SOUTHERN CALIFORNIA EDISON
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October 13, 2021

Office of Electrical Infrastructure Safety
California Natural Resources Agency
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E-Filing
Docket# Risk-Model-Group

Subject: Southern California Edison Company's Report on Its Current Wildfire Risk Modeling Practices

I. Introduction

On September 29, 2021, the Office of Energy Infrastructure Safety (OEIS or Energy Safety) issued guidelines for the recently established OEIS-led wildfire risk-modeling working group with the intent to bring more consistency in wildfire risk modeling between the California utilities. As part of the guidance, Energy Safety required the utilities to either augment their presentations for the October 5-6 workshops or submit a report by October 13 with the following information:

- Data used broken down by model, including:
  - Scale and geographical context
  - Topography
  - Quality of historical outage, fault, and ignition data
  - Usage of outage and fault events to augment ignition data
  - Integration of potential ignitions avoided due to PSPS events (to account for bias in ignition data post during PSPS events)
  - Asset data (including asset age, health, inspection results, type, etc.)
  - Impacts of system hardening and other initiative efforts
  - Climate conditions (including historical wind conditions, relative humidity, temperature, etc.)
  - Vegetation (including type, density, height, etc.)
  - Fuel characteristics (including load, size, continuity, vertical arrangement, moisture, etc.)
  - Impacts of Routine and Enhanced vegetation management activities (including tree-trimming, tree-removal, inspections, etc.)
  - Frequency of updates to datasets and inputs, including any associated triggers to determine the need for updates
  - Accuracy and quality checks for data and inputs
- Model descriptions for ignition, consequence, and PSPS models, including:
  - Algorithms used and machine learning capabilities
  - Impact of climate change
  - Ingress and egress
  - Modeling components, linkages, and interdependencies
  - Weight of each data components and inputs
  - Automatization implemented
  - Frequency of updates to modeling, including the basis for updates
- How model outputs are analyzed and utilized for each model, including:
  - Confidences for each modeling component, including how such confidences were determined
  - Range of uncertainty for model outputs, including how those ranges are determined and how uncertainty is minimized

    - Systems used to verify the model outputs, including verifier (subject matter experts, third-party) and description of implementing lessons learned
    - How uncertainty affects the interpretations of model outputs
    - Determination of highest risk areas based on model outputs
    - Use of subject matter expertise for inputs and further verification
- Description of any collaborations previously undertaken among the utilities, as well as details on consistency across utilities, including:
    - What modeling approaches are already consistent
    - Which modeling approaches have the potential for more consistency and how approaches would benefit from consistency
    - Where consistency is infeasible or not necessary.
- Description of any collaborations previously undertaken and/or ongoing with other entities
- Anticipated changes to any of the models between now and the 2022 WMP Update
- Attachments of any internal or third-party validations completed, and description of any peer review utilized

This document provides SCE's responses to Energy Safety's requirements regarding its wildfire risk modeling practices. In the responses below, SCE notes if the requested information was included in SCE's October 5-6, 2021 presentation.

II. <u>Responses to Risk Modeling Practices Reporting Requirements</u>

As described in SCE's October 5-6 working group presentation, SCE primarily uses its Wildfire Risk Reduction model (WRRM) framework to estimate wildfire risk. The WRRM has two primary components, a point of ignition (POI) component, which is comprised of a number of machine-learning models designed to estimate the probability of ignition occurring from individual assets, and consequence component that estimates the relative impact of fires if ignitions occur. In addition, SCE has developed a PSPS risk model, which uses wind and weather condition data to estimate the probability of de-energization and the consequence of de-energization for customers. Presently, the PSPS model is used to calculate risk spend efficiencies (RSEs) and inform PSPS decision making by comparing the risk of wildfire to the risk of PSPS events. The responses below focus on providing the requested information as it relates to WRRM and PSPS models and associated components.

A. <u>Data used broken down by model</u>

i. Scale and geographical context

WRRM – Data elements for POI and consequence components are calculated at asset and/or line segment level. The POI component covers SCE's entire service area. The consequence component covers all High Fire Risk Areas (HFRA) within SCE's service area plus a 20-mile buffer.

PSPS – PSPS risk is calculated at the circuit level and covers SCE's HFRA.

ii. Topography

WRRM – Data elements related to topography include elevation, slope, and land use land cover (LULC).

