1	0	1	0	1	1	0	0	0	# ignitions
	3.a.v	Wire-to-wire contact / contamination	Distribution	System	Yes	1	1	3	3	8	5	6	6	6	# ignitions
	3.a.vi	Wire-to-wire contact / contamination	Transmission	Non-HFTD	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	3.a.vii	Wire-to-wire contact / contamination	Transmission	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	3.a.viii	Wire-to-wire contact / contamination	Transmission	HFTD Tier 2	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	3.a.ix	Wire-to-wire contact / contamination	Transmission	HFTD Tier 3	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	3.a.x	Wire-to-wire contact / contamination	Transmission	System	Yes	0	0	0	0	0	0	0	0	0	# ignitions
4. Contamination	4.a.i	Contamination	Distribution	Non-HFTD	Yes	1	0	0	0	2	0	0	0	0	# ignitions
	4.a.ii	Contamination	Distribution	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	4.a.iii	Contamination	Distribution	HFTD Tier 2	Yes	0	0	1	0	0	0	0	0	0	# ignitions
	4.a.iv	Contamination	Distribution	HFTD Tier 3	Yes	0	0	0	0	0	0	0	0	0	# ignitions

	4.a.v	Contamination	Distribution	System	Yes	1	0	1	0	2	0	0	0	0	# ignitions
	4.a.vi	Contamination	Transmission	Non-HFTD	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	4.a.vii	Contamination	Transmission	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	4.a.viii	Contamination	Transmission	HFTD Tier 2	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	4.a.ix	Contamination	Transmission	HFTD Tier 3	Yes	0	0	0	0	1	0	0	0	0	# ignitions
	4.a.x	Contamination	Transmission	System	Yes	0	0	0	0	1	0	0	0	0	# ignitions
5. Utility work / Operation	5.a.i	Utility work / Operation	Distribution	Non-HFTD	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	5.a.ii	Utility work / Operation	Distribution	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	5.a.iii	Utility work / Operation	Distribution	HFTD Tier 2	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	5.a.iv	Utility work / Operation	Distribution	HFTD Tier 3	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	5.a.v	Utility work / Operation	Distribution	System	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	5.a.vi	Utility work / Operation	Transmission	Non-HFTD	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	5.a.vii	Utility work / Operation	Transmission	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	5.a.viii	Utility work / Operation	Transmission	HFTD Tier 2	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	5.a.ix	Utility work / Operation	Transmission	HFTD Tier 3	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	5.a.x	Utility work / Operation	Transmission	System	Yes	0	0	0	0	0	0	0	0	0	# ignitions
6. Vandalism / Theft	6.a.i	Vandalism / Theft	Distribution	Non-HFTD	Yes	3	0	0	1	4	4	5	5	5	# ignitions
	6.a.ii	Vandalism / Theft	Distribution	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	6.a.iii	Vandalism / Theft	Distribution	HFTD Tier 2	Yes	0	0	0	0	1	0	0	0	0	# ignitions
	6.a.iv	Vandalism / Theft	Distribution	HFTD Tier 3	Yes	0	0	0	0	1	2	1	0	0	# ignitions
	6.a.v	Vandalism / Theft	Distribution	System	Yes	3	0	0	1	6	6	6	6	6	# ignitions
	6.a.vi	Vandalism / Theft	Transmission	Non-HFTD	Yes	1	0	0	0	0	0	0	0	0	# ignitions
	6.a.vii	Vandalism / Theft	Transmission	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	6.a.viii	Vandalism / Theft	Transmission	HFTD Tier 2	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	6.a.ix	Vandalism / Theft	Transmission	HFTD Tier 3	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	6.a.x	Vandalism / Theft	Transmission	System	Yes	1	0	0	0	0	0	0	0	0	# ignitions
7. Other	7.a.i	All Other	Distribution	Non-HFTD	Yes	2	0	0	0	1	6	6	7	7	# ignitions
	7.a.ii	All Other	Distribution	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	7.a.iii	All Other	Distribution	HFTD Tier 2	Yes	1	0	1	0	2	0	2	1	1	# ignitions
	7.a.iv	All Other	Distribution	HFTD Tier 3	Yes	1	0	0	0	1	1	1	1	1	# ignitions
	7.a.v	All Other	Distribution	System	Yes	4	0	1	0	4	7	9	10	10	# ignitions
	7.a.vi	All Other	Transmission	Non-HFTD	Yes	0	1	0	0	0	0	0	0	0	# ignitions
	7.a.vii	All Other	Transmission	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	7.a.viii	All Other	Transmission	HFTD Tier 2	Yes	0	0	0	0	0	1	0	0	0	# ignitions
	7.a.ix	All Other	Transmission	HFTD Tier 3	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	7.a.x	All Other	Transmission	System	Yes	0	1	0	0	0	1	0	0	0	# ignitions
8. Unknown	8.a.i	Unknown	Distribution	Non-HFTD	Yes	14	3	7	5	0	3	1	2	2	# ignitions
	8.a.ii	Unknown	Distribution	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	8.a.iii	Unknown	Distribution	HFTD Tier 2	Yes	1	0	2	1	0	0	0	0	0	# ignitions
	8.a.iv	Unknown	Distribution	HFTD Tier 3	Yes	6	2	3	0	1	0	0	0	0	# ignitions
	8.a.v	Unknown	Distribution	System	Yes	21	5	12	6	1	3	1	2	2	# ignitions
	8.a.vi	Unknown	Transmission	Non-HFTD	Yes	0	0	1	1	0	0	0	0	0	# ignitions
	8.a.vii	Unknown	Transmission	HFTD Zone 1	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	8.a.viii	Unknown	Transmission	HFTD Tier 2	Yes	1	1	0	0	0	0	0	0	0	# ignitions
	8.a.ix	Unknown	Transmission	HFTD Tier 3	Yes	0	0	0	0	0	0	0	0	0	# ignitions
	8.a.x	Unknown	Transmission	System	Yes	1	1	1	1	0	0	0	0	0	# ignitions

Utility	Southern California Edison Company
Table No.	8
Date Modified	2/18/2022

Table 8: State of service territory and utility equipment

Metric type	#	Outcome metric name	Non-HFTD 2015	HFTD Zone 1 2015	HFTD Tier 2 2015	HFTD Tier 3 2015	Non-HFTD 2016	HFTD Zone 1 2016	HFTD Tier 2 2016	HFTD Tier 3 2016	Non-HFTD 2017	HFTD Zone 1 2017	HFTD Tier 2 2017	HFTD Tier 3 2017	Non-HFTD 2018	HFTD Zone 1 2018	HFTD Tier 2 2018	HFTD Tier 3 2018
1. State of service territory and equipment in urban areas	1.a.	Circuit miles (including WUI and non-WUI)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	1.b.	Circuit miles in WUI	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	1.c.	Number of critical facilities (including WUI and non-WUI)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	1.d.	Number of critical facilities in WUI	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	1.e.	Number of customers (including WUI and non-WUI)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	1.f.	Number of customers in WUI	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	1.g.	Number of customers belonging to access and functional needs populations (including WUI and non-WUI)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	1.h.	Number of customers belonging to access and functional needs populations in WUI	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	1.i.	Circuit miles of overhead transmission lines (including WUI and non-WUI)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	1.j.	Circuit miles of overhead transmission lines in WUI	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	1.k.	Circuit miles of overhead distribution lines (including WUI and non-WUI)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	1.l.	Circuit miles of overhead distribution lines in WUI	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	1.m.	Number of substations (including WUI and non-WUI)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Note: These columns are placeholders for future QR submissions. (Non-HFTD 2022 – HFTD Tier 3 2022)

#	Non-HFTD 2019	HFTD Zone 1 2019	HFTD Tier 2 2019	HFTD Tier 3 2019	Non-HFTD 2020	HFTD Zone 1 2020	HFTD Tier 2 2020	HFTD Tier 3 2020	Non-HFTD 2021	HFTD Zone 1 2021	HFTD Tier 2 2021	HFTD Tier 3 2021	Non-HFTD 2022	HFTD Zone 1 2022	HFTD Tier 2 2022	HFTD Tier 3 2022	Unit(s)	Comments
1.a.	17,160	1	1,126	1,453	17,053	1	1,035	1,428	16,353	0	1,011	1,129					Circuit miles	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. Furthermore, 2019 data included all circuit miles, including those outside of California, whereas 2020-2021 data solely includes circuit miles within the state of California for assets SCE maintains (which does include some assets outside of SCE's service territory). SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
1.b.	3,446	0	750	1,364	3,482	0	674	1,339	2,264	0	481	762					Circuit miles in WUI	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. Furthermore, 2019 data included all circuit miles, including those outside of California, whereas 2020-2021 data solely includes circuit miles within the state of California for assets SCE maintains (which does include some assets outside of SCE's service territory). SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
1.c.	36,757	6	2,550	3,923	36,911	6	2,207	3,917	36,944		1,889	2,991					Number of critical facilities	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. Furthermore, 2019 data included some locations outside of SCE's service territory within California, whereas 2020-2021 data solely includes critical facilities within SCE's service territory within California. SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
1.d.	7,305	5	1,676	3,489	7,502	5	1,417	3,489	4,657	0	860	2,098					Number of critical facilities in WUI	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. Furthermore, 2019 data included some locations outside of SCE's service territory within California, whereas 2020-2021 data solely includes critical facilities within SCE's service territory within California. SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
1.e.	3,790,432	545	209,126	323,745	3,790,432	545	209,126	323,745	3,316,257	15	126,254	226,932					Number of customers	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
1.f.	778,819	525	149,646	294,005	778,819	525	149,646	294,005	511,274	13	71,212	183,954					Number of customers in WUI	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
1.g.	1,032,899	32	30,783	44,840	1,032,899	32	30,783	44,840	1,201,396	7	27,699	44,897					Number of customers belonging to access and functional needs populations	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
1.h.	206,260	21	23,970	41,362	206,260	21	23,970	41,362	168,390	0	16,523	37,295					Number of customers belonging to access and functional needs populations in WUI	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
1.i.	1,954	0	218	224	1,937	0	204	215	2,581	0	303	353					Circuit miles of overhead transmission lines	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. Furthermore, 2019 data included all circuit miles, including those outside of California, whereas 2020-2021 data solely includes circuit miles within the state of California for assets SCE maintains (which does include some assets outside of SCE's service territory). SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
1.j.	293	0	131	182	301	0	121	174	255	0	110	158					Circuit miles of overhead transmission lines in WUI	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. Furthermore, 2019 data included all circuit miles, including those outside of California, whereas 2020-2021 data solely includes circuit miles within the state of California for assets SCE maintains (which does include some assets outside of SCE's service territory). SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
1.k.	15,206	1	908	1,229	15,116	1	831	1,213	13,772	0	708	775					Circuit miles of overhead distribution lines	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. Furthermore, 2019 data included all circuit miles, including those outside of California, whereas 2020-2021 data solely includes circuit miles within the state of California for assets SCE maintains (which does include some assets outside of SCE's service territory). SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
1.l.	3,153	0	619	1,181	3,181	0	553	1,166	2,009	0	370	604					Circuit miles of overhead distribution lines in WUI	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. Furthermore, 2019 data included all circuit miles, including those outside of California, whereas 2020-2021 data solely includes circuit miles within the state of California for assets SCE maintains (which does include some assets outside of SCE's service territory). SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
1.m.	231	0	23	17	230	0	12	13	392	0	18	19					Number of substations	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. Furthermore, 2019 data included all substations, including those outside of California, whereas 2020-2021 data solely includes substations within the state of California for assets SCE maintains (which does include some assets outside of SCE's service territory). SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.

