

REPORT

RISK MODELING WORKING GROUP SUMMARY REPORT, PHASE IV

Summary of Discussions from 2025



PREPARED FOR

Office of Energy Infrastructure Safety
715 P Street, 15th Floor
Sacramento, CA 95814

Date: July 23, 2026

PREPARED BY

Francisco Joglar
111 Rockville Pike, Suite 550, Rockville,
MD 20850



JENSEN HUGHES

Revision Record Summary

<i>Revision</i>	<i>Revision Summary</i>
0	Initial issue

Table of Contents

EXECUTIVE SUMMARY	4
1.0 INTRODUCTION.....	6
1.1 Background	6
1.2 Document Scope and Preparation	7
1.3 Membership of the Risk Modeling Working Group.....	7
1.4 RMWG Members	8
1.5 Contributions	8
2.0 PHASE IV SUMMARIES.....	9
2.1 01/22/25 – Introduction to Phase IV	9
2.2 02/26/25 – Best Practice Outline, Stakeholder Review Process, Catastrophic Fires	10
2.3 03/26/25 – Best Practice Outline, Consequences – Natural Units and Monetized Units, Risk Framework.....	11
2.4 04/23/25 – Financial Impacts of Wildfire, Smoke Impact	12
2.5 05/27/25 – Weather and Fire Weather, Approaches Document	13
2.6 06/25/25 – Non-Utility Mitigations and Infrastructure, Population and Socio-Economic Factors, Approaches Document.....	14
2.7 07/23/25 – Design Scenarios and Extreme Events, Approaches Document.....	14
2.8 08/27/25 – Assets, Vegetation, Probability of Ignition, and Approaches Document	15
2.9 09/24/25 – Risk Communication, Model Documentation, and Approaches Document	16
2.10 10/29/25 – Technosylva: Fuels and Urban Conflagration	16
2.11 11/19/25 – Future Development Weigh-In and Approaches Document	17
3.0 CONCLUSIONS AND RECOMMENDATIONS.....	19
4.0 NEXT STEPS	20

Executive Summary

The Office of Energy Infrastructure Safety (Energy Safety) formed the Risk Modeling Working Group (RMWG) in 2021 with the stated goals to develop consistent approaches to wildfire risk modeling, improve collaboration among electrical corporations and provide an environment for stakeholders to provide input on wildfire risk modeling methodologies.

This report summarizes the discussions from Phase IV, which occurred in 2025. The topics discussed in these meetings are listed in Table 1.

Table 1. List of Phase IV (2025) RMWG meetings

Date	Topic
01/22/2025	Introduction to Phase IV
02/26/2025	Best Practice Outline, Stakeholder Review Process, Catastrophic Fires
03/26/2025	Best Practice Outline, Consequences – Natural Units and Monetized Units, Risk Framework
04/23/2025	Financial Impacts of Wildfire, Smoke Impact
05/27/2025	Weather and Fire Weather, Approaches Document
06/25/2025	Non-Utility Mitigations and Infrastructure, Population and Socio-Economic Factors, Approaches Document
07/23/2025	Design Scenarios and Extreme Events, Approaches Document
08/27/2025	Assets, Vegetation, Probability of Ignition, and Approaches Document
09/24/2025	Risk Communication, Model Documentation, and Approaches Document
10/29/2025	Technosylva: Fuels and Urban Conflagration
11/19/2025	Future Development Weigh-in and Approaches Document

The general structure of the meetings was similar to Phase I meetings, with the Office of Energy Infrastructure Safety (Energy Safety) providing the electrical corporations with a series of prompts prior to the meeting and asking them to prepare a short presentation to guide the discussion. In some meetings, an external speaker presented on a related topic for discussion.

Phase IV commenced in January 2025 with a review of the stakeholder interviews that took place during 2024 and an overview of the proposed plan for the development of the Approaches document – a document that will summarize approaches and potential best practices for electrical corporations for modeling the wildfire risk to the public from their equipment. The February meeting opened with a review of feedback provided by stakeholders on the proposed outline for the Approaches document. Later in the meeting, the first technical discussion took place focused on catastrophic wildfires and tail risk scenarios with the goal of future incorporation of these scenarios into wildfire risk models through weather event frequencies and probability of occurrence.

The March meeting discussed the approaches used by electrical corporations to model specific aspects of consequences including natural units and monetized risk. Southern California Edison (SCE) explained the current metrics used for the safety, reliability, and financial components of their consequence model as well as their process for categorizing risk by severity of consequences. Additionally, San Diego Gas & Electric (SDG&E) presented their monetization approach for converting natural units to dollar values. This session continued with a presentation on the different risk frameworks currently employed by electrical corporations, emphasizing challenges in consistently defining “wildfire risk” due to the utilization of both asset-based and community-based approaches.

The next three technical discussions covered several aspects of wildfire consequence modeling and operational modeling. The April discussion examined the financial losses and smoke impacts caused by wildfires, with participants identifying discrepancies between current research findings and utility risk models regarding the primary drivers of total wildfire losses and emphasizing the need for additional California-specific research on wildfire economic impacts. In May, the focus shifted to operational decision-making, with Pacific Gas & Electric (PG&E) presenting their Fire Potential Index (FPI) development and implementation processes for using weather and fire weather data. The June meeting returned to impact modeling, focusing on non-utility mitigations, infrastructure, population dynamics, and socioeconomic factors, with SCE presenting their egress modeling approach utilizing historical fire frequency data, population egress constraints, and a social vulnerability proxy, and SDG&E presenting their egress simulation model integrating Technosylva fire spread data, historical weather data, and Open Street Map routing data.