PSPS – Data elements used in the PSPS model related to topography include wind direction, and wind speed.

iii. Quality of historical outage, fault, and ignition data

WRRM – For the WRRM, SCE utilizes historical outage and fault data since 2008, historical CPUC-reportable ignition data since 2015, and more granular data beyond CPUC-reportable ignitions since 2019. All outage data is validated and reported from SCE's ODRM system.

PSPS – The PSPS model does not utilize historical outage, fault or ignition data. Rather, the model utilizes 10 years' worth of Atmospheric Data Solutions (ADS) hourly wind gust information at 2-kilometer grid level.

iv. **Usage of outage and fault events to augment ignition data**
WRRM – The WRRM uses outage and fault events to augment by converting the outage and fault data to calculate the probability of a spark causing a fault, then converting that to POI using ignition data and using outage as a fault proxy.
PSPS – Outage and fault events are not included in the PSPS model.

v. **Integration of potential ignitions avoided due to PSPS events (to account for bias in ignition data post during PSPS events)**
WRRM – The WRRM does not take into consideration potential ignitions avoided due to PSPS events.
PSPS – The PSPS model does not utilize ignition data, therefore does not include data related to ignitions avoided due to PSPS events.

vi. **Asset data (including asset age, health, inspection results, type, etc.)**
WRRM – The asset data utilized in the WRRM include asset type, asset age, asset outage information (includes health of the asset), asset failure events, and asset failure frequency. This data also informs the prioritization of P2 remediations which are based on inspection results.
PSPS – The PSPS model does not take into consideration asset data. However, asset health and inspection results are used to adjust wind-gust thresholds.

vii. **Impacts of system hardening and other initiative efforts**
WRRM – The POI component of the WRRM is frequently updated with latest system hardening and infrastructure replacement information. The consequence component does not take system hardening or other infrastructure replacement into account.
PSPS – The PSPS model does not directly consider system hardening efforts, however, the information is indirectly accounted for in the model because the installation of covered conductor may increase wind gust thresholds, thereby lowering the probability of de-energization.

viii. **Climate conditions (including historical wind conditions, relative humidity, temperature, etc.)**
WRRM – The WRRM utilizes historical wind conditions, relative humidity, ten-year projection of fuels, wind speed, wind direction, 1, 10, and 100-hour fuel moisture, temperature, and other conditions.
PSPS – The PSPS model utilizes wind gust data, wind speed, Fire Potential Index (FPI) data that includes relative humidity, and temperature data.

ix. **Vegetation (including type, density, height, etc.)**
WRRM – Vegetation data utilized in the POI component includes vegetation type, vegetation density, and location. The consequence component uses an updated version of the LANDFIRE 2016 fuels data that Technosylva enhanced with all large fire disturbances from 2016-2019. In addition, a prototype enhancement of urban fuel types was applied to support urban encroachment enhancements.
PSPS – The PSPS model does not utilize vegetation data. However known vegetation P2 are applied in the operational side for PSPS decision making.

x. **Fuel characteristics (including load, size, continuity, vertical arrangement, moisture, etc.)**
See response to A.ix.

xi. **Impacts of Routine and Enhanced vegetation management activities (including tree-trimming, tree-removal, inspections, etc.)**

WRRM – Routine and enhanced vegetation management is included in the POI component, in particular tree removals.

PSPS – The PSPS model does not take into account routine or enhanced vegetation management activities. However, known vegetation P2 are applied in the operational side for PSPS decision making.

xii. **Frequency of updates to datasets and inputs, including any associated triggers to determine the need for updates**

WRRM – The WRRM datasets and inputs are typically refreshed bi-annually (every 6 months) to update fuel and asset conditions. In addition, SCE's vendors may also update the model and components periodically. In some circumstances, SCE may request an update to the datasets for issues that should be taken into account such as burn scars.

PSPS – The PSPS model is in a nascent stage and SCE is currently determining a reasonable update schedule.

xiii. **Accuracy and quality checks for data and inputs**

WRRM - See slide 15 of SCE's October 5-6 workshop presentation. SCE conducts internal and third party validation to review model inputs, pressure test changes to the model, and analyze data quality and accuracy.

PSPS – ADS uses latest models plus calibration with SCE weather observations and applies Palantir principles to improve PSPS data quality.

B. <u>Model descriptions for ignition, consequence, and PSPS models</u>

i. **Algorithms used and machine learning capabilities**

WRRM – The WRRM has machine learning capabilities. SCE included its algorithms and further described the calculations used in its response to WSD Action Statement Remedial Compliance Plan Guidance-3.[1]

PSPS – The PSPS model does not use machine learning or algorithms, but rather is based on a back casting of the past 10 years of weather data and de-energization criteria on a circuit basis to estimate how many times the circuit would be de-energized.

ii. **Impact of climate change**

WRRM – For the POI component, the impact of climate change through 2020 is captured in historical trends in ignition and temperature data. For the consequence component, climate change is captured by accounting for the worst historical weather days in the past 20 years in the input data.