	1.n	Number of substations in WUI	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	47	0	16	16	43	0	6	12	43	0	6	10	Number of substations in WUI	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. Furthermore, 2019 data included all substations, including those outside of California, whereas 2020-2021 data solely includes substations within the state of California for assets SCE maintains (which does include some assets outside of SCE's service territory). SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
,	1.o.	Number of weather stations (including WUI and non-WUI)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	35	0	18	32	51	0	107	94	51	0	142	136	Number of weather stations	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
	1.p.	Number of weather stations in WUI	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	20	0	11	31	29	0	63	89	16	0	69	86	Number of weather stations in WUI	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
2. State of service territory and equipment in rural areas	2.a.	Circuit miles (including WUI and non-WUI)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8,536	0	2,127	3,724	8,543	0	2,012	3,676	6,186	1	1,982	3,390	Circuit miles	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. Furthermore, 2019 data included all circuit miles, including those outside of California, whereas 2020-2021 data solely includes circuit miles within the state of California for assets SCE maintains (which does include some assets outside of SCE's service territory). SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
	2.b.	Circuit miles in WUI	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3,263	0	1,492	2,729	3,307	0	1,408	2,695	1,758	0	830	1,677	Circuit miles in WUI	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. Furthermore, 2019 data included all circuit miles, including those outside of California, whereas 2020-2021 data solely includes circuit miles within the state of California for assets SCE maintains (which does include some assets outside of SCE's service territory). SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
	2.c.	Number of critical facilities (including WUI and non-WUI)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7,692	0	1,456	2,894	7,744	0	1,338	2,890	4,846	0	1,290	2,948	Number of critical facilities	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. Furthermore, 2019 data included some locations outside of SCE's service territory within California, whereas 2020-2021 data solely includes critical facilities within SCE's service territory within California. SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
	2.d.	Number of critical facilities in WUI	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2,397	0	1,036	2,348	2,460	0	940	2,343	1,613	0	687	1,822	Number of critical facilities in WUI	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. Furthermore, 2019 data included some locations outside of SCE's service territory within California, whereas 2020-2021 data solely includes critical facilities within SCE's service territory within California. SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
	2.e.	Number of customers (including WUI and non-WUI)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	225,587	20	53,624	92,195	225,587	20	53,624	92,195	195,511	8	55,535	112,997	Number of customers	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
	2.f.	Number of customers in WUI	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	94,950	16	44,971	83,235	94,950	16	44,971	83,235	107,381	2	45,662	99,248	Number of customers in WUI	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
	2.g.	Number of customers belonging to access and functional needs populations (including WUI and non-WUI)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	37,100	4	7,741	9,410	37,100	4	7,741	9,410	61,769	0	15,305	21,164	Number of customers belonging to access and functional needs populations	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
	2.h.	Number of customers belonging to access and functional needs populations in WUI	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	19,384	1	6,718	8,676	19,384	1	6,718	8,676	37,808	0	13,355	19,610	Number of customers belonging to access and functional needs populations in WUI	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
	2.i.	Circuit miles of overhead transmission lines (including WUI and non-WUI)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1,353	0	454	772	1,348	0	444	757	1,328	0	647	1,027	Circuit miles of overhead transmission lines	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. Furthermore, 2019 data included all circuit miles, including those outside of California, whereas 2020-2021 data solely includes circuit miles within the state of California for assets SCE maintains (which does include some assets outside of SCE's service territory). SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
	2.j.	Circuit miles of overhead transmission lines in WUI	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	334	0	284	419	336	0	277	410	133	0	144	236	Circuit miles of overhead transmission lines in WUI	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. Furthermore, 2019 data included all circuit miles, including those outside of California, whereas 2020-2021 data solely includes circuit miles within the state of California for assets SCE maintains (which does include some assets outside of SCE's service territory). SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
	2.k.	Circuit miles of overhead distribution lines (including WUI and non-WUI)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7,183	0	1,673	2,952	7,195	0	1,567	2,919	4,859	1	1,335	2,363	Circuit miles of overhead distribution lines	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. Furthermore, 2019 data included all circuit miles, including those outside of California, whereas 2020-2021 data solely includes circuit miles within the state of California for assets SCE maintains (which does include some assets outside of SCE's service territory). SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
	2.l.	Circuit miles of overhead distribution lines in WUI	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2,929	0	1,208	2,310	2,970	0	1,131	2,285	1,626	0	686	1,441	Circuit miles of overhead distribution lines in WUI	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. Furthermore, 2019 data included all circuit miles, including those outside of California, whereas 2020-2021 data solely includes circuit miles within the state of California for assets SCE maintains (which does include some assets outside of SCE's service territory). SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.

	2.m.	Number of substations (including WUI and non-WUI)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	125	0	18	32	112	0	13	29	124	0	24	39	Number of substations	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. Furthermore, 2019 data included all circuit miles, including those outside of California, whereas 2020-2021 data solely includes circuit miles within the state of California for assets SCE maintains (which does include some assets outside of SCE's service territory). SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
	2.n	Number of substations in WUI	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	25	0	10	26	21	0	6	24	16	0	5	18	Number of substations in WUI	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. Furthermore, 2019 data included all circuit miles, including those outside of California, whereas 2020-2021 data solely includes circuit miles within the state of California for assets SCE maintains (which does include some assets outside of SCE's service territory). SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
	2.o.	Number of weather stations (including WUI and non-WUI)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	20	0	53	152	30	0	144	273	30	0	187	395	Number of weather stations	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
	2.p.	Number of weather stations in WUI	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9	0	39	119	14	0	105	216	11	0	75	187	Number of weather stations in WUI	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
3. State of service territory and equipment in highly rural areas	3.a.	Circuit miles (including WUI and non-WUI)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	12,179	1	2,758	2,992	11,688	1	2,645	2,916	14,411	1	2,876	3,500	Circuit miles	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. Furthermore, 2019 data included all circuit miles, including those outside of California, whereas 2020-2021 data solely includes circuit miles within the state of California for assets SCE maintains (which does include some assets outside of SCE's service territory). SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
	3.b.	Circuit miles in WUI	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	94	0	35	44	94	0	25	44	2,722	0	910	1,629	Circuit miles in WUI	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. Furthermore, 2019 data included all circuit miles, including those outside of California, whereas 2020-2021 data solely includes circuit miles within the state of California for assets SCE maintains (which does include some assets outside of SCE's service territory). SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
	3.c.	Number of critical facilities (including WUI and non-WUI)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	21,784	0	1,767	2,598	21,728	0	1,613	2,560	13,483	5	2,062	3,260	Number of critical facilities	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. Furthermore, 2019 data included some locations outside of SCE's service territory within California, whereas 2020-2021 data solely includes critical facilities within SCE's service territory within California. SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
	3.d.	Number of critical facilities in WUI	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	98	0	22	32	99	0	18	29	3,020	4	938	1,881	Number of critical facilities in WUI	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. Furthermore, 2019 data included some locations outside of SCE's service territory within California, whereas 2020-2021 data solely includes critical facilities within SCE's service territory within California. SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
	3.e.	Number of customers (including WUI and non-WUI)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	379,812	8	24,861	37,774	379,812	8	24,861	37,774	944,764	420	92,639	127,383	Number of customers	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
	3.f.	Number of customers in WUI	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2,566	0	968	1,578	2,566	0	968	1,578	297,274	377	67,958	110,603	Number of customers in WUI	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
	3.g.	Number of customers belonging to access and functional needs populations (including WUI and non-WUI)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	44,535	0	2,492	2,674	44,535	0	2,492	2,674	332,340	0	19,356	25,302	Number of customers belonging to access and functional needs populations	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
	3.h.	Number of customers belonging to access and functional needs populations in WUI	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	342	0	54	100	342	0	54	100	107,332	0	15,341	23,146	Number of customers belonging to access and functional needs populations in WUI	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
	3.i.	Circuit miles of overhead transmission lines (including WUI and non-WUI)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5,161	0	1,286	1,400	4,764	0	1,256	1,372	4,034	0	1,000	988	Circuit miles of overhead transmission lines	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. Furthermore, 2019 data included all circuit miles, including those outside of California, whereas 2020-2021 data solely includes circuit miles within the state of California for assets SCE maintains (which does include some assets outside of SCE's service territory). SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
	3.j.	Circuit miles of overhead transmission lines in WUI	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8	0	3	3	8	0	3	5	239	0	162	201	Circuit miles of overhead transmission lines in WUI	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. Furthermore, 2019 data included all circuit miles, including those outside of California, whereas 2020-2021 data solely includes circuit miles within the state of California for assets SCE maintains (which does include some assets outside of SCE's service territory). SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
	3.k.	Circuit miles of overhead distribution lines (including WUI and non-WUI)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7,018	1	1,472	1,593	6,924	1	1,389	1,544	10,377	1	1,876	2,512	Circuit miles of overhead distribution lines	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. Furthermore, 2019 data included all circuit miles, including those outside of California, whereas 2020-2021 data solely includes circuit miles within the state of California for assets SCE maintains (which does include some assets outside of SCE's service territory). SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.

3.l.	Circuit miles of overhead distribution lines in WUI	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	86	0	31	41	86	0	21	39	2,483	0	748	1,429	Circuit miles of overhead distribution lines in WUI	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. Furthermore, 2019 data included all circuit miles, including those outside of California, whereas 2020-2021 data solely includes circuit miles within the state of California for assets SCE maintains (which does include some assets outside of SCE's service territory). SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
3.m.	Number of substations (including WUI and non-WUI)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	420	0	62	49	322	0	49	40	241	0	63	46	Number of substations	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. Furthermore, 2019 data included all circuit miles, including those outside of California, whereas 2020-2021 data solely includes circuit miles within the state of California for assets SCE maintains (which does include some assets outside of SCE's service territory). SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
3.n	Number of substations in WUI	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	0	0	0	2	0	0	1	23	0	12	16	Number of substations in WUI	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. Furthermore, 2019 data included all circuit miles, including those outside of California, whereas 2020-2021 data solely includes circuit miles within the state of California for assets SCE maintains (which does include some assets outside of SCE's service territory). SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
3.o.	Number of weather stations (including WUI and non-WUI)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	36	0	90	137	47	0	348	465	43	0	248	342	Number of weather stations	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.
3.p.	Number of weather stations in WUI	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0	3	0	0	0	10	4	14	0	80	157	Number of weather stations in WUI	It is important to note that GIS models are updated frequently to reflect changes within SCE's service area and for data clean-up. SCE does not have the ability to analyze and calculate information in previous years since the GIS data is dynamic and cannot be pulled retroactively. Accordingly, while SCE has provided data on an annual basis starting with 2019, 2015-2018 data is not available. SCE is still conducting quality control review of all the data and will correct any errors once its review is complete.

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Notes:
Transmission lines refer to all lines at or above 65kV, and distribution lines refer to all lines below 65kV. Report net additions using positive numbers and net removals and undergrounding using negative numbers for circuit miles and numbers of substations. Only report changes expected within the target year.
For example, if 20 net overhead circuit miles are planned for addition by 2023, with 15 being added by 2022 and 5 more added by 2023, then report "15" for 2022 and "5" for 2023. Do not report cumulative change across years. In this case, do not report "20" for 2023, but instead the number planned to be added for just that year, which is "5".