The following four meetings focused on utility approaches to specific components of their wildfire risk models. The July meeting examined design basis scenarios and extreme events, with the Mussey Grade Road Alliance (MGRA) presenting on the challenges utilities face when modeling climate change impacts, population migration, and "black swan" events. A technical presentation from the United States Department of Agriculture (USDA) Forest Service highlighted the importance of weather sequences in developing design scenarios. The August meeting, led by PG&E, featured presentations on their methodology for collecting and implementing asset and vegetation data in their models, as well as their approach to modeling probability of ignition through several machine learning models.

The September session focused on model documentation and risk communication in Wildfire Mitigation Plans (WMPs). SDG&E raised concerns about current WMP reporting requirements, arguing that they lack alignment with their decision-making processes. Energy Safety continued the discussion by providing insights into their WMP evaluation process and explaining the intent of each reporting requirement. Jensen Hughes then presented documentation standards and stakeholder roles, with particular emphasis on verification and validation of models. The October meeting featured a comprehensive presentation by Technosylva on fuel data modeling and urban conflagration. Technosylva discussed the development of their fuel models and how they differ from traditional fuel models, as well as their urban conflagration model development process, which predicts encroachment distances and building loss factors.

The last meeting of 2025 was a discussion on future development of wildfire risk models and an end-of-year status update of the Approaches document. A representative from both the Small and Multi-Jurisdictional Utilities (SMJUs) and the Large Investor-Owned Utilities (IOUs) each presented their joint perspectives on the technological advancements and current limitations of wildfire risk models.

1.0 Introduction

1.1 BACKGROUND

Energy Safety formed the RMWG in 2021 with the stated goals to:

- + Develop a more consistent approach to wildfire risk modeling
- + Improve collaboration among the electrical corporations on wildfire risk modeling
- + Provide an environment for stakeholders and experts to provide input on wildfire risk modeling methods
- + Increase transparency in electrical corporation approaches to wildfire risk modeling

The group has met approximately monthly since 2021 to discuss a variety of topics. These discussions have been organized into annual phases (except for Phase I which spanned 2021-2022).

Phase I consisted of 13 meetings from October 2021 to December 2022. Table 2 provides a list of the topics discussed during Phase I of the RMWG. The discussions, outcomes, and takeaways from these meetings are summarized in the Phase I Summary Report¹ which was published on June 15, 2023².

Table 2. List of Topics from Phase I

Date	Topic
10/05/2021-10/06/2021	Initial RMWG Presentations
10/27/2021	RMWG Organizational Conference
11/17/2021	Review of Consequence Models
12/08/2021	Risk Drivers, Probability of Ignition Models, and Data/Inputs
03/02/2022	Likelihood of Vegetation Risk Events and Ignitions
04/13/2022	PSPS Likelihood and PSPS Consequence, Reliability Analysis, and Impacts
05/25/2022	Modeling Algorithms, Part 1
06/15/2022	Wildfire Related Modeling Algorithms, Part 2
07/13/2022	Modeling Algorithms, Components, Linkages, and Interdependencies, Part 1
08/10/2022	Modeling Algorithms, Components, Linkages, Interdependencies, and Climate Change, Part 2
09/14/2022	Lessons Learned, Guideline Improvements, Topics for the Next Session
12/14/2022	Comprehensive Accounting for Wildfire Smoke Consequences

Phase II consisted of 12 meetings from January 2023 to December of 2023. Table 3 provides a list of the topics discussed during Phase II of the RMWG. The discussions, outcomes, and takeaways from these meetings are summarized in the Phase II Summary Report³ which was published on June 4, 2025.⁴

¹ Level 4 Ventures, Inc. *Risk Modeling Working Group Summary Report, Phase I*, 2023.

² Risk Model Group Docket,
<https://efiling.energysafety.ca.gov/EFiling/DocketInformation.aspx?docketnumber=Risk-Model-Group>

³ Jensen Hughes, Inc. *Risk Modeling Working Group Summary Report, Phase II*, 2025.

⁴ Risk Model Group Docket,
<https://efiling.energysafety.ca.gov/EFiling/DocketInformation.aspx?docketnumber=Risk-Model-Group>

Table 3. List of Topics from Phase II

Date	Topic
01/11/2023	Finalizing Session Topics for RMWG 2023
02/15/2023	Coordination of Government Wildfire Plans with Utility Wildfire Mitigation Plans
03/15/2023	Creating and Maintaining an Out-Year Fuelscape
04/12/2023	Wildfire Consequence Modelling – Conflagration Risks
05/10/2023	Approaches to Factoring Suppression into Fire Models
06/14/2023	Approaches to Factoring Ingress and Egress into Fire Models
07/11/2023	Approaches to Modeling Long Duration, High Intensity Wildfires
08/09/2023	PSPS Planning Models
09/14/2023	Avoiding Bias in Wildfire Probability Modeling
10/11/2023	Standardized Wildfire Risk Type Classifications and in situ Wildfire Risk Assessment
11/08/2023	Model Maintenance and Data Collection
12/13/2023	Review of Wildfire Related Operational Models

Phase III consisted of 3 meetings during 2024. The meetings were paused in the second half of the year to regroup and strategize outcomes for the working group. Table 4 provides a list of the topics discussed during Phase III of the RMWG. The discussions, outcomes, and takeaways from these meetings are summarized in the Phase III Summary Report⁵ which was published on May 18, 2026.⁶

Table 4. List of Topics from Phase III

Date	Topic
03/20/2024	Phase II Outcomes
04/24/2024	Phase II Outcomes
06/26/2024	Phase III Outcomes

Phase IV consisted of 11 meetings during 2025. This Phase IV Summary Report documents the discussions occurring during Phase IV (2025). The topics discussed in these meetings are listed in Table 1 in the Executive Summary of this report.