PSPS – For the PSPS model, the impact of climate change through 2020 is captured by using the past 10 years of weather data to compare with de-energization criteria on a circuit basis to estimate how many times the circuit would be de-energized.

iii. **Ingress and egress**

WRRM – Ingress and egress are not currently used in the WRRM. However, SCE is currently developing a model to address potential locations with ingress/egress issues.

PSPS – Ingress and egress are not considered in the PSPS model.

iv. **Modeling components, linkages, and interdependencies**

WRRM – The modeling components of the WRRM, including linkages and dependencies are covered in SCE's October 5-6 presentation on slides 9-12. To summarize, the POI component includes asset attributes including age, loading, location, and asset subtype, weather

[1] SCE 2021 WMP Revision - CLEAN, pp. 58-60, 85-88, and 307-308.

conditions, and outage information. The consequence component includes fuel information, structure information, population information, and terrain information.

In terms of linkages and interdependencies, there might be some correlated or interdependent variables used in SCE's predictive models. However, SCE uses tree-based models, which accounts for overlap or correlations of different input features on its own (i.e., random selection methodology can address interactive effects between variables). For example, if both maximum and average loading are used in SCE's transformer POI model, then they are interdependent or correlated. The tree-based model will randomly select one variable at a time to create the decision trees and the correlated variables will not be "double counted" because they have the same or similar impacts on the models. The consequence component does not have direct linkages.

PSPS – The modeling components for the PSPS model include historical weather (wind gusts, windspeed and FPI), circuit by circuit PSPS de-energization criteria, number of customers and types of customers (e.g., AFN) connected to the circuits. There are no linkages and interdependencies with these components.

v. **Weight of each data components and inputs**

WRRM: SCE's POI models use tree-based machine-learning models instead of regression models, so there is no weight assigned to the components. The random selection decides the relative importance of each input feature. Random forests and gradient boosting models (RF and GBM) are part of a greater set of models that utilize ensembles of decision trees (or "ensemble models"). SCE selected these ensemble models because of their ease in interpretability and relative speed in development/training. RF and GBM models differ in how they construct these decision trees leading to specific strengths and weaknesses. These strengths and weaknesses depend on the intricacies of the input data and are studied through trial and error, measured by the individual algorithms' performance during testing and validation. The goal is to achieve optimal performance on both training and testing/validation data sets, because models that perform accurately on the training set but do not perform well on the test/validation set do not "generalize" well. Ultimately, models are adopted after evaluating and optimizing relevant model accuracy on the test and validation hold out data sets.

PSPS – For the PSPS model, all inputs are weighted equally on the probability of de-energization side. On the consequence side of the PSPS model, there is more weight given to AFN and NRCI customers. SCE creates an index that amplifies the safety/consequence of PSPS events for these circuits.

vi. **Automatization implemented**

For both the WRRM and PSPS models, SCE has incorporated built-in scripts into the models to allow for automation. However, the scripts are manually refreshed to ensure the input/output accuracy and code execution are appropriate.

WRRM – The POI components use Python or R script, and the consequence component uses scripts developed by Technosylva.

PSPS – The PSPS model was developed using Python script, however scripts may be manually pushed to execute.

vii. **Frequency of updates to modeling, including the basis for updates**

See response to A.vii.

C. <u>How model outputs are analyzed and utilized for each model</u>

i. **Confidences for each modeling component, including how such confidences were determined**

WRRM – See SCE's October 5-6 presentation, Slide 11. For the POI component, accuracy is measured by the area under the curve (AUC) of the test data set. SCE continuously monitors the POI component output and compares the results with actual events. For the consequence component, SCE compares and validates outputs with the previous component output. The fire propagation inputs are also calibrated to historical and latest fires.

PSPS – For the PSPS model, the ADS data set is calibrated with historical and actual weather station observations.

ii. **Range of uncertainty for model outputs, including how those ranges are determined and how uncertainty is minimized**

WRRM – The POI component is calibrated against actual historical ignitions to minimize uncertainties. For the consequence component, SCE is increasing the number of weather scenarios and simulations to minimize uncertainty.