Table 9: Location of actual and planned utility equipment additions or removal year over year

Metric type	**#**	**Outcome metric name**	Non-HFTD **2020**	HFTD Zone 1 **2020**	HFTD Tier 2 **2020**	HFTD Tier 3 **2020**	Non-HFTD **2021**	HFTD Zone 1 **2021**	HFTD Tier 2 **2021**	HFTD Tier 3 **2021**	Non-HFTD **2022**	HFTD Zone 1 **2022**	HFTD Tier 2 **2022**	HFTD Tier 3 **2022**	**Unit(s)**	**Comments**
			Actual								Projected					
1. Planned utility equipment net addition (or removal) year over year - in urban areas	1.a.	Circuit miles of overhead transmission lines (including WUI and non-WUI)	4.0	0.0	1.5	1.5	8.1	0	3.9	0	4.6	0	8.2	1.5	Circuit miles	
	1.b.	Circuit miles of overhead distribution lines (including WUI and non-WUI)	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Circuit miles	SCE does not routinely track planned additions or removals by population density or WUI. While SCE has a number of planned distribution projects over the next few years, they are not far enough along in the project lifecycle to have a complete list of affected structures (new or existing), circuit path/route geometries, and/or geospatial coordinates. Therefore, SCE is unable to map all projects in GIS and subdivide as requested. SCE is also seeking to improve its processes associated with this WMP requirement.
	1.c.	Circuit miles of overhead transmission lines in WUI	0.1	0.0	1.5	1.1	1	0	1.7	0	2.2	0	3.8	0.7	Circuit miles in WUI	
	1.d.	Circuit miles of overhead distribution lines in WUI	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Circuit miles in WUI	SCE does not routinely track planned additions or removals by population density or WUI. While SCE has a number of planned distribution projects over the next few years, they are not far enough along in the project lifecycle to have a complete list of affected structures (new or existing), circuit path/route geometries, and/or geospatial coordinates. Therefore, SCE is unable to map all projects in GIS and subdivide as requested. SCE is also seeking to improve its processes associated with this WMP requirement.
	1.e.	Number of substations (including WUI and non-WUI)	0	0	0	0	0	0	0	0	0	0	0	0	Number of substations	
	1.f.	Number of substations in WUI	0	0	0	0	0	0	0	0	0	0	0	0	Number of substations in WUI	
	1.g.	Number of weather stations (including WUI and non-WUI)	16	0	89	62	1	0	35	46	Not Available	Not Available	Not Available	Not Available	Number of weather stations	Site/structure locations have not yet been determined and SCE is therefore unable to provide the locational attributes as requested
	1.h.	Number of weather stations in WUI	9	0	52	58	0	0	14	30	Not Available	Not Available	Not Available	Not Available	Number of weather stations in WUI	Site/structure locations have not yet been determined and SCE is therefore unable to provide the locational attributes as requested
2. Planned utility equipment net addition (or removal) year over year - in rural areas	2.a.	Circuit miles of overhead transmission lines (including WUI and non-WUI)	3.5	0.0	3.7	5.5	1.0	0.0	5.5	0.0	0.5	0.0	1.6	7.0	Circuit miles	
	2.b.	Circuit miles of overhead distribution lines (including WUI and non-WUI)	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Circuit miles	SCE does not routinely track planned additions or removals by population density or WUI. While SCE has a number of planned distribution projects over the next few years, they are not far enough along in the project lifecycle to have a complete list of affected structures (new or existing), circuit path/route geometries, and/or geospatial coordinates. Therefore, SCE is unable to map all projects in GIS and subdivide as requested. SCE is also seeking to improve its processes associated with this WMP requirement.
	2.c.	Circuit miles of overhead transmission lines in WUI	2.5	0.0	2.5	3.9	0.0	0.0	1.1	0.0	0.0	0.0	0.2	2.9	Circuit miles in WUI	
	2.d.	Circuit miles of overhead distribution lines in WUI	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Circuit miles in WUI	SCE does not routinely track planned additions or removals by population density or WUI. While SCE has a number of planned distribution projects over the next few years, they are not far enough along in the project lifecycle to have a complete list of affected structures (new or existing), circuit path/route geometries, and/or geospatial coordinates. Therefore, SCE is unable to map all projects in GIS and subdivide as requested. SCE is also seeking to improve its processes associated with this WMP requirement.
	2.e.	Number of substations (including WUI and non-WUI)	0	0	0	0	0	0	0	0	0	0	0	0	Number of substations	
	2.f.	Number of substations in WUI	0	0	0	0	0	0	0	0	0	0	0	0	Number of substations in WUI	
	2.g.	Number of weather stations (including WUI and non-WUI)	10	0	91	121	1	0	43	119	Not Available	Not Available	Not Available	Not Available	Number of weather stations	Site/structure locations have not yet been determined and SCE is therefore unable to provide the locational attributes as requested
	2.h.	Number of weather stations in WUI	5	0	66	97	0	0	19	50	Not Available	Not Available	Not Available	Not Available	Number of weather stations in WUI	Site/structure locations have not yet been determined and SCE is therefore unable to provide the locational attributes as requested
3. Planned utility equipment net addition (or removal) year over year - in highly rural areas	3.a.	Circuit miles of overhead transmission lines (including WUI and non-WUI)	4.3	0.0	5.7	18.9	2.3	0.0	3.6	0.0	1.2	0.0	1.4	1.9	Circuit miles	
	3.b.	Circuit miles of overhead distribution lines (including WUI and non-WUI)	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Circuit miles	SCE does not routinely track planned additions or removals by population density or WUI. While SCE has a number of planned distribution projects over the next few years, they are not far enough along in the project lifecycle to have a complete list of affected structures (new or existing), circuit path/route geometries, and/or geospatial coordinates. Therefore, SCE is unable to map all projects in GIS and subdivide as requested. SCE is also seeking to improve its processes associated with this WMP requirement.
	3.c.	Circuit miles of overhead transmission lines in WUI	0	0	0	0.3	0.3	0	1.9	0	0.7	0	0.7	1.7	Circuit miles in WUI	
	3.d.	Circuit miles of overhead distribution lines in WUI	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Circuit miles in WUI	SCE does not routinely track planned additions or removals by population density or WUI. While SCE has a number of planned distribution projects over the next few years, they are not far enough along in the project lifecycle to have a complete list of affected structures (new or existing), circuit path/route geometries, and/or geospatial coordinates. Therefore, SCE is unable to map all projects in GIS and subdivide as requested. SCE is also seeking to improve its processes associated with this WMP requirement.
	3.e.	Number of substations (including WUI and non-WUI)	1	0	0	0	0	0	0	0	0	0	0	0	Number of substations	
	3.f.	Number of substations in WUI	0	0	0	0	0	0	0	0	0	0	0	0	Number of substations in WUI	
	3.g.	Number of weather stations (including WUI and non-WUI)	11	0	91	102	2	0	59	99	Not Available	Not Available	Not Available	Not Available	Number of weather stations	Site/structure locations have not yet been determined and SCE is therefore unable to provide the locational attributes as requested
	3.h.	Number of weather stations in WUI	0	0	2	2	0	0	16	44	Not Available	Not Available	Not Available	Not Available	Number of weather stations in WUI	Site/structure locations have not yet been determined and SCE is therefore unable to provide the locational attributes as requested

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Notes:
Transmission lines refer to all lines at or above 65kV, and distribution lines refer to all lines below 65kV.
In future submissions update planned upgrade numbers with actuals
In the comments column on the far-right, enter the relevant program target(s) associate

Table 10: Location of actual and planned utility infrastructure upgrades year over year

			Actual								Projected					
Metric type	**#**	**Outcome metric name**	Non-HFTD **2020**	HFTD Zone 1 **2020**	HFTD Tier 2 **2020**	HFTD Tier 3 **2020**	Non-HFTD **2021**	HFTD Zone 1 **2021**	HFTD Tier 2 **2021**	HFTD Tier 3 **2021**	Non-HFTD **2022**	HFTD Zone 1 **2022**	HFTD Tier 2 **2022**	HFTD Tier 3 **2022**	**Unit(s)**	**Comments**
1. Planned utility infrastructure upgrades year over year - in urban areas	1.a.	Circuit miles of overhead transmission lines planned for upgrades (including WUI and non-WUI)	0	0	0	0	13.1	0	3.4	0.9	0	0	0	0	Circuit miles	SCE does not routinely track planned upgrades by population density or WUI but has endeavored to provide this data where feasible. SCE is also seeking to improve its processes associated with this WMP requirement.
	1.b.	Circuit miles of overhead distribution lines planned for upgrades (including WUI and non-WUI)	4.7	0.0	16.4	46.2	32.3	0.0	63.9	252.6	35.2	0.0	73.5	149.4	Circuit miles	SCE does not routinely track planned upgrades by population density or WUI but has endeavored to provide this data where feasible. SCE is also seeking to improve its processes associated with this WMP requirement. For 2021-2022, this data is still "projected" from SCE's prior submission and SCE is still seeking a path to provide this data as accurately as possible.
	1.c.	Circuit miles of overhead transmission lines planned for upgrades in WUI	0	0	0	0	9.8	0	0.7	0.9	0	0	0	0	Circuit miles in WUI	SCE does not routinely track planned upgrades by population density or WUI but has endeavored to provide this data where feasible. SCE is also seeking to improve its processes associated with this WMP requirement.
	1.d.	Circuit miles of overhead distribution lines planned for upgrades in WUI	4.3	0.0	16.1	44.9	16.4	0.0	62.3	247.1	28.5	0.0	66.8	148.1	Circuit miles in WUI	SCE does not routinely track planned upgrades by population density or WUI but has endeavored to provide this data where feasible. SCE is also seeking to improve its processes associated with this WMP requirement. For 2021-2022, this data is still "projected" from SCE's prior submission and SCE is still seeking a path to provide this data as accurately as possible.
	1.e.	Number of substations planned for upgrades (including WUI and non-WUI)	1	0	6	1	3	0	0	2	10	0	0	2	Number of substations	SCE does not routinely track planned upgrades by population density or WUI but has endeavored to provide this data where feasible. SCE is also seeking to improve its processes associated with this WMP requirement.
	1.f.	Number of substations planned for upgrades in WUI	1	0	4	1	1	0	0	1	4	0	0	1	Number of substations in WUI	SCE does not routinely track planned upgrades by population density or WUI but has endeavored to provide this data where feasible. SCE is also seeking to improve its processes associated with this WMP requirement.
	1.g.	Number of weather stations planned for upgrades (including WUI and non-WUI)	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Number of weather stations	SCE does not routinely track planned upgrades by population density or WUI but has endeavored to provide this data where feasible. SCE is also seeking to improve its processes associated with this WMP requirement.
	1.h.	Number of weather stations planned for upgrades in WUI	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Number of weather stations in WUI	SCE does not routinely track planned upgrades by population density or WUI but has endeavored to provide this data where feasible. SCE is also seeking to improve its processes associated with this WMP requirement.
2. Planned utility infrastructure upgrades year over year - in rural areas	2.a.	Circuit miles of overhead transmission lines planned for upgrades (including WUI and non-WUI)	0	0	0	0	3	0	28.3	25.6	0.5	0	3.5	0	Circuit miles	SCE does not routinely track planned upgrades by population density or WUI but has endeavored to provide this data where feasible. SCE is also seeking to improve its processes associated with this WMP requirement.
	2.b.	Circuit miles of overhead distribution lines planned for upgrades (including WUI and non-WUI)	9.5	0.0	93.0	390.4	60.7	0.0	304.9	938.6	28.8	0.0	186.9	268.3	Circuit miles	SCE does not routinely track planned upgrades by population density or WUI but has endeavored to provide this data where feasible. SCE is also seeking to improve its processes associated with this WMP requirement. For 2021-2022, this data is still "projected" from SCE's prior submission and SCE is still seeking a path to provide this data as accurately as possible.
	2.c.	Circuit miles of overhead transmission lines planned for upgrades in WUI	0	0	0	0	0	0	4.6	10.6	0	0	0	0	Circuit miles in WUI	SCE does not routinely track planned upgrades by population density or WUI but has endeavored to provide this data where feasible. SCE is also seeking to improve its processes associated with this WMP requirement.
	2.d.	Circuit miles of overhead distribution lines planned for upgrades in WUI	7.4	0.0	58.5	296.2	47.9	0.0	247.8	763.9	19.9	0.0	132.5	202.2	Circuit miles in WUI	SCE does not routinely track planned upgrades by population density or WUI but has endeavored to provide this data where feasible. SCE is also seeking to improve its processes associated with this WMP requirement. For 2021-2022, this data is still "projected" from SCE's prior submission and SCE is still seeking a path to provide this data as accurately as possible.
	2.e.	Number of substations planned for upgrades (including WUI and non-WUI)	0	0	0	4	2	0	3	2	7	0	2	3	Number of substations	SCE does not routinely track planned upgrades by population density or WUI but has endeavored to provide this data where feasible. SCE is also seeking to improve its processes associated with this WMP requirement.
	2.f.	Number of substations planned for upgrades in WUI	0	0	0	4	0	0	1	2	3	0	1	1	Number of substations in WUI	SCE does not routinely track planned upgrades by population density or WUI but has endeavored to provide this data where feasible. SCE is also seeking to improve its processes associated with this WMP requirement.
	2.g.	Number of weather stations planned for upgrades (including WUI and non-WUI)	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Number of weather stations	SCE does not routinely track planned upgrades by population density or WUI but has endeavored to provide this data where feasible. SCE is also seeking to improve its processes associated with this WMP requirement.
	2.h.	Number of weather stations planned for upgrades in WUI	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Number of weather stations in WUI	SCE does not routinely track planned upgrades by population density or WUI but has endeavored to provide this data where feasible. SCE is also seeking to improve its processes associated with this WMP requirement.