1.2 DOCUMENT SCOPE AND PREPARATION

The purpose of this document is to summarize the discussions from each meeting of the RMWG during Phase IV (2025). Jensen Hughes, Inc. (JH) prepared this document on behalf of Energy Safety. The content was prepared based on slides and detailed minutes provided to JH by Energy Safety.

1.3 MEMBERSHIP OF THE RISK MODELING WORKING GROUP

The RMWG meetings are open to Energy Safety, electrical corporations, stakeholders, and technical experts to allow for open dialogue. This process allows the group to dive into technical details among members who are committed to attending regularly. Interested parties applied to be members of the working group by submitting an application to the Risk Model Group docket.

⁵ Jensen Hughes, Inc. *Risk Modeling Working Group Summary Report, Phase III*, 2025.

⁶ Risk Model Group Docket,
<https://efiling.energysafety.ca.gov/EFiling/DocketInformation.aspx?docketnumber=Risk-Model-Group>

1.4 RMWG MEMBERS

The membership during Phase IV of the RMWG is listed in Table 5.

Table 5. RMWG Members During Phase IV

State Agency:	Large IOU:	Stakeholder Organization:
Office of Energy Infrastructure Safety (Energy Safety)	Pacific Gas & Electric (PG&E)	Green Power Institute (GPI)
California Public Utility Commission (CPUC)	San Diego Gas & Electric (SDG&E)	CPUC Public Advocates
California Department of Forestry and Fire Protection (CAL FIRE)	Southern California Edison (SCE)	Mussey Grade Road Alliance (MGRA)
Wildfire Safety Advisory Board (WSAB)	SMJU:	Vendor:
California Department of Insurance (DOI)	Bear Valley Electric Service (BVES)	Technosylva
California Department of Conservation	Liberty Utilities (LU)	Reax Engineering
	PacifiCorp (PC)	Cloudfire
	Publicly Owned Utilities (POU):	Moody's RMS
	Sacramento Municipal Utility District (SMUD)	Technical Consultant:
	Turlock Irrigation District (TID)	Jensen Hughes
		Filsinger Energy

1.5 CONTRIBUTIONS

Members of the RMWG during Phase IV were invited to provide comments on this Summary Report. Members had 14 days to review, and no comments were received.

2.0 Phase IV Summaries

The following subsections provide a high-level summary of the discussions from Phase IV of the RMWG occurring during the calendar year of 2025. Each meeting included a set of questions or prompts which electrical corporations were asked to address during the meeting. The discussions centered on these prompts but were allowed to diverge from the prompts as the conversation evolved. In some meetings there was also an external speaker invited to provide a technical presentation related to the topic at hand.

The following sections provide the following information from the meetings:

- + Summary of external speaker's comments (if applicable)
- + For each question that was posed:
 - What are the electrical corporations doing the same? What are they doing differently?
 - What questions or parts of questions were not answered?
- + Other discussion:
 - What additional topics were covered that were not prompted?
 - What actions, suggestions, or recommendations for follow-up were mentioned? Were these addressed in a future meeting?

2.1 01/22/25 – INTRODUCTION TO PHASE IV

The focus of this meeting was to review the stakeholder interviews that took place during 2024 and present a plan for the development of the Approaches document. The stakeholder interviews were conducted to gather feedback on the structure and content of the RMWG meetings from Phases I, II, and III. The key takeaway of the interviews was that the purpose, objective, intended outcomes, and scope of the RMWG were not clearly defined. Additionally, both utility and non-utility stakeholders perceived inconsistencies between the WMP and RAMP requirements and expressed desire for more coordination with other related groups and initiatives. This feedback was used to improve planning and inform which content should be covered in the 2025 and 2026 meetings.

The original intent of the RMWG meetings was to develop a more consistent and transparent approach to wildfire risk modeling that both improved collaboration among utilities and included input from stakeholders and experts. For Phase IV, the objective of the RMWG meetings was to transition away from gathering information and into establishing a best practices document (later renamed to “Approaches” document, to acknowledge that different methods may be equally useful in different circumstances). Secondary goals for Phase IV included providing and knowledge sharing for the SMJUs that are earlier in their risk model development than the Large ECs, identifying gaps in industry best practices, and recommending the party responsible for making improvements to those gaps (i.e., utilities, academia, or government stakeholders).

The purpose of the Approaches document is to record the assumptions and approaches used by different utilities when implementing a wildfire risk model. This document would be developed collaboratively amongst stakeholders, while incorporating the findings and discussions of the RMWG on streamlining electrical corporations' risk management practices.

2.2 02/26/25 – BEST PRACTICE OUTLINE, STAKEHOLDER REVIEW PROCESS, CATASTROPHIC FIRES

This session focused on three distinct topics including: (1) reviewing stakeholder comments for the Approaches document outline, (2) the WMP review process used by CalAdvocates and GPI, and (3) catastrophic wildfires and tail risk scenarios. The stakeholder feedback for the Approaches document was received following the January RMWG meeting and can be generalized into the following three themes:

- + **Perceived inconsistencies** in definitions, framework and requirements provided in the RDF and the approaches document.
- + **Clarification of content purpose**, specifically for sections of the Approaches document that would discuss activities outside of the electrical corporations' control.
- + **Level of detail** expected to be provided in different sections of the Approaches document. Much of the concern was centered around the asset and tree database information and landscape fuels sections.

The Approaches document outline was updated based on this feedback to better align with the RDF framework. Additional discussion on the application of fault and/or event trees within the wildfire risk modeling space was provided. This discussion served as an example of how other industries, such as nuclear power, currently model fire risk and how this can be translated to modeling utility wildfire risk.