3. Planned utility infrastructure upgrades year over year - in highly rural areas	3.a.	Circuit miles of overhead transmission lines planned for upgrades (including WUI and non-WUI)	0	0	0	0	4.4	0	1.2	12.1	0	0	0	0	Circuit miles	SCE does not routinely track planned upgrades by population density or WUI but has endeavored to provide this data where feasible. SCE is also seeking to improve its processes associated with this WMP requirement.
	3.b.	Circuit miles of overhead distribution lines planned for upgrades (including WUI and non-WUI)	3.0	0.0	121.2	88.8	30.9	0.0	109.6	381.8	19.2	0.0	108.5	149.7	Circuit miles	SCE does not routinely track planned upgrades by population density or WUI but has endeavored to provide this data where feasible. SCE is also seeking to improve its processes associated with this WMP requirement. For 2021-2022, this data is still "projected" from SCE's prior submission and SCE is still seeking a path to provide this data as accurately as possible.
	3.c.	Circuit miles of overhead transmission lines planned for upgrades in WUI	0	0	0	0	1.3	0	0.8	2.6	0	0	0	0	Circuit miles in WUI	SCE does not routinely track planned upgrades by population density or WUI but has endeavored to provide this data where feasible. SCE is also seeking to improve its processes associated with this WMP requirement.
	3.d.	Circuit miles of overhead distribution lines planned for upgrades in WUI	0.1	0.0	1.8	2.2	0.4	0.0	1.5	12.1	0.1	0.0	2.2	2.6	Circuit miles in WUI	SCE does not routinely track planned upgrades by population density or WUI but has endeavored to provide this data where feasible. SCE is also seeking to improve its processes associated with this WMP requirement. For 2021-2022, this data is still "projected" from SCE's prior submission and SCE is still seeking a path to provide this data as accurately as possible.
	3.e.	Number of substations planned for upgrades (including WUI and non-WUI)	5	0	1	3	0	0	2	2	5	0	17	9	Number of substations	SCE does not routinely track planned upgrades by population density or WUI but has endeavored to provide this data where feasible. SCE is also seeking to improve its processes associated with this WMP requirement.
	3.f.	Number of substations planned for upgrades in WUI	0	0	0	0	0	0	1	1	1	0	2	1	Number of substations in WUI	SCE does not routinely track planned upgrades by population density or WUI but has endeavored to provide this data where feasible. SCE is also seeking to improve its processes associated with this WMP requirement.
	3.g.	Number of weather stations planned for upgrades (including WUI and non-WUI)	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Number of weather stations	SCE does not routinely track planned upgrades by population density or WUI but has endeavored to provide this data where feasible. SCE is also seeking to improve its processes associated with this WMP requirement.
	3.h.	Number of weather stations planned for upgrades in WUI	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Number of weather stations in WUI	SCE does not routinely track planned upgrades by population density or WUI but has endeavored to provide this data where feasible. SCE is also seeking to improve its processes associated with this WMP requirement.

Utility	Southern California Edison Company	Notes:
Table No.	11	"PSPS" = Public Safety Power Shutoff
		In future submissions update planned
Date Modified	2/18/2022	upgrade numbers with actuals

Note: Final QC of PSPS data is being peformed. Updated statistics of SCE's 2021 PSPS season will be provided in SCE's March 1, 2022 PSPS Post Season Report and incorporated into future Quarterly Data Table submissions'

Table 11: Recent use of PSPS and other PSPS metrics

			Actual													Projected					
Metric type	**#**	**Outcome metric name**	**2015**	**2016**	**2017**	**2018**	**2019**	Q1 **2020**	Q2 **2020**	Q3 **2020**	Q4 **2020**	Q1 **2021**	Q2 **2021**	Q3 **2021**	Q4 **2021**	Q1 **2022**	Q2 **2022**	Q3 **2022**	Q4 **2022**	**Unit(s)**	**Comments**
1. Recent use of PSPS	1.a.	Frequency of PSPS events (total)	0	0	1	3	7	0	0	2	8	1	1	1	5	0	0	2	6	Number of instances where utility operating protocol requires de-energization of a circuit or portion thereof to reduce ignition probability, per year. Only include events in which de-energization ultimately occurred	During 2020, SCE initiated 12 PSPS events (2 of which SCE did not de-energize, Table 11, Metric Type 5.a.) with 16 periods of concern, i.e., periods of time when de-energization was likely to occur due to forecast weather and fuel conditions, 16 relates to periods of concerns. For Q2-Q4 2021 time periods, SCE used 2020 recorded data adjusted for improvement expected based on SCE's planned wildfire mitigation activities to create a baseline. To factor in weather variability, which has significant impacts on PSPS events, SCE developed a range around the baseline. The range was based on an 18 year backcast analysis that analyzed how current PSPS triggers would have resulted in PSPS events when applied to historical weather data. For further details on calculating the range, please see section 8.5
	1.b.	Scope of PSPS events (total)	0	0	7	6	267	0	0	7	417	160	1	1	122	0	0	13	182	Circuit-events, measured in number of events multiplied by number of circuits de-energized per year	SCE interprets this line item as de-energized circuit count. Additionally, the numbers being reported may not align with the ESRB-8 report because that report uses preliminary operations data that has not been fully validated. For Q2-Q4 2021 time periods, SCE used 2020 recorded data adjusted for improvement expected based on SCE's planned wildfire mitigation activities to create a baseline. To factor in weather variability, which has significant impacts on PSPS events, SCE developed a range around the baseline. The range was based on an 18 year backcast analysis that analyzed how current PSPS triggers would have resulted in PSPS events when applied to historical weather data. For further details on calculating the range, please see section 8.5
	1.c.	Duration of PSPS events (total)	0	0	87,019	3,570	5,275,193	0	0	3,981	4,451,955	1,953,962	224	88	1,745,980	540,596	62	227,118	2,469,956	Customer hours per year	For Q2-Q4 2021 time periods, SCE used 2020 recorded data adjusted for improvement expected based on SCE's planned wildfire mitigation activities to create a baseline. To factor in weather variability, which has significant impacts on PSPS events, SCE developed a range around the baseline. The range was based on an 18 year backcast analysis that analyzed how current PSPS triggers would have resulted in PSPS events when applied to historical weather data. For further details on calculating the range, please see section 8.5
2. Customer hours of PSPS and other outages	2.a.	Customer hours of planned outages including PSPS (total)	0	11,067,182	10,406,442	9,556,442	10,918,480	1,236,491	770,811	1,295,679	6,103,855	3,778,268	Not Currently Available	Not Currently Available	Not Currently Available	Not Currently Available	Not Currently Available	Not Currently Available	Not Currently Available	Total customer hours of planned outages per year	SCE has not traditionally calculated reliability metrics tied to planned outages. Since 2019, SCE has been improving and refining its planned outage reliability reporting, therefore the years after 2018 reflect not only actual changes but changes due to the improved process. Further, SCE does not consider PSPS to be planned outages but has included PSPS metrics in this row as requested by WSD. SCE is currently unable to provide planned outage data metrics due to recent IT system implementation issues. SCE is actively investigating this issue and will provide the data when it is available. Forecast is based on time-series forecast.
	2.b.	Customer hours of unplanned outages, not including PSPS (total)	8,401,612	9,276,813	7,788,697	6,088,158	7,617,913	1,480,964	1,496,752	2,350,456	2,224,812	1,615,913	1,896,189	3,106,304	173,281	1,688,577	1,696,471	2,728,380	1,199,047	Total customer hours of unplanned outages per year	Forecast is based on time-series forecast.
	2.c.	System Average Interruption Duration Index (SAIDI) (including PSPS)	100.15	241.21	214.28	183.09	215.91	31.46	26.25	42.21	96.41	63.08	Not Currently Available	Not Currently Available	Not Currently Available	Not Currently Available	Not Currently Available	Not Currently Available	Not Currently Available	SAIDI index value = sum of all interruptions in time period where each interruption is defined as sum(duration of interruption * # of customer interruptions) / Total number of customers served	SCE has not traditionally calculated reliability metrics tied to planned outages. Since 2019, SCE has been improving and refining its planned outage reliability reporting, therefore the years after 2018 reflect not only actual changes but changes due to the improved process. Further, SCE does not consider PSPS to be planned outages but has included PSPS metrics in this row as requested by WSD. SCE is currently unable to provide planned outage data metrics due to recent IT system implementation issues. SCE is actively investigating this issue and will provide the data when it is available. Forecast is based on time-series forecast.
	2.d.	System Average Interruption Duration Index (SAIDI) (excluding PSPS)	100.15	241.21	213.25	183.04	154.47	31.46	26.25	42.16	44.88	39.76	Not Currently Available	Not Currently Available	Not Currently Available	Not Currently Available	Not Currently Available	Not Currently Available	Not Currently Available	SAIDI index value = sum of all interruptions in time period where each interruption is defined as sum(duration of interruption * # of customer interruptions) / Total number of customers served	SCE has not traditionally calculated reliability metrics tied to planned outages. Since 2019, SCE has been improving and refining its planned outage reliability reporting, therefore the years after 2018 reflect not only actual changes but changes due to the improved process. Forecast is based on time-series forecast. SCE is currently unable to provide planned outage data metrics due to recent IT system implementation issues. SCE is actively investigating this issue and will provide the data when it is available.
	2.e.	System Average Interruption Frequency Index (SAIFI) (including PSPS)	1.164	1.335	1.203	1.029	1.105	0.222	0.216	0.282	0.321	0.293	Not Currently Available	Not Currently Available	Not Currently Available	Not Currently Available	Not Currently Available	Not Currently Available	Not Currently Available	SAIFI index value = sum of all interruptions in time period where each interruption is defined as (total # of customer interruptions) / (total # of customers served)	SCE has not traditionally calculated reliability metrics tied to planned outages. Since 2019, SCE has been improving and refining its planned outage reliability reporting, therefore the years after 2018 reflect not only actual changes but changes due to the improved process. Further, SCE does not consider PSPS to be planned outages but has included PSPS metrics in this row as requested by WSD. SCE is currently unable to provide planned outage data metrics due to recent IT system implementation issues. SCE is actively investigating this issue and will provide the data when it is available. Forecast is based on time-series forecast.
	2.f.	System Average Interruption Frequency Index (SAIFI) (excluding PSPS)	1.164	1.335	1.203	1.029	1.067	0.222	0.216	0.281	0.279	0.270	Not Currently Available	Not Currently Available	Not Currently Available	Not Currently Available	Not Currently Available	Not Currently Available	Not Currently Available	SAIFI index value = sum of all interruptions in time period where each interruption is defined as (total # of customer interruptions) / (total # of customers served)	SCE is currently unable to provide planned outage data metrics due to recent IT system implementation issues. SCE is actively investigating this issue and will provide the data when it is available. Forecast is based on time-series forecast.
3. Critical infrastructure impacted by PSPS	3.a.	Critical infrastructure impacted by PSPS	0	0	NA	NA	5,868	0	0	12	5,123	2,066	78	3	2,497	857	32	6	3,162	Number of critical infrastructure (in accordance with D.19-05-042) locations impacted per hour multiplied by hours offline per year	The numbers being reported may not align with the ESRB-8 report because that report uses preliminary operations data that has not been fully validated. SCE also notes, that earlier PSPS events were not tracked and recorded in the same level of detail as it is now, therefore not all data is available. For Q2-Q4 2021 time periods, SCE used 2020 recorded data adjusted for improvement expected based on SCE's planned wildfire mitigation activities to create a baseline. To factor in weather variability, which has significant impacts on PSPS events, SCE developed a range around the baseline. The range was based on an
4. Community outreach of PSPS metrics	4.a.	# of customers impacted by PSPS	0	0	2,861	112	198,826	0	0	270	229,530	116,349	78	9	83,968	43,631	29	105	117,562	# of customers impacted by PSPS (if multiple PSPS events impact the same customer, count each event as a separate customer)	The numbers being reported may not align with the ESRB-8 report because that report uses preliminary operations data that has not been fully validated. For Q2-Q4 2021 time periods, SCE used 2020 recorded data adjusted for improvement expected based on SCE's planned wildfire mitigation activities to create a baseline. To factor in weather variability, which has significant impacts on PSPS events, SCE developed a range around the baseline. The range was based on an 18 year backcast analysis that analyzed how current PSPS triggers would have resulted in PSPS events when applied to historical weather data. For further details on calculating the range, please see section 8.5
	4.b.	# of medical baseline customers impacted by PSPS	0	0	NA	NA	4,043	0	0	11	7,725	3,415	2	0	3,174	1,281	1	4	4,087	# of customers impacted by PSPS (if multiple PSPS events impact the same customer, count each event as a separate customer)	The numbers being reported may not align with the ESRB-8 report because that report uses preliminary operations data that has not been fully validated. SCE also notes, that earlier PSPS events were not tracked and recorded in the same level of detail as it is now, therefore not all data is available. For Q2-Q4 2021 time periods, SCE used 2020 recorded data adjusted for improvement expected based on SCE's planned wildfire mitigation activities to create a baseline. To factor in weather variability, which has significant impacts on PSPS events, SCE developed a range around the baseline. The range was based on an 18 year backcast analysis that analyzed how current PSPS triggers would have resulted in PSPS events when applied to historical weather data. For further details on calculating the range, please see section 8.5
	4.c.	# of customers notified prior to initiation of PSPS event	0	0	NA	NA	155,824	0	0	232	143,908	110,217	66	0	78,120	41,449	28	99	111,684	# of customers notified of PSPS event prior to initiation (if multiple PSPS events impact the same customer, count each event in which customer was notified as a separate customer)	The numbers being reported may not align with the ESRB-8 report because that report uses preliminary operations data that has not been fully validated. SCE also notes, that earlier PSPS events were not tracked and recorded in the same level of detail as it is now, therefore not all data is available.
	4.d.	# of medical baseline customers notified prior to initiation of PSPS event	0	0	NA	NA	3,044	0	0	15	7,531	3,138	2	0	2,136	1,217	1	4	3,883	# of customers notified of PSPS event prior to initiation (if multiple PSPS events impact the same customer, count each event in which customer was notified as a separate customer)	The numbers being reported may not align with the ESRB-8 report because that report uses preliminary operations data that has not been fully validated. SCE also notes, that earlier PSPS events were not tracked and recorded in the same level of detail as it is now, therefore not all data is available.
	4.e.	% of customers notified prior to a PSPS event impacting them	0	0	NA	NA	78%	0	0	85%	62%	95%	85%	0%	93%	95%	95%	95%	95%	=4.c. / 4.a.	SCE also notes, that earlier PSPS events were not tracked and recorded in the same level of detail as it is now, therefore not all data is available.
	4.f.	% of medical baseline customers notified prior to a PSPS event impacting them	0	0	NA	NA	75%	0	0	100%	88%	92%	100%	0%	67%	95%	95%	95%	95%	=4.d. / 4.b.	SCE also notes, that earlier PSPS events were not tracked and recorded in the same level of detail as it is now, therefore not all data is available.
5. Other PSPS metrics	5.a.	Number of PSPS events triggered where no de-energization occurred	0	0	NA	NA	7	0	2	0	0	0	1	0	1	0	2	2	0	Number of instances where utility notified the public of a potential PSPS event but no de-energization followed	SCE also notes, that earlier PSPS events were not tracked and recorded in the same level of detail as it is now, therefore not all data is available.
	5.b.	Number of customers located on de-energized circuit	0	0	NA	NA	237,666	0	0	5,820	407,853	597,448	78	9	155,522	0	0	18,725	262,154	Number of customers	This data includes the number of customers on a circuit whether they were de-energized or not For Q2-Q4 2021 time periods, SCE used 2020 recorded data adjusted for improvement expected based on SCE's planned wildfire mitigation activities to create a baseline. To factor in weather variability, which has significant impacts on PSPS events, SCE developed a range around the baseline. The range was based on an 18 year backcast analysis that analyzed how current PSPS triggers would have resulted in PSPS events when applied to historical weather data. For further details
	5.c.	Customer hours of PSPS per RFW OH circuit mile day	0	0	NA	NA	NA	0	0	17	434	875	11	0	491	363	5	7	384	=1.c. / RFW OH circuit mile days in time period	For Q2-Q4 2021 time periods, SCE used 2020 recorded data adjusted for improvement expected based on SCE's planned wildfire mitigation activities to create a baseline. To factor in weather variability, which has significant impacts on PSPS events, SCE developed a range around the baseline. The range was based on an 18 year backcast analysis that analyzed how current PSPS triggers would have resulted in PSPS events when applied to historical weather data. For further details on calculating the range, please see section 8.5
	5.d.	Frequency of PSPS events (total) - High Wind Warning wind conditions	0	0	NA	NA	NA	0	0	1	8	1	1	0	2	1	1	1	5	Events over time period that overlapped with a High Wind Warning as defined by the National Weather Service	For Q2-Q4 2021 time periods, SCE used 2020 recorded data adjusted for improvement expected based on SCE's planned wildfire mitigation activities to create a baseline. To factor in weather variability, which has significant impacts on PSPS events, SCE developed a range around the baseline. The range was based on an 18 year backcast analysis that analyzed how current PSPS triggers would have resulted in PSPS events when applied to historical weather data. For further details on calculating the range, please see section 8.5
	5.e.	Scope of PSPS events (total) - High Wind Warning wind conditions	0	0	NA	NA	NA	0	0	7	392	151	1	0	88	57	1	3	180	Estimated customers impacted over time period that overlapped with a High Wind Warning as defined by the National Weather Service	For Q2-Q4 2021 time periods, SCE used 2020 recorded data adjusted for improvement expected based on SCE's planned wildfire mitigation activities to create a baseline. To factor in weather variability, which has significant impacts on PSPS events, SCE developed a range around the baseline. The range was based on an 18 year backcast analysis that analyzed how current PSPS triggers would have resulted in PSPS events when applied to historical weather data. For further details on calculating the range, please see section 8.5
	5.f.	Duration of PSPS events (total) - High Wind Warning wind conditions	0	0	NA	NA	NA	0	0	3,500	4,298,692	1,826,480	4	0	1,741,266	757,989	2	1,452	2,506,582	Customer hours over time period that overlapped with a High Wind Warning as defined by the National Weather Service	For Q2-Q4 2021 time periods, SCE used 2020 recorded data adjusted for improvement expected based on SCE's planned wildfire mitigation activities to create a baseline. To factor in weather variability, which has significant impacts on PSPS events, SCE developed a range around the baseline. The range was based on an 18 year backcast analysis that analyzed how current PSPS triggers would have resulted in PSPS events when applied to historical weather data. For further details on calculating the range, please see section 8.5 SCE also notes, that earlier PSPS events were not tracked and recorded in the same level of detail as it is now, therefore not all data is available. Historical numbers were corrected as the original anlaysis methodology was found to be faulty. Additionally, Since historical numbers were adjusted, the forecast