CalAdvocates and Green Power Institute (GPI) then presented on their individual review processes for WMP submissions. CalAdvocates explained that their primary goal during their review is to assess relative risk rather than absolute risk, essentially comparing differences in results of model versions. CalAdvocates emphasized their reliance on narrative discussions of the relationship between risk models and mitigation programs. In addition, CalAdvocates noted they analyze tabular and geospatial data to rank and compare risk scores for circuit segments on a per circuit and per mile basis.

GPI noted that due to capacity limitations they do not typically perform their own analyses of the data and instead rely on data requests from other stakeholders. Additionally, due to their own policy focuses, GPI prioritizes vegetation management and woody biomass end use topics in their reviews.

The final segment of the session discussed catastrophic wildfires and tail risk scenarios. Created as a result of 2023 RMWG discussion, the following definition of catastrophic wildfires was published in the 2023 WMP guidelines: "Catastrophic wildfire is a wildfire that caused at least one death, damaged over 500 structures, or burned over 5,000 acres." Organizations such as Federal Emergency Management Agency (FEMA) and National Fire Protection Association (NFPA) have slightly different definitions generally indicating that multiple deaths, a fraction of damaged structures, or critical infrastructure inoperability duration constitute a catastrophic wildfire.

Indicators of tail risk scenarios for wildfires include duration of extreme winds, the fuelscape, and high exposure combined with short warning times. Although tail risk scenarios do not impact the relative risk ranking given usage of a consistent duration across cases, they do impact the cost-benefit of mitigation activities. JH noted that there should be further discussion on the incorporation of tail risk scenarios through weather event frequency and the probability of occurrence. Additional discussion detailing the best practices at the enterprise level compared to the planning and operations levels was also noted for a future meeting.

2.3 03/26/25 – BEST PRACTICE OUTLINE, CONSEQUENCES – NATURAL UNITS AND MONETIZED UNITS, RISK FRAMEWORK

During the March RMWG meeting, overviews of the Phase II (2023) Summary Report and comments received on the Approaches document were provided and discussed. The technical topics for this session included a joint IOU consequence presentation featuring SCE and SDG&E and a presentation on risk frameworks presented by JH. The technical discussions from this meeting are captured in the sections “Risk Analysis Frameworks” and “Consequence Analysis” of the Approaches document.

The Phase II (2023) Summary Report covered topics including coordination with government agencies, fuel scape management, conflagration modeling, fire suppression strategies, ingress/egress modeling, simulation duration, planning models for Public Safety Power Shutoffs (PSPS), bias avoidance, and model maintenance. Key findings from the summary report revealed that electrical corporations were not ready to incorporate conflagration modeling due to lack of data, most did not plan to include suppression in models at the time, and there was interest in a standardized approach if required by Energy Safety.

SCE and SDG&E presented on consequences, specifically regarding natural units and monetized risk. SCE presented their approach to calculating consequences from fire perimeters using natural units, including safety metrics (fatalities per structure, not including fire service fatalities), reliability metrics (customer minutes of interruption using the Interruption Cost Estimate, or ICE, calculator), and financial metrics (structure value of approximately \$1M per structure and suppression costs). SCE incorporates social vulnerability multipliers (Access and Functional Needs, or AFN) and fire risk egress constraints as multipliers in their calculations. SCE uses a two-step process for categorizing wildfire and PSPS risk by severity of consequences, dividing areas into severe risk, high consequence, and other High Fire Risk Area (HFRA) categories, with location-by-location review for mitigation package selection. SCE noted improvements to their Wildland Urban Interface (WUI) layer with decay functions and 19 new fuel models in their REAX model, allowing fire spread to continue into urban areas with distance-dependent decay based on underlying fuel types.

SDG&E presented their monetization approach, converting natural units to dollar values using \$16M per fatality, \$4M per injury, and \$48K for reliability impacts, with \$3.85 per customer minute interrupted. A significant development was SDG&E's move from 8-hour to 24-hour fire simulations to better align with historical fire data and power law distributions. This change was justified through analysis of 125 weather days showing strong alignment between their power law and Technosylva's 24-hour framework, with validation against historical fires like the 2003 Cedar Fire and 2007 Witch Fire. For PSPS calculations, SDG&E uses scaling factors for sensitive populations, with 87% of PSPS risk coming from reliability impacts in their example calculations.

The risk framework discussion presented different utility approaches to risk calculation and highlighted ongoing definitional challenges around “wildfire risk” - whether approaches should be asset-based or community-based. Asset-based approaches focus on risk at specific locations from individual assets, while community-based approaches consider cumulative risk to communities from all assets. This distinction affects how burn likelihood and consequences are calculated and interpreted. SCE noted that significant changes are anticipated due to Risk Decision Framework (RDF) proceedings that may substantially impact current approaches, with utilities expressing concern that pending decisions could require starting from scratch with their methodologies.

Several technical challenges and areas for improvement were identified throughout the presentations:

- + Structure valuation emerged as a significant assumption, with utilities using \$1M per structure based on median listing prices, though stakeholders questioned whether this represents replacement cost versus market value and whether it adequately accounts for commercial versus residential structures,

- + Utilities were concerned with the reliability component in terms of impact on overall risk calculations, with questions raised about potential double-counting between different consequence categories,
- + Utilities acknowledged that while their current approaches provide relative ranking capabilities, there are opportunities for refinement, particularly in understanding building survivability factors and incorporating more granular data when available,

2.4 04/23/25 – FINANCIAL IMPACTS OF WILDFIRE, SMOKE IMPACT

The April RMWG meeting discussed the comments received on the Phase II (2023) Summary Report and examined the financial impacts of wildfire through research studies. During the comment period, only GPI submitted in-line comments for the Phase II Summary Report; no utilities or other stakeholders provided comments. The following are the key GPI comments that were addressed:

- + Long Duration Fire Modeling: GPI clarified that while there was no specific consensus to adopt 24-hour fire simulations, the general agreement was that extending models beyond 8 hours may impact absolute risk but not significantly affect relative risk rankings across service territories. The document was updated to reflect that benefits of long-duration modeling remain unclear.
- + Document Scope and Timeline: A significant discussion emerged about whether the Phase II Summary Report should be a "snapshot in time" versus a "living document." The group agreed to keep the report as a historical record of 2023 discussions, with any updates since those meetings confined to the "next steps" section to avoid mixing old discussions with new information.
- + Ingress/Egress Considerations: Comments addressed consensus language around mitigation measures, with GPI recommending changes to avoid language suggesting current mitigations are "not sufficient" and instead focusing on mitigation consequences.

JH presented their findings from a research review focused on the financial impacts of wildfire. Two major studies^{7,8} were reviewed which attempted to quantify the broader economic impacts of wildfire beyond direct structure loss. As part of the review, JH took the costs presented in the NIST study⁷ and ranked them by the percentage of total loss estimated in millions of dollars. This ultimately showed that about 80% of the total loss estimated in this study is due to impacts on housing prices and smoke impacts, while the remaining costs such as structures and fatalities currently considered in utility risk models are each below 1% of the total loss estimated. Several concerns were raised by stakeholders regarding these conclusions:

- + Calibration Issues: MGRA questioned why direct property losses appeared so low compared to observed losses in major California fires, noting that recent fires have caused tens of billions in direct property damage while the study suggested much lower relative impacts.
- + Methodological Concerns: The NIST study used national average values which may not be representative of conditions and values in California.
- + Smoke Impact Uncertainty: Multiple participants, including both utility and non-utility parties, expressed concern about the reliability of smoke-related mortality estimates, noting high uncertainty in attribution methods and the challenge of separating wildfire smoke from other pollution sources.

⁷ D. S. Thomas, D. T. Butry, S. W. Gilbert, D. H. Webb, and J. F. Fung, *The Costs and Losses of Wildfires*, NIST Special Publication 1215, National Institute of Standards and Technology, 2017. doi: 10.6028/NIST.SP.1215.

⁸ K. Barrett, *The Full Community Costs of Wildfire*. Headwaters Economics, 2018.

JH conducted an additional literature review focusing on smoke impacts and resulting mortality estimates. While the mortality estimates can provide a basis for inclusion of smoke impacts in utility risk models, there are several technical challenges in smoke modeling:

- + Smoke Production and Transport: Studies rely on databases like Global Fire Emissions Database combined with atmospheric transport models (GEOS-CHEM, WRF-SFIRE-CHEM) to predict smoke dispersion patterns.
- + Health Impact Assessment: Researchers use concentration-response functions from air pollution studies, though there's uncertainty about whether PM2.5 from wildfire smoke has similar health impacts as urban pollution.
- + Attribution Challenges: Difficulty separating wildfire smoke impacts from baseline air pollution, particularly in areas with existing air quality issues.

Regarding whether to include smoke impacts in risk models, members of both utility and non-utility parties preferred deferring smoke impact studies to academic or regulatory bodies, citing resource constraints and a lack of specialized expertise as limitations. In addition to deferral of smoke impact studies, two other options were proposed by participants: (1) electrical corporations include smoke in MAVF, or (2) joint utility studies are conducted. Utilities also noted that simply adding per-acre smoke costs could dramatically shift mitigation priorities toward rural areas, potentially creating unintended consequences in risk model outcomes.

When compared to the research presented, several coverage gaps were identified in current utility risk models. Research suggests that utility risk models are not currently capturing smoke-related mortality, housing market impacts, evacuation costs, psychological impacts, and broader economic disruption impacts. Utilities also identified the need for California-specific research on wildfire economic impacts, particularly given the state's unique fire risk profile, structure values, and population density patterns.

2.5 05/27/25 – WEATHER AND FIRE WEATHER, APPROACHES DOCUMENT

The primary topic for the May RMWG was weather and fire weather as well as updates to the Approaches document. PG&E presented their Fire Potential Index (FPI) development, tracing its evolution from 2015 to the current version 5.0. The FPI is an operational model that influences EPSS and PSPS decisions, using machine learning with approximately 30 features including weather, fuels, topography, and satellite data. Built on 30+ year climatology with 2x2 km spatial resolution, the model is trained on historical fire data using satellite detection and growth analysis from Sonoma Technology Inc. The system outputs 5 risk ratings (R1-R5) updated hourly and is used for field work precautions, EPSS decisions, and PSPS considerations. The presentation emphasized the distinction between operational and planning models, with FPI serving operational needs rather than long-term planning purposes.

JH presented updates to the “Impact Modeling” and “Consequence Analysis” sections of the Approaches document, which covered different analytical approaches used by utilities to model impacts and consequences including case studies/reconstructions, ensemble of deterministic models, and index approaches. The drafted updates addressed geospatial aggregation levels ranging from enterprise-wide down to individual assets, wildfire impacts including structure damage and fatalities/injuries, PSPS and PEDS impacts, and financial consequence analysis covering structure costs, suppression costs, and broader economic impacts. Technosylva raised concerns about data availability challenges for building characteristics and evacuation modeling. JH identified the need for standardization in suppression cost estimates and structure valuation approaches, and validation concerns for statistical models used in consequence analysis. SCE agreed that there should be standardization of these values to certain extent but cautioned against being locked into a specific value.

2.6 06/25/25 – NON-UTILITY MITIGATIONS AND INFRASTRUCTURE, POPULATION AND SOCIO-ECONOMIC FACTORS, APPROACHES DOCUMENT

The June RMWG meeting focused on egress modeling and social vulnerability approaches used by electrical corporations. Updates to the Approaches document were also presented during the meeting.