Utility	Southern California Edison Company
Table No.	12
Date Modified	2/18/2022

Notes:
Risk Spend Efficiency (RSE) is defined as "An estimate of the cost-effectiveness of initiatives, calculated by dividing the mitigation risk reduction benefit by the mitigation cost estimate based on the full set of risk reduction benefits estimated from the incurre
CAPEX = Capital expenditure; OPEX = Operating expenditure
In future submissions update planned spend, line miles treated, RSE, etc. with updated projections and actuals. Additional instructions can be found in QR information.

Regarding the Territory and HFTD split requested per the 2022 WMP Update Guidelines, SCE has taken three approaches:
(1) Wildfire activities – SCE deploys its wildfire activity spend to mitigate risk in the HFTD. Accordingly, spend for wildfire activities is shown as entirely within HFTD (i.e., Territory spend = HFTD spend).
(2) Vegetation management to achieve clearances around electric lines and equipment – SCE is complying with the 2022 WMP Update Guidelines by setting forth these costs broken down by HFTD and Non-HFTD. SCE notes, however, that this estimate reflects SCE's attempt to reasonably allocate these costs across its service area pursuant to respective tree counts and trim cadences in the HFTD and Non-HFTD areas, respectively. From an operational perspective, though, the same vegetation management contract crews often work in both HFTD and Non-HFTD areas, sometimes on the same day, making it difficult to precisely calculate the costs incurred in different areas. SCE further notes that from a regulatory cost recovery perspective, the CPUC's SCE 2021 General Rate Case Final Decision (D.21-08-036) authorized a Vegetation Management Balancing Account (VMBA) that does not differentiate between HFTD and Non-HFTD areas. Accordingly, SCE records all vegetation management line clearance costs in the VMBA, irrespective of where the trims take place.
(3) Non-wildfire activities – SCE does not track the HFTD vs. Non-HFTD split of its non-wildfire activities. Accordingly, all spend for these activities is simply shown in the Territory column, though this is not to imply that no spend occurs in the HFTD areas.

Table 12: Mitigation initiative financials

Metric type	WMP Table # / Category	2022 WMP Initiative #	Initiative activity	2021 WMP ID	Primary driver targeted	Secondary driver targeted	Year initiated	Estimated RSE territory-wide	Estimated RSE in non-HFTD region	Estimated RSE in HFTD Zone 1	Estimated RSE in HFTD Tier 2	Estimated RSE in HFTD Tier 3	If existing: most recent proceeding that has reviewed program	If new: memorandum account	Current compliance status - in / exceeding compliance with regulations	Associated rule(s) - if multiple, separate by semi-colon	If spend not disaggregated by category, note spend category or mark general operations	Comments
Other	Risk Assessment & Mapping	7.3.1.1	A summarized risk map that shows the overall ignition probability and estimated wildfire consequence along the electric lines and equipment					N/A	N/A	N/A	N/A	N/A						
Other	Risk Assessment & Mapping	7.3.1.2	Climate-driven risk map and modelling based on various relevant weather scenarios					N/A	N/A	N/A	N/A	N/A						
Other	Risk Assessment & Mapping	7.3.1.3	Ignition probability mapping showing the probability of ignition along the electric lines and equipment					N/A	N/A	N/A	N/A	N/A						
Other	Risk Assessment & Mapping	7.3.1.4	Initiative mapping and estimation of wildfire and PSPS risk-reduction impact					N/A	N/A	N/A	N/A	N/A						
Other	Risk Assessment & Mapping	7.3.1.5	Match drop simulations showing the potential wildfire consequence of ignitions that occur along the electric lines and equipment					N/A	N/A	N/A	N/A	N/A						
Other	Situational Awareness & Forecasting	7.3.2.1	Advanced weather monitoring and weather stations	SA-1	PSPS - for sectionalization, etc.		2018	1	1	N/A	2	2		GSRPBA				
Other	Situational Awareness & Forecasting	7.3.2.2.1	Continuous monitoring sensors	SA-9			2018	N/A	N/A	N/A	N/A	N/A		GSRPBA, WMPMA				
Other	Situational Awareness & Forecasting	7.3.2.2.2	Continuous monitoring sensors	SA-10	PSPS - for sectionalization, etc.		2018	586	600	N/A	552	599		NA				
Other	Situational Awareness & Forecasting	7.3.2.3	Fault indicators for detecting faults on electric lines and equipment				N/A	N/A	N/A	N/A	N/A	N/A		N/A				
Other	Situational Awareness & Forecasting	7.3.2.4	Forecast of a fire risk index, fire potential index, or similar	SA-8	PSPS - for sectionalization, etc.		2019	105	94	N/A	105	114		NA				
Other	Situational Awareness & Forecasting	7.3.2.4.1	Forecast of a fire risk index, fire potential index, or similar					N/A	N/A	N/A	N/A	N/A						
Other	Situational Awareness & Forecasting	7.3.2.4.2	Forecast of a fire risk index, fire potential index, or similar				2019	N/A	N/A	N/A	N/A	N/A		FRMMA				
Other	Situational Awareness & Forecasting	7.3.2.4.3	Forecast of a fire risk index, fire potential index, or similar				2020	N/A	N/A	N/A	N/A	N/A		WMPMA				
Other	Situational Awareness & Forecasting	7.3.2.4.4	Forecast of a fire risk index, fire potential index, or similar					N/A	N/A	N/A	N/A	N/A		WMPMA				
Other	Situational Awareness & Forecasting	7.3.2.5	Personnel monitoring areas of electric lines and equipment in elevated fire risk conditions	SA-3	PSPS - for sectionalization, etc.		2018	115	103	N/A	115	125		NA				
Other	Situational Awareness & Forecasting	7.3.2.6	Weather forecasting and estimating impacts on electric lines and equipment				2018	N/A	N/A	N/A	N/A	N/A		GSRPBA, WMPMA				
Other	Situational Awareness & Forecasting	7.3.2.6	Weather forecasting and estimating impacts on electric lines and equipment					N/A	N/A	N/A	N/A	N/A		FRMMA				
Grid hardening	Grid Design & System Hardening	7.3.3.1	Capacitor maintenance and replacement program				N/A	N/A	N/A	N/A	N/A	N/A		NA				Costs for this initiative are included as part of 7.3.4.9.1
Grid hardening	Grid Design & System Hardening	7.3.3.2	Circuit breaker maintenance and installation to de-energize lines upon detecting a fault	SH-6	Equipment failure	Other contact with object	2018	17873	N/A	N/A	14361	20374		GSRPBA				
Grid hardening	Grid Design & System Hardening	7.3.3.3.1	Covered conductor installation	SH-1	Other contact with object	Wire-to-wire contact	2018	WCCP: 7,884 FR Poles: 3,725	N/A	N/A	WCCP: 6,741 FR Poles: 3,758	WCCP: 8,630 FR Poles: 3,708		GSRPBA				Recorded spend reflects WCCP program only, while miles also include covered conductor installed in HFTD under other programs (95, 185, and 77 miles of non-WCCP in 2019, 2020, and 2021, respectively)
Grid hardening	Grid Design & System Hardening	7.3.3.3.2	Covered conductor installation	SH-10	Equipment failure	Other contact with object	2018	12847	9795	N/A	8370	15265		GSRPBA				
Grid hardening	Grid Design & System Hardening	7.3.3.3.3	Covered conductor installation	SH-16	Other contact with object	Wire-to-wire contact	2022	538	N/A	N/A	N/A	538		NA				
Grid hardening	Grid Design & System Hardening	7.3.3.4	Covered conductor maintenance					N/A	N/A	N/A	N/A	N/A						Costs for this initiative are included as part of 7.3.4.9.1
Grid hardening	Grid Design & System Hardening	7.3.3.5	Crossarm maintenance, repair, and replacement					N/A	N/A	N/A	N/A	N/A						Costs for this initiative are included as part of 7.3.4.9.1
Grid hardening	Grid Design & System Hardening	7.3.3.6	Distribution pole replacement and reinforcement, including with composite poles				N/A	N/A	N/A	N/A	N/A	N/A		NA				
Grid hardening	Grid Design & System Hardening	7.3.3.7	Expulsion fuse replacement	SH-4	Equipment failure	Other contact with object	2018	3767	1143	N/A	2918	4213		GSRPBA				
Grid hardening	Grid Design & System Hardening	7.3.3.8.1	Grid topology improvements to mitigate or reduce PSPS events	SH-7			2020	N/A	N/A	N/A	N/A	N/A						This activity entails evaluating circuits highly impacted by PSPS to develop targeted plans for grid hardening and circuit modifications to reduce PSPS impact; cost resulting from this evaluation appear in 7.3.3.3.1, 7.3.3.9 and 7.3.2.1.
Grid hardening	Grid Design & System Hardening	7.3.3.8.2	Grid topology improvements to mitigate or reduce PSPS events	SH-12			2021	N/A	N/A	N/A	N/A	N/A		MGCVR				
Grid hardening	Grid Design & System Hardening	7.3.3.9	Installation of system automation equipment	SH-5	Equipment failure	Other contact with object	2018	RAR: 4,946 RCS: 2,466	RAR: 581 RCS: 2,237	N/A	RAR: 2,880 RCS: 1,486	RAR: 7,810 RCS: 4,597		GSRPBA, FHPMA				
Grid hardening	Grid Design & System Hardening	7.3.3.10	Maintenance, repair, and replacement of connectors, including hotline clamps					N/A	N/A	N/A	N/A	N/A						Costs for this initiative are included as part of 7.3.4.9.1
Grid hardening	Grid Design & System Hardening	7.3.3.11	Mitigation of impact on customers and other residents affected during PSPS event					N/A	N/A	N/A	N/A	N/A						Costs associated with mitigation of impact on customers during PSPS events are included in 7.3.6.6
Grid hardening	Grid Design & System Hardening	7.3.3.12	Other corrective action	SH-14	Wire-to-wire contact	Equipment failure	2019	3496	N/A	N/A	2086	4915		WMPMA				Additional 2021 recorded spend for this activity is included in 7.3.3.3.1 and 7.3.4.9.1
Grid hardening	Grid Design & System Hardening	7.3.3.12.1	Other corrective action	SH-17	Other contact with object	Equipment failure	2020	28788	0	N/A	N/A	29618		NA				
Grid hardening	Grid Design & System Hardening	7.3.3.13	Pole loading infrastructure hardening and replacement program based on pole loading assessment program				N/A	N/A	N/A	N/A	N/A	N/A		NA				This is captured on Initiative 7.3.3.6.; under Distribution Pole Remediations
Grid hardening	Grid Design & System Hardening	7.3.3.14	Transformers maintenance and replacement				N/A	N/A	N/A	N/A	N/A	N/A		NA				
Grid hardening	Grid Design & System Hardening	7.3.3.15	Transmission tower maintenance and replacement	SH-13	Contamination	Equipment failure	2020	41	N/A	N/A	0	64		WMPMA				Recorded 2021 spend for this activity is included in 7.3.4.10
Grid hardening	Grid Design & System Hardening	7.3.3.16	Undergrounding of electric lines and/or equipment	SH-2	Other contact with object	Wire-to-wire contact	2019	1622	N/A	N/A	1784	1575		WMPMA				
Grid hardening	Grid Design & System Hardening	7.3.3.17.1	Updates to grid topology to minimize risk of ignition in HFTDs	SH-8	Equipment failure	Vandalism / Theft	2019	532	N/A	N/A	25	805		WMPMA				
Grid hardening	Grid Design & System Hardening	7.3.3.17.2	Updates to grid topology to minimize risk of ignition in HFTDs	SH-11	Equipment failure	Other contact with object	2019	205	N/A	N/A	55	287		WMPMA				
Grid hardening	Grid Design & System Hardening	7.3.3.17.3	Updates to grid topology to minimize risk of ignition in HFTDs	SH-15	Equipment failure		2019	5	N/A	N/A	0	15		WMPMA				Recorded 2021 spend for this activity is included in 7.3.4.9.1
Asset inspection	Asset Management & Inspections	7.3.4.1	Detailed inspections of distribution electric lines and equipment				N/A	N/A	N/A	N/A	N/A	N/A						
Asset inspection	Asset Management & Inspections	7.3.4.2	Detailed inspections of transmission electric lines and equipment				N/A	N/A	N/A	N/A	N/A	N/A						
Asset inspection	Asset Management & Inspections	7.3.4.3	Improvement of inspections	IN-8			2021	Enabling	Enabling	Enabling	Enabling	Enabling		WMPMA				
Asset inspection	Asset Management & Inspections	7.3.4.4	Infrared inspections of distribution electric lines and equipment	IN-3	Equipment failure		2017	560	N/A	N/A	535	567		Previously FRMMA, Currently WMPMA				
Asset inspection	Asset Management & Inspections	7.3.4.5	Infrared inspections of transmission electric lines and equipment	IN-4	Equipment failure		2019	0	N/A	N/A	0	N/A		WMPMA				
Asset inspection	Asset Management & Inspections	7.3.4.5.1	Transmission Conductor & Splice Assessment	IN-9	Equipment failure		2022	0	N/A	N/A	N/A	N/A		NA				
Asset inspection	Asset Management & Inspections	7.3.4.6	Intrusive pole inspections				N/A	N/A	N/A	N/A	N/A	N/A		Base O&M				
Asset inspection	Asset Management & Inspections	7.3.4.7	LiDAR inspections of distribution electric lines and equipment					N/A	N/A	N/A	N/A	N/A						Costs for this initiative are included as part of 7.3.5.7
Asset inspection	Asset Management & Inspections	7.3.4.8	LiDAR inspections of transmission electric lines and equipment					N/A	N/A	N/A	N/A	N/A						Costs for this initiative are included as part of 7.3.5.8
Asset inspection	Asset Management & Inspections	7.3.4.9.1	Other discretionary inspection of distribution electric lines and equipment, beyond inspections mandated by rules and regulations	IN-1.1	Equipment failure	Other contact with object	2018	Distribution Ground: 2,668 Distribution Aerial: 856	N/A	N/A	Distribution Ground: 2,752 Distribution Aerial: 901	Distribution Ground: 2,643 Distribution Aerial: 808		Previously FRMMA, GSRPBA, Currently WMPMA				After internal quality assurance, 2021 inspection counts have been updated
Asset inspection	Asset Management & Inspections	7.3.4.9.2	Other discretionary inspection of distribution electric lines and equipment, beyond inspections mandated by rules and regulations	IN-5	Equipment failure	Other contact with object	2019	See IN-1.1	See IN-1.1	See IN-1.1	See IN-1.1	See IN-1.1		NA				
Asset inspection	Asset Management & Inspections	7.3.4.10	Other discretionary inspection of transmission electric lines and equipment	IN-1.2	Equipment failure	Other contact with object	2018	Transmission Ground: 1,976 Transmission Aerial: 579	N/A	N/A	Transmission Ground: 1,090 Transmission Aerial: 572	Transmission Ground: 1,117 Transmission Aerial: 585		Previously FRMMA, GSRPBA, Currently WMPMA				After internal quality assurance, 2021 inspection counts have been updated
Asset inspection	Asset Management & Inspections	7.3.4.11	Patrol inspections of distribution electric lines and equipment				N/A	N/A	N/A	N/A	N/A	N/A						