SCE presented their approach to egress modeling, which utilizes hexagonal geometry based on the Uber H3 Spatial Hierarchy with 1000-meter spacing between centroids. Their methodology combines population egress constraints with historical fire frequency data from CalFire dating back to 1970, identifying areas where people must pass through constrained evacuation routes. SCE's analysis revealed that egress-constrained areas often overlap with high fire risk zones, particularly in locations like Santa Clarita, Malibu, the I-5 corridor, and mountain communities. The model was validated through consultation with emergency planning officials and visual analysis of constraint patterns.

For social vulnerability, SCE developed an Access and Functional Needs (AFN) index based on CPUC definitions, acknowledging the challenges of using potentially outdated census data. Their analysis showed that AFN customers are generally not concentrated in high fire risk areas within their service territory, although there are some exceptions in certain areas. The model applies a maximum circuit score multiplier of 2 for AFN populations.

SDG&E presented their wildfire egress simulation model, which runs millions of simulations across their territory using Technosylva fire spread data combined with historical weather patterns. Their approach simulates ignition at every asset, creates fire spread ellipses at 2, 4, and 8-hour intervals, and uses Open Street Map routing data to model evacuation paths. The model identifies customers within fire spread areas and calculates evacuation times based on road characteristics and population demographics. SDG&E validates their model through visual inspection and subject matter expert review. Their AFN identification relies on CARE and FERA program participation, with approximately 11% of AFN customers located in High Fire Threat Districts.

Both utilities noted that in their cost-benefit frameworks, financial attributes dominate wildfire risk calculations, with safety components including egress and AFN factors representing only 5-6% of total risk. This raised discussions about appropriate scaling and normalization of safety factors relative to financial impacts.

JH presented updates to the Approaches document, highlighting comments received on the "Impact Modeling" and "Consequence Analysis" sections, including requests for example calculations and alignment with Phase IV RDF risk reduction units. The document was being expanded to include new sections on landscape fire spread and Fire Potential Index (FPI), with utilities requesting to review and verify that their methodologies are accurately represented.

2.7 07/23/25 – DESIGN SCENARIOS AND EXTREME EVENTS, APPROACHES DOCUMENT

The July RMWG meeting focused on design basis scenarios and extreme events in wildfire risk modeling. MGRA presented on the challenges utilities face in modeling extreme events beyond historical data. MGRA emphasized that while utilities effectively use 30-40 year historical weather databases for standard risk modeling, they struggle with extreme event scenarios like climate change impacts, population migration, and "black swan" events with 1000+ year return intervals. MGRA recommended that utilities develop contingency planning and adaptive mechanisms rather than trying to engineer solutions for every extreme scenario, suggesting a balanced approach between engineering solutions up to a certain risk threshold and disaster planning beyond that point.

Mark Finney from USDA Forest Service presented on weather design scenarios, emphasizing that weather sequences matter significantly for fire outcomes, not just single conditions. He demonstrated how different wind direction sequences can produce identical burned areas but vastly different intensity patterns and impacts. Finney advocated for generating artificial weather time series using autoregressive models of Energy Release Component (ERC) to capture extreme events not represented in historical data, while acknowledging the challenge of properly incorporating wind patterns that are often decoupled from moisture conditions except for powerline-caused ignitions.

The meeting also reviewed progress on the Approaches document, with new sections added on egress, social vulnerability, and wildfire smoke impacts. Utilities discussed their different approaches to modeling transmission versus distribution systems, with ongoing challenges in standardizing risk assessment methodologies across different utility territories and asset types.

2.8 08/27/25 – ASSETS, VEGETATION, PROBABILITY OF IGNITION, AND APPROACHES DOCUMENT

The August RMWG meeting covered several key topics including asset and vegetation data, probability of ignition, and updates to the Approaches document.

PG&E presented findings from the Institute of Electrical and Electronics Engineers (IEEE) Technical Report TR130 on protection methods to reduce wildfire risk from transmission and distribution lines. The presentation provided an overview on how electrical faults cause fires, how different industry practices affect ignition risk, the methods being currently implemented to reduce risk, and sensor-based methods to detect incipient or pre-fault signals. The presentation emphasized that no single solution eliminates risk and a layered defense-in-depth approach is necessary.

PG&E also presented their approach to probability of ignition modeling, explaining their framework where probability of ignition equals probability of failure times probability of ignition given outage. PG&E uses 22 different machine learning models for various failure types including conductor failures (line slap, wire-down, other failures), support structure failures (electrical and structural), and vegetation contact (branch failure, trunk failure, other vegetation failures). The models identify key features like conductor count, length, age, and environmental factors. Data limitations include missing or incomplete failure records and the challenge of correlating high-consequence days with high-ignition probability days since models aggregate to single wildfire season values.

JH presented analysis on design basis and extreme scenarios, building on previous discussions. The presentation examined how current utility approaches calculate risk by multiplying LoRE (likelihood of risk events) and CoRE (consequence of risk events) and compared this to more integrated approaches that consider wind speed distributions, equipment failure probabilities, and fire consequence modeling together. Key findings showed that the method of scenario definition significantly impacts calculated risk values, and there's a need for internal consistency between probability and consequence calculations.

Updates to the Approaches document included adding new sections on risk scenario development, climatology and weather methods, fuel models, and validation approaches.

2.9 09/24/25 – RISK COMMUNICATION, MODEL DOCUMENTATION, AND APPROACHES DOCUMENT

The September RMWG meeting focused primarily on model documentation and risk communication in wildfire mitigation plans (WMPs). The meeting was structured around presentations from SDG&E, Energy Safety, and JH, followed by discussions on improving WMP guidelines and documentation requirements.