	Actual																						Projected							Projected						
	2019							2020							2021							2022							2023						
2022 WMP Initiative #	CAPEX ($ thousands) Territory	CAPEX HFTD	OPEX ($ thousands) Territory	OPEX HFTD	Line miles treated Territory	Line miles HFTD	Alternative units (if used)	CAPEX ($ thousands) Territory	CAPEX HFTD	OPEX ($ thousands) Territory	OPEX HFTD	Line miles treated Territory	Line miles HFTD	Alternative units (if used)	CAPEX ($ thousands) Territory	CAPEX HFTD	OPEX ($ thousands) Territory	OPEX HFTD	Line miles treated Territory	Line miles HFTD	Alternative units (if used)	CAPEX ($ thousands) Territory	CAPEX HFTD	OPEX ($ thousands) Territory	OPEX HFTD	Line miles to be treated Territory	Line miles HFTD	Alternative units (if used)	CAPEX ($ thousands) Territory	CAPEX HFTD	OPEX ($ thousands) Territory	OPEX HFTD	Line miles to be treated Territory	Line miles HFTD	Alternative units (if used)
7.3.1.1																																			
7.3.1.2																																			
7.3.1.3																																			
7.3.1.4																																			
7.3.1.5																																			
7.3.2.1	$ 6,282	$ 6,282	$ 1,244	$ 1,244			352	$ 7,509	$ 7,509	$ 2,073	$ 2,073			593	$ 5,607	$ 5,607	$ 2,023	$ 2,023			406	$ 3,021	$ 3,021	$ 3,369	$ 3,369			175	$ 1,445	$ 1,445	$ 3,304	$ 3,304			95
7.3.2.2.1	$ 3,445	$ 3,445	$ 154	$ 154			80	$ 260	$ 260	$ 211	$ 211			80	$ 8,362	$ 8,362	$ 135	$ 135			130	$ 100	$ 100	$ 299	$ 299						$ 294	$ 294			
7.3.2.2.2	$ 970	$ 970	$ 469	$ 469			95	$ 94	$ 94	$ 2,235	$ 2,235			5			$ 2,994	$ 2,994			-	$ 128	$ 128	$ 3,906	$ 3,906			20 Additional HD Cameras	$ 129	$ 129	$ 4,404	$ 4,404			20 Additional HD Cameras
7.3.2.3																																			
7.3.2.4			$ 871	$ 871				$ -	$ -	$ 1,636	$ 1,636						$ 2,755	$ 2,755						$ 2,873	$ 2,873						$ 2,850	$ 2,850			
7.3.2.4.1																																			
7.3.2.4.2																																			
7.3.2.4.3																																			
7.3.2.4.4													14000																						
7.3.2.5	$ 6,487	$ 6,487	$ 1,384	$ 1,384				$ 4,106	$ 4,106	$ 1,658	$ 1,658				$ 3,500	$ 3,500	$ 3,014	$ 3,014			2 High Performance Computing Clusters (HPCC)	$ 703	$ 703	$ 3,235	$ 3,235			500 Weather Stations with ML Capability			$ 2,749	$ 2,749			TBD
7.3.2.6													14000																						
7.3.2.6													14000																						
7.3.3.1																																			
7.3.3.2	$ 839	$ 839	$ 420	$ 420			156	$ 9,786	$ 9,786	$ (9)	$ (9)			109	$ 5,153	$ 5,153	$ 14	$ 14			95	$ 10,193	$ 10,193					125	$ 3,312	$ 3,312	$ 3,523	$ 3,523			114
7.3.3.3.1	$ 239,911	$ 239,911	$ -	$ -			372	$ 546,151	$ 546,151	$ -	$ -			982	$ 897,600	$ 897,600	$ 545	$ 545			1,503	$ 719,110	$ 719,110	$ 1,450	$ 1,450			1,250	$ 765,805	$ 765,805	$ 857	$ 857			1,250
7.3.3.3.2	$ 9,378	$ 9,378					101	$ 9,654	$ 9,654	$ -	$ -			405	$ 21,940	$ 21,940					538	$ 16,552	$ 16,552					700	$ 16,265	$ 16,265					500
7.3.3.3.3			$ -	$ -				$ -	$ -	$ -	$ -													$ 108	$ 108			115			$ 369	$ 369			402
7.3.3.4																																			
7.3.3.5																																			
7.3.3.6	$ 359,296							$ 283,684							$ 503,097							$ 544,812							$ 544,462						
7.3.3.7	$ 70,298	$ 70,298	$ 258	$ 258			7,765	$ 8,955	$ 8,955	$ 3,262	$ 3,262			3,025	$ (479)	$ (479)	$ 36	$ 36			352			$ 1,402	$ 1,402			483			$ 1,662	$ 1,662			574
7.3.3.8.1								$ -	$ -	$ -	$ -										140 Circuits identified for scoping							70 Circuits identified for scoping							TBD
7.3.3.8.2								$ -	$ -	$ -	$ -											$ 5,393	$ 5,393						$ 5,743	$ 5,743					
7.3.3.9	$ 11,112	$ 11,112	$ -	$ -			71	$ 5,867	$ 5,867	$ -	$ -			49	$ 2,738	$ 2,738					23	$ 3,615	$ 3,615					31	TBD	TBD					TBD
7.3.3.10																																			
7.3.3.11																																			
7.3.3.12			$ -	$ -				$ -	$ -	$ 554	$ 554		9715		$ 92	$ 92					361	$ 4,931	$ 4,931	$ 5,815	$ 5,815			1,800	$ 7,617	$ 7,617	$ 10,479	$ 10,479			3,587
7.3.3.12.1								$ 1,855	$ 1,855	$ -	$ -				$ 3,668	$ 3,668						$ 10,596	$ 10,596					1 Iso Bank	$ 23,917	$ 23,917					2 GFNs
7.3.3.13																																			
7.3.3.14	$ 102,432		$ 1,163					$ 96,432		$ 1,399					$ 97,069		$ 1,275					$ 98,653		$ 1,482					$ 101,248		$ 1,521				
7.3.3.15			$ -	$ -																	52			$ 250	$ 250			21	$ -	$ -					-
7.3.3.16								$ 961	$ 961	$ -	$ -				$ 6,586	$ 6,586					6	$ 51,960	$ 51,960					13	$ 42,664	$ 42,664					11
7.3.3.17.1			$ -	$ -			1	$ -	$ -	$ 125	$ 125			6			$ 946	$ 946			10			$ 2,516	$ 2,516			11	TBD	TBD					TBD
7.3.3.17.2			$ -	$ -				$ -	$ -	$ 74	$ 74		9715		$ 190	$ 190	$ 132	$ 132			2 Projects, 17 Assessments	$ 1,925	$ 1,925	$ 660	$ 660			8 Projects, 13 Assessments	$ 1,800	$ 1,800	$ 199	$ 199			TBD
7.3.3.17.3			$ -	$ -																	16	$ 570	$ 570					25	$ 375	$ 375					7
7.3.4.1			$ 21,681							$ 26,362							$ 26,522																		
7.3.4.2			$ 3,599							$ 5,957							$ 5,759																		
7.3.4.3	$ 13,391	$ 13,391	$ 1,979	$ 1,979				$ 28,719	$ 28,719	$ 14,972	$ 14,972		9,715		$ 18,611	$ 18,611	$ 3,727	$ 3,727				$ 9,504	$ 9,504	$ 3,955	$ 3,955				$ 4,700	$ 4,700	$ 3,147	$ 3,147			
7.3.4.4			$ -	$ -			4,962	$ -	$ -	$ 791	$ 791		4,416	5,900			$ 464	$ 464			4,410			$ 427	$ 427			4,408			$ 430	$ 430			4,425
7.3.4.5			$ 1	$ 1			6,700	$ -	$ -	$ 384	$ 384		1,005				$ 94	$ 94			1,046			$ 209	$ 209			1,000			$ 219	$ 219			1,000
7.3.4.5.1			$ -	$ -																				$ 1,500	$ 1,500			75 spans w/ Line Vue, 50 splices with X-Ray, 15 Conductor Samples			$ 1,494	$ 1,494			150 spans w/ Line Vue, 70 splices with X-Ray, 15 Conductor Samples
7.3.4.6			$ 5,915				147,770			$ 6,133				146,621			$ 5,966				144,122			$ 6,952				143,600			$ 7,144				143,600
7.3.4.7																																			
7.3.4.8																																			
7.3.4.9.1	$ 229,992	$ 229,992	$ 238,512	$ 238,512			499,192	$ 85,219	$ 85,219	$ 105,553	$ 105,553			367,067	$ 82,458	$ 82,458	$ 85,925	$ 85,925			359,947	$ 67,995	$ 67,995	$ 78,700	$ 78,700			360,000	$ 61,872	$ 61,872	$ 78,274	$ 78,274			360,000
7.3.4.9.2			$ 643	$ 643			449	$ -	$ -	$ 403	$ 403			268			$ 149	$ 149			238			$ 70	$ 70			190			$ 69	$ 69			190
7.3.4.10	$ 52,990	$ 52,990	$ 58,418	$ 58,418			89,581	$ 35,934	$ 35,934	$ 51,820	$ 51,820			66,942	$ 13,380	$ 13,380	$ 24,802	$ 24,802			41,614	$ 21,963	$ 21,963	$ 22,560	$ 22,560			38,000	$ 11,953	$ 11,953	$ 21,045	$ 21,045			37,995
7.3.4.11			$ 23,849							$ 25,218							$ 27,315																		

Asset inspection	Asset Management & Inspections	7.3.4.12	Patrol inspections of transmission electric lines and equipment					N/A	N/A	N/A	N/A						$ 2,733							$ 3,567							$ 4,561																		
Asset inspection	Asset Management & Inspections	7.3.4.13	Pole loading assessment program to determine safety factor				NA	N/A	N/A	N/A	N/A	N/A	PLP Balancing Account				$ 21,200				189,565			$ 11,133				125,714			$ 3,742				20,066			$ 497				2,000							
Asset inspection	Asset Management & Inspections	7.3.4.14	Quality assurance / quality control of inspections					N/A	N/A	N/A	N/A			Costs for this initiative are included as part of 7.3.4.9.1 and 7.3.4.10																																			
Asset inspection	Asset Management & Inspections	7.3.4.15	Substation inspections				NA	N/A	N/A	N/A	N/A	N/A	NA				$ 5,452							$ 5,704							$ 4,309																		
Vegetation management project	Vegetation Management & Inspections	7.3.5.1	Additional efforts to manage community and environmental impacts					N/A	N/A	N/A	N/A	N/A										$ -	$ -	$ -	$ -						$ 20,599	$ 20,599						$ 16,710	$ 16,710						$ 16,641	$ 16,641			
Vegetation inspection	Vegetation Management & Inspections	7.3.5.2	Detailed inspections and management practices for vegetation clearances around distribution electrical lines and equipment				NA	N/A	N/A	N/A	N/A	N/A	Previously Na, Currently VMBA				$ 58,598							$ 25,756	$ 16,432			470k (Trees in HFTD)			$ 24,943	$ 15,914			600k (Trees in HFTD)			$ 25,242	$ 14,828			600k (Trees in HFTD)			$ 25,740	$ 15,346			600k (Trees in HFTD)
Vegetation inspection	Vegetation Management & Inspections	7.3.5.3	Detailed inspections and management practices for vegetation clearances around transmission electrical lines and equipment				NA	N/A	N/A	N/A	N/A	N/A	Previously Na, Currently VMBA				$ 36,355							$ 1,774	$ 1,132			180k (Trees in HFTD)			$ 1,500	$ 702			150k (Trees in HFTD)			$ 4,675	$ 2,983			100k (Trees in HFTD)			$ 4,594	$ 2,931			100k (Trees in HFTD)
Vegetation management project	Vegetation Management & Inspections	7.3.5.4	Emergency response vegetation management due to red flag warning or other urgent weather conditions					N/A	N/A	N/A	N/A	N/A		This activity is not individually tracked. Associated costs and units are captured in VM-2																																			
Vegetation management project	Vegetation Management & Inspections	7.3.5.5.1	Fuel management (including all wood management) and management of "slash" from vegetation management activities	VM-2	Contact with vegetation	Equipment failure	2019	6166	N/A	N/A	6233	6127	Previously WMPMA, Currently VMBA	Cost forecasts also include some transmission poles			$ 1,655	$ 1,655			100,000	$ -	$ -	$ 7,459	$ 7,459			230,000			$ 11,026	$ 11,026			161,100			$ 20,589	$ 20,589			170k Exempt Distribution Poles, 35k Non-Exempt Distribution Poles			$ 21,240	$ 21,240			170k Exempt Distribution Poles, 35k Non-Exempt Distribution Poles
Vegetation management project	Vegetation Management & Inspections	7.3.5.5.2	Fuel management (including all wood management) and management of "slash" from vegetation management activities	VM-3	Contact with vegetation		2019	0	N/A	N/A	0	0	Previously FHPMA, Currently VMBA									$ -	$ -	$ -	$ -			31			$ 349	$ 349			62			$ 1,585	$ 1,585			32			$ 280	$ 280			
Vegetation inspection	Vegetation Management & Inspections	7.3.5.6	Improvement of inspections					N/A	N/A	N/A	N/A	N/A																																					
Vegetation inspection	Vegetation Management & Inspections	7.3.5.7	Remote sensing inspections of vegetation around distribution electric lines and equipment					N/A	N/A	N/A	N/A	N/A																			$ 1,181	$ 1,181			90 Circuit Miles			$ 3,182	$ 3,182			500 Circuit Miles			$ 3,224	$ 3,224			500 Circuit Miles
Vegetation inspection	Vegetation Management & Inspections	7.3.5.8	Remote sensing inspections of vegetation around transmission electric lines and equipment				2019	N/A	N/A	N/A	N/A	N/A	Previously WMPMA, Currently VMBA				$ 4,532	$ 4,532			1570 Circuit Miles	$ -	$ -	$ 4,092	$ 4,092		1227	1700 Circuit Miles			$ 3,180	$ 3,180			1590 Circuit Miles			$ 2,048	$ 2,048			1600 Circuit Miles			$ 1,903	$ 1,903			1600 Circuit Miles
Vegetation inspection	Vegetation Management & Inspections	7.3.5.9	Other discretionary inspections of vegetation around distribution electric lines and equipment					N/A	N/A	N/A	N/A	N/A																																					
Vegetation inspection	Vegetation Management & Inspections	7.3.5.10	Other discretionary inspections of vegetation around transmission electric lines and equipment					N/A	N/A	N/A	N/A	N/A																																					
Vegetation inspection	Vegetation Management & Inspections	7.3.5.11	Patrol inspections of vegetation around distribution electric lines and equipment					N/A	N/A	N/A	N/A	N/A	Previously Na, Currently VMBA																									$ 18,283	$ 18,283						$ 18,832	$ 18,832			
Vegetation inspection	Vegetation Management & Inspections	7.3.5.12	Patrol inspections of vegetation around transmission electric lines and equipment					N/A	N/A	N/A	N/A	N/A	Previously Na, Currently VMBA																									$ 962	$ 962						$ 991	$ 991			
Vegetation inspection	Vegetation Management & Inspections	7.3.5.13	Quality assurance / quality control of vegetation management				2019						Previously WMPMA, Currently VMBA				$ 989	$ 989				$ -	$ -	$ 3,966	$ 3,966		14,000				$ 3,221	$ 3,221						$ 6,159	$ 6,159			8000 Circuit Miles			$ 6,571	$ 6,571			8000 Circuit Miles
Vegetation management project	Vegetation Management & Inspections	7.3.5.14	Recruiting and training of vegetation management personnel					N/A	N/A	N/A	N/A	N/A		Recruiting costs for Vegetation Management activities are captured in general labor.																																			
Vegetation management project	Vegetation Management & Inspections	7.3.5.15	Identification and remediation of "at-risk species"					N/A	N/A	N/A	N/A	N/A																																					
Vegetation management project	Vegetation Management & Inspections	7.3.5.16.1	Removal and remediation of trees with strike potential to electric lines and equipment	VM-1	Contact with vegetation		2018	2959	N/A	N/A	2944	2568	Previously GDRPBA, Currently VMBA				$ 15,271	$ 15,271			130,000 trees assessed	$ -	$ -	$ 46,685	$ 46,685			100,000 trees assessed			$ 32,432	$ 32,432			131,400 trees assessed			$ 42,636	$ 42,636			330 circuits assessed			$ 45,359	$ 45,359			200 circuits assessed
Vegetation management project	Vegetation Management & Inspections	7.3.5.16.2	Removal and remediation of trees with strike potential to electric lines and equipment	VM-4	Contact with vegetation		NA	8915	N/A	N/A	9307	8806					$ 31,158	$ 30,413			13,500 removals identified	$ -	$ -	$ 37,604	$ 37,604			9,000 removals identified			$ 16,165	$ 16,165			1,301 circuits assessed			$ 31,258	$ 31,258			900 circuits assessed			$ 36,212	$ 36,212			900 circuits assessed
Vegetation inspection	Vegetation Management & Inspections	7.3.5.17	Substation inspection					N/A	N/A	N/A	N/A	N/A																																					
Vegetation management project	Vegetation Management & Inspections	7.3.5.18	Substation vegetation management					N/A	N/A	N/A	N/A	N/A		Associated costs are captured in 7.3.5.2																												169 Substations Inspected							
Vegetation management project	Vegetation Management & Inspections	7.3.5.19	Vegetation management enterprise system	VM-6			2021	Enabling	Enabling	Enabling	Enabling	Enabling	Previously WMPMA, GDRPBA, Currently VMBA		$ 4,219	$ 4,219						$ 16,128	$ 16,128	$ 1,056	$ 1,056				$ 11,005	$ 11,005	$ 635	$ 635				$ 6,800	$ 6,800	$ 3,500	$ 3,500				$ 2,300	$ 2,300	$ 3,800	$ 3,800			
Vegetation management project	Vegetation Management & Inspections	7.3.5.20	Vegetation management to achieve clearances around electric lines and equipment		Contact with vegetation		N/A	270	N/A	N/A	281	263	Previously FHPMA, Currently VMBA				$ 169,223	$ 167,414						$ 326,799	$ 216,021						$ 359,962	$ 229,770						$ 379,262	$ 238,421						$ 347,246	$ 217,453			
Vegetation management project	Vegetation Management & Inspections	7.3.5.21	Vegetation management activities post-fire					N/A	N/A	N/A	N/A	N/A																																					
Other	Grid Operations & Operating Protocols	7.3.6.1	Automatic recloser operations					N/A	N/A	N/A	N/A	N/A			$ 1,488							$ 957							$ 2,239																				
Other	Grid Operations & Operating Protocols	7.3.6.2	Protective equipment and device settings					N/A	N/A	N/A	N/A	N/A	NA																																				
Other	Grid Operations & Operating Protocols	7.3.6.3	Crew-accompanying ignition prevention and suppression resources and services					N/A	N/A	N/A	N/A	N/A																																					
Other	Grid Operations & Operating Protocols	7.3.6.4	Personnel work procedures and training in conditions of elevated fire risk					N/A	N/A	N/A	N/A	N/A																																					
Other	Grid Operations & Operating Protocols	7.3.6.5	Protocols for PSPS re-energization					N/A	N/A	N/A	N/A	N/A					$ 1,375	$ 1,375				$ -	$ -	$ 111	$ 111						$ 394	$ 394						$ 709	$ 709						$ 738	$ 738			
Other	Grid Operations & Operating Protocols	7.3.6.6	PSPS events and mitigation of PSPS impacts	PSPS-2	PSPS - for sectionalization, etc.		2018	211 Partnership: 35 Rebates: 4 CCBB: 2 CRC/CCV: 1	211 Partnership: 35 Rebates: 4 CCBB: 3 CRC/CCV: 1	N/A	211 Partnership: 35 Rebates: 5 CCBB: 2 CRC/CCV: 1	211 Partnership: 36 Rebates: 5	Previously GDRPBA, FRMMA, WMPMA, Currently FRMMA, WMPMA		$ 585	$ 585	$ 1,906	$ 1,906			13 CRCs	$ 6,843	$ 6,843	$ 11,092	$ 11,092		14,000	56 CRCs, 720 CCBB Batteries, 1041 Rebates	$ 3,285	$ 3,285	$ 25,537	$ 25,537			64 CRCs, 6021 CCBB Batteries, 2427 Rebates	$ 7,560	$ 7,560	$ 28,131	$ 28,131			2,750 CCBB Customers, 4,000 Battery Rebates			$ 22,894	$ 22,894			2,750 CCBB Customers, 4,000 Battery Rebates
Other	Grid Operations & Operating Protocols	7.3.6.6.1	PSPS Incident Management Team										NA				$ 5,774	$ 5,774				$ -	$ -	$ 8,935	$ 8,935				$ 11,217	$ 11,217	$ 14,812	$ 14,812				$ 12,650	$ 12,650	$ 14,953	$ 14,953				$ 4,550	$ 4,550	$ 15,987	$ 15,987			
Other	Grid Operations & Operating Protocols	7.3.6.6.2.1.2	Customer Resiliency Programs										NA				$ -	$ -													$ 37	$ 37																	
Other	Grid Operations & Operating Protocols	7.3.6.6.2.1.3	Customer Resiliency Equipment										NA				$ 11	$ 11				$ -	$ -	$ 4	$ 4						$ 4,138	$ 4,138						$ 2,595	$ 2,595						$ 2,000	$ 2,000			
Other	Grid Operations & Operating Protocols	7.3.6.7	Stationed and on-call ignition prevention and suppression resources and services					N/A	N/A	N/A	N/A	N/A																																					
Other	Data Governance	7.3.7.1	Centralized repository for data	DG-1			2021	Enabling	Enabling	Enabling	Enabling	Enabling	Previously GDRPBA, Currently WMPMA		$ 1,181	$ 1,181	$ -	$ -				$ 1,796	$ 1,796	$ -	$ -		14,000		$ 9,317	$ 9,317						$ 16,487	$ 16,487	$ 4,132	$ 4,132				$ 8,115	$ 8,115	$ 5,660	$ 5,660			
Other	Data Governance	7.3.7.2	Collaborative research on utility ignition and/or wildfire					N/A	N/A	N/A	N/A	N/A																																					
Other	Data Governance	7.3.7.3	Documentation and disclosure of wildfire-related data and algorithms					N/A	N/A	N/A	N/A	N/A																																					
Other	Data Governance	7.3.7.4	Tracking and analysis of near miss data					N/A	N/A	N/A	N/A	N/A																																					
Other	Resource Allocation Methodology	7.3.8.1	Allocation methodology development and application					N/A	N/A	N/A	N/A	N/A	Previously FRMMA, WMPMA, Currently WMPMA				$ 42,644	$ 42,644				$ -	$ -	$ 32,860	$ 32,860		14000				$ 13,246	$ 13,246						$ 10,372	$ 10,372						$ 10,644	$ 10,644			
Other	Resource Allocation Methodology	7.3.8.2	Risk reduction scenario development and analysis				2018	N/A	N/A	N/A	N/A	N/A																																					
Other	Resource Allocation Methodology	7.3.8.3	Risk spend efficiency analysis					N/A	N/A	N/A	N/A	N/A																																					
Other	Emergency Planning & Preparedness	7.3.9.1	Adequate and trained workforce for service restoration	DEP-2	PSPS - for sectionalization, etc.		2018	UAS: 2,119 IMT/Field Training: 262	UAS: 2,322 IMT/Field Training: 256	N/A	UAS: 3,225 IMT/Field Training: 262	UAS: 1,872 IMT/Field Training: 280	WMPMA				$ 1,445	$ 1,445				$ -	$ -	$ 616	$ 616			50 UAS Operators Trained			$ 377	$ 377			60 resources passed the FAA exam			$ 1,777	$ 1,777			Technically qualify 50 UAS operators			$ 1,863	$ 1,863			Technically qualify 50 UAS operators
Other	Emergency Planning & Preparedness	7.3.9.2	Community outreach, public awareness, and communications efforts					N/A	N/A	N/A	N/A	N/A		Costs included in 7.3.10.1.2																																			
Other	Emergency Planning & Preparedness	7.3.9.3	Customer support in emergencies					N/A	N/A	N/A	N/A	N/A		Costs included in 7.3.10.1.2																																			
Other	Emergency Planning & Preparedness	7.3.9.4	Disaster and emergency preparedness plan					N/A	N/A	N/A	N/A	N/A		Costs included in 7.3.6.6.1																																			
Other	Emergency Planning & Preparedness	7.3.9.5	Preparedness and planning for service restoration				2018	N/A	N/A	N/A	N/A	N/A	Previously GDRPBA, Currently WMPMA				$ 9,414	$ 9,414				$ -	$ -	$ 5,328	$ 5,328		14,000				$ 3,530	$ 3,530						$ 7,337	$ 7,337						$ 7,386	$ 7,386			
Other	Emergency Planning & Preparedness	7.3.9.6	Protocols in place to learn from wildfire events					N/A	N/A	N/A	N/A	N/A																																					
Other	Stakeholder Cooperation & Community Engagement	7.3.10.1.1	Community engagement	DEP-1.2			2018	Enabling	Enabling	Enabling	Enabling	Enabling	Previously GDRPBA, Currently WMPMA				$ 755	$ 755			13	$ -	$ -	$ 142	$ 142			9			$ 11	$ 11			11			$ 110	$ 110			9			$ 112	$ 112			9
Other	Stakeholder Cooperation & Community Engagement	7.3.10.1.2	Community engagement	DEP-1.3			2018	Enabling	Enabling	Enabling	Enabling	Enabling	Previously FRMMA, GDRPBA, Currently WMPMA				$ 4,516	$ 4,516				$ -	$ -	$ 5,490	$ 5,490		14,000				$ 9,195	$ 9,195						$ 11,443	$ 11,443						$ 11,489	$ 11,489			
Other	Stakeholder Cooperation & Community Engagement	7.3.10.1.3	Community engagement	DEP-4			2018	N/A	N/A	N/A	N/A	N/A	Previously FRMMA, Currently WMPMA				$ (651)	$ (651)				$ -	$ -	$ -	$ -			5			$ 856	$ 856			9			$ 6,038	$ 6,038			6			$ 6,299	$ 6,299			6
Other	Stakeholder Cooperation & Community Engagement	7.3.10.2	Cooperation and best practice sharing with agencies outside CA					N/A	N/A	N/A	N/A	N/A																																					
Other	Stakeholder Cooperation & Community Engagement	7.3.10.3	Cooperation with suppression agencies	DEP-3			2020	8478	N/A	N/A	6017	9846	WMPMA				$ -	$ -				$ -	$ -	$ 2,158	$ 2,158			1 MOU			$ 17,545	$ 17,545			3 MOUs			$ 18,000	$ 18,000			3 MOUs			$ 17,707	$ 17,707			3 MOUs
Other	Stakeholder Cooperation & Community Engagement	7.3.10.4	Forest service and fuel reduction cooperation and joint roadmap					N/A	N/A	N/A	N/A	N/A																																					
Other	Alternative Technologies	7.3.11	Alternative Technology Pilot Programs		Wire-to-wire contact	Equipment failure	2018	7069	N/A	N/A	7059	10321	Previously GDRPBA, Currently WMPMA	Drivers and RSEs reflective of Early Fault			$ 1	$ 1				$ -	$ -	$ 159	$ 159		14000		$ 2,015	$ 2,015	$ 2	$ 2				$ 6,985	$ 6,985												