SDG&E presented challenges with current WMP reporting requirements, particularly with Table 5-5 (risk ranking by risk per mile) and Table 6-4 (top 20% highest risk segments). They argued that risk per mile doesn't align with their strategic decision-making process, which relies on Cost-Benefit Ratio (CBR) metrics and considers factors like mitigation effectiveness, engineering constraints, and project bundling opportunities. SDG&E proposed alternative approaches including presenting multiple model versions, focusing on risk reduction work rather than rankings, and incorporating CBR calculations and financial models into tabular formats.

Energy Safety discussed their evaluation process for various WMP tables, identifying issues with Table 5-5 (unclear definitions of "top risk" and misalignment with utility prioritization methods), Table 6-1 (overlapping information with other tables), and Table 6-4 (difficulty understanding relative risk changes over time). They found Table 6-3 useful for understanding cost-benefit scores but noted it lacked granularity on mitigation combinations. The discussion revealed challenges in capturing the full picture of risk reduction, particularly regarding PSPS (Public Safety Power Shutoffs) implementation and residual risk after mitigation.

JH presented documentation standards and stakeholder roles, drawing parallels between building fire modeling standards and wildfire risk modeling. They outlined different audience needs: owners (executive and program level), designers (model developers), and reviewers (regulators and intervenors). The presentation covered requirements for summary and detailed documentation in Appendix B of WMPs, highlighting issues with unclear audience targeting, content overlap between sections, and inconsistent interpretations across utilities.

The meeting included extensive discussion on verification and validation of models. JH emphasized the difference between verification (ensuring models work as designed) and validation (determining model accuracy). They noted that while utilities provide validation documentation, verification documentation is often lacking. SCE and other utilities expressed concerns about the burden of annual detailed documentation requirements, suggesting alignment with RAMP (Risk Assessment Mitigation Phase) cycles every 3-4 years rather than annual submissions.

Key themes throughout the meeting included the need for better alignment between WMP requirements and utility decision-making processes, challenges in presenting risk information that accounts for bundling and operational constraints, and the balance between technical detail and practical implementation timelines. The discussion also touched on the upcoming AB 747⁹ bill effective January 2027 and its potential impact on scheduling.

2.10 10/29/25 – TECHNOSYLVA: FUELS AND URBAN CONFLAGRATION

The October RMWG meeting featured a comprehensive presentation by Technosylva on fuel data modeling and urban conflagration modeling.

Technosylva's presentation focused on two main areas: fuel data improvements and urban fire impact modeling. For fuel data, they demonstrated how they customize and enhance existing datasets like LandFire, which is

⁹ Levine, M. (2019). *Assembly Bill No. 747: Planning and zoning: general plan: safety element*. California Legislature. https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201920200AB747

intended as a technical dataset requiring tailoring rather than direct use. Their approach involves using high-resolution LiDAR data, satellite imagery, machine learning, and ground truth validation to create more accurate fuel classifications. They have developed dynamic fuel models that change over time, particularly for grasslands which they update twice yearly due to their highly variable nature influenced by weather and precipitation patterns.

Technosylva discussed their improvements over traditional fuel models, particularly addressing underestimation issues in timber fire behavior and overestimation in swampland models. They developed the CalFire Field Atlas with detailed plots of 25-50 acres each using drone equipment and LiDAR to better understand fuel characteristics. Their validation work included an analysis of over 5,500 fires, which claimed their custom fuel models achieve 75-81% accuracy performance depending on the service territory.

For urban conflagration modeling, Technosylva presented their research on modeling fire impacts in built environments, which has become increasingly important as catastrophic wildfires have impacted more structures since 2013. Their Urban Conflagration (UC) model analyzes 1,900 fire observations to understand encroachment distances and building loss factors. The model incorporates weather conditions, building density, building age, and applies machine learning to predict building vulnerability.

The presentation included extensive discussion about uncertainty measurement and ensemble analysis approaches. Technosylva has developed a 20-year reanalysis of weather data for the western U.S. at 2km resolution to better understand fire behavior conditions. They use Monte Carlo simulations and probabilistic modeling to evaluate different scenarios and provide utilities with distribution of results for planning purposes.

There was significant technical discussion about the differences between their models and existing approaches, validation methodologies, and how these improvements translate to utility risk modeling applications. The conversation mentioned the WSAB recommendation to compare multiple wildfire spread models and how different fuel and weather models can provide varying risk profiles for decision-making.

2.11 11/19/25 – FUTURE DEVELOPMENT WEIGH-IN AND APPROACHES DOCUMENT

The November RMWG meeting focused on future development of wildfire risk models and updates to the Approaches document.

PacifiCorp led the SMJU presentation, highlighting technological advances including composite risk scoring for comprehensive fire risk assessment, machine learning applications in operational forecasting tools, and ensemble forecasting to identify gaps and extend forecast horizons. They noted limitations for smaller utilities such as less available data for model validation, lack of standardized plug-and-play models requiring customization, and high costs associated with live fuel moisture sampling. The presentation also referred to publications like the EPSS Effectiveness Metric Enhancement¹⁰ from UCLA and the Hourly Wildfire Potential Index¹¹ by NOAA that demonstrate efforts toward advancing wildfire risk modeling.

SCE presented the joint Large IOU perspective, emphasizing challenges in obtaining clean wildfire databases and the need for consistent reporting across agencies. They discussed SCE's development of a new Wildfire Integrated Model (WIM) that combines granular physics-based modeling from Technosylva with stochastic modeling from RMS to capture both deterministic operational scenarios and tail risk from potential

¹⁰ Liberty Utilities, *EPSS Effectiveness Metric Enhancement Whitepaper*, Report GIRS-2024-07-L, 2024. doi: 10.34948/G4H594.

¹¹ National Oceanic and Atmospheric Administration. (n.d.). *Experimental Hourly Wildfire Potential (HWP)*. NOAA Global Systems Laboratory. Retrieved May 28, 2026, from https://gsl.noaa.gov/fire_weather/research/

conflagrations. The presentation covered regulatory requirements from RDF proceedings and SB884, the importance of updated fuels data and building inventory improvements, and the need for better coordination with agencies like CalFire, Caltrans, and CARB on operational thresholds and evacuation planning.

JH provided updates on the Approaches document, addressing comments received on previous sections and walking through newly drafted sections on data collection, physical systems, and smoke-related mortality. Key discussions included definitions of expected value versus tail value calculations, the distinction between causal and predictive modeling approaches, and how to handle extreme scenarios in risk assessments. The document was expanded to include sections on probability of ignition modeling approaches, asset-based versus location-based risk definitions, and model documentation requirements for regulatory reporting.

3.0 Conclusions and Recommendations

Some of the key conclusions and recommendations made by the RMWG participants during this phase of the RMWG are summarized below. Note that this list documents the general consensus of the RMWG at the time of these meetings and does not reflect a specific list of actions to be undertaken.

Key conclusions include:

- + **Stakeholder Feedback Integration:** Stakeholder interviews from 2024 revealed that the RMWG's purpose, objectives, and scope needed clearer definition, leading to improved planning for Phase IV meetings and transitioning toward developing an "Approaches" document
- + **Risk Framework Challenges:** Significant definitional challenges exist around "wildfire risk" with utilities using both asset-based and community-based approaches, affecting how burn likelihood and consequences are calculated and interpreted
- + **Consequence Modeling Gaps:** Current utility risk models may not capture the full scope of wildfire economic impacts, with research suggesting that smoke-related mortality, housing market impacts, and broader economic disruption represent approximately 80% of total wildfire losses
- + **Financial Dominance in Risk Calculations:** Financial attributes dominate wildfire risk calculations in utility cost-benefit frameworks, with safety components (including egress and social vulnerability factors) representing only 5-6% of total risk
- + **Documentation and Communication Issues:** Current WMP reporting requirements lack alignment with utility decision-making processes, with utilities relying on Cost-Benefit Ratio (CBR) metrics rather than risk-per-mile rankings for strategic decisions
- + **Model Validation and Verification (V&V) Challenges:** While utilities provide validation documentation, verification documentation is often lacking, with ongoing challenges in standardizing risk assessment methodologies across different utility territories
- + **Technological Advancements:** Utilities are incorporating machine learning applications, ensemble forecasting, and composite risk scoring, though smaller utilities face limitations including less available data and high costs for model customization

Key recommendations include:

- + **Approaches Document Development:** Continue collaborative development of the Approaches document to record assumptions and approaches used by different utilities, incorporating RMWG findings to streamline risk management practices
- + **California-Specific Research:** Conduct additional California-specific research on wildfire economic impacts, particularly given the state's unique fire risk profile, structure values, and population density patterns
- + **Smoke Impact Assessment:** Consider three options for smoke impact inclusion: (1) defer studies to academic/regulatory bodies, (2) include smoke in Multi-Attribute Value Function (MAVF), or (3) conduct joint utility studies

- + **WMP Reporting Alignment:** Improve alignment between WMP requirements and utility decision-making processes, potentially moving from annual detailed documentation to alignment with RAMP cycles every 3-4 years
- + **Standardization Efforts:** Develop standardized approaches for suppression cost estimates, structure valuation methods, and fuel model validation across utility territories
- + **Enhanced Coordination:** Improve coordination with agencies like CalFire, Caltrans, and CARB on operational thresholds, evacuation planning, and consistent wildfire database reporting
- + **Future Development Focus:** Address limitations for smaller utilities through standardized plug-and-play models, improved data sharing, and cost-effective validation approaches for wildfire risk modeling

4.0 Next Steps

Phase I and II of the RMWG covered a wide range of technical topics related to electrical corporation wildfire and outage risk modeling. These meetings focused on information gathering and knowledge sharing, including from outside experts, as various approaches used by the electrical corporations varied significantly at the start of the RMWG. The approaches used by the electrical corporations have started to converge in some areas, while continuing to evolve differently in other areas. As the electrical corporation risk models mature and become more stable, it has become more practical to establish areas of consensus or difference in wildfire and outage modeling approaches. Phase III of the RMWG, which occurred in 2024, mostly focused on how to use the information and discussions from Phases I and II of the RMWG to inform guidelines, as well as restructure the RMWG to move away from information sharing into reaching tangible conclusions that could be used to inform risk modeling moving forward.

The focus during Phase IV was to summarize the different approaches implemented by electrical corporations for modeling the wildfire risk to the public from their equipment. The Approaches document will summarize the discussions of the RMWG, and the modeling approaches presented by the electrical corporations in their WMPs. The document will serve as guidance for how to conduct the analyses and present the results for review by other stakeholders. Areas where consensus has been reached on best practice will be documented and recommended for use. Areas where there is no consensus on best practice will be discussed with recommendations made on the comparisons needed to justify an individual approach. Areas where future developments are needed in order to improve will be summarized with recommendations made on potentially responsible parties for driving these improvements. The objective is to document areas where there is and is not consensus in wildfire and outage risk modeling approaches with discussion around why one approach may be used over another, as well as discussion of areas that need continual improvement and possible paths forward.

The Approaches document will continue to be developed through 2026. All RMWG members are invited to participate in redlining the Approaches document as it is being developed. In 2026 there will be RMWG meetings to go over technical topics to be included in the Approaches document, and time for RMWG attendees to provide feedback and discuss comments on the document as a group before it is finalized and published on the Energy Safety docket. The Approaches document is expected to be published by the end of 2026.