PSPS – For the PSPS model, the ADS data set is calibrated to historical actual weather station observations to minimize uncertainty.

iii. **Systems used to verify the model outputs, including verifier (subject matter experts, third-party) and description of implementing lessons learned**

WRRM – See SCE's October 5-6 presentation, slide 15. For the POI component, SCE internal SMEs evaluate model inputs to ensure they are appropriate and that all applicable inputs are captured. The SMEs also examine the output and component performance to make sure the output is accurate. Furthermore, before major updates are implemented, SCE hosts challenge sessions, known as "red team" sessions with fire science, data scientists, and risk management experts (including external experts) to review model input, output, assumptions, code, and compare with existing models to ensure that the updates will improve the existing models. For the consequence component, SCE performs independent reviews on Technosylva consequence data to determine if changes are needed, and also benchmarks Technosylva output to prior component outputs.

PSPS – For the PSPS model, SCE's risk modeling SMEs work with the PSPS operations team to calibrate model output with observations and experiences from in-field operations.

iv. **How uncertainty affects the interpretations of model outputs**

WRRM – The WRRM is primarily used to scope grid hardening activities. SCE uses the output of the WRRM to understand relative ranking between all different assets in same asset type. By doing so, SCE focuses on relative risk among assets and less so on the uncertainty of the output.

PSPS – In the PSPS risk model, SCE uses the past 10 years of weather data and de-energization criteria on a circuit basis to estimate how many times the circuit would be de-energized. The uncertainty is addressed by using 10-year average frequency and duration of the potential PSPS events.

v. **Determination of highest risk areas based on model outputs**

WRRM – For the WRRM, highest risk areas is based on the output of the POI component multiplied by the output of the consequence component (i.e., risk = probability * consequence of an event). This risk is quantified at a granular asset or segment level.

PSPS – For the PSPS model, risk is determined by multiplying the probability of a PSPS event occurring by the consequence of that event occurring (i.e., risk = probability * consequence of an event). This risk is quantified at the circuit level.

vi. **Use of subject matter expertise for inputs and further verification**
See response to C.iii above.

D. <u>Description of any collaborations previously undertaken among the utilities, as well as details on consistency across utilities</u>

See SCE's October 5-6 workshop presentation, slide 14, for an overview of the IOU collaboration on risk modeling. The IOUs have met extensively on risk modeling, conducting at least ten meetings in 2021 to discuss risk modeling and potential wildfire risk modeling alignment opportunities.

i. **What modeling approaches are already consistent**
WRRM – For POI modeling, the overall modeling approach used by the IOUs is generally consistent in that all IOUs use numerous sub-driver models to estimate POI risk. For example, sub-driver models include contact from object (e.g., vegetation), assets (e.g., transformers, conductor, etc.), and transmission models. For the consequence component, all three IOUs are currently using Technosylva to estimate the consequence of an ignition.

ii. **Provide list of proceedings at the CPUC where risk is discussed**
Issues related to Risk are being considered by the CPUC in the RAMP and Risk-Based Decision-Making Framework OIR.

iii. **Which modeling approaches have the potential for more consistency and how approaches would benefit from consistency**
The IOUs are currently working on building consistency on the types of data and the granularity of data used in sub-driver models. Building this consistency will help utilize best practices thereby improving the accuracy of the respective models. This will also be useful in comparing modeling outputs across the utilities, which would be useful for potential future third-party validation.

iv. **Where consistency is infeasible or not necessary.**
As discussed above, the IOUs are working towards building consistency among the data types and granularity of data used in the sub driver models. However, given each IOUs' unique service area, the types of data collected may be different. In addition, the sub-driver models themselves may utilize different calculations/algorithms based on the prevalence of those sub-drivers in the IOUs' respective service areas and aligning these aspects may be infeasible or impractical. Furthermore, because the working group includes some smaller utilities, the data collected and risk modeling capabilities may be at different stages, and consistency may not be feasible at this time.

E. <u>Description of any collaborations previously undertaken and/or ongoing with other entities</u>

SCE collaborates with numerous other entities through research, sharing best practices, and discussions on risk modeling. There are many conferences, meetings, and other forums that SCE actively participates and are facilitated by groups such as the International Wildfire Risk Mitigation Consortium (IWRMC), Western Energy Institute, Electric Power Research institute (EPRI), National Fire Protection Association (NFPA), CAL FIRE, Edison Electric Institute, Utility Analytics Institute (UAI), Utility Data Science Panel, Electricity Subsector Coordinating Council, Federal Emergency Management Agency (FEMA), North American Electric Reliability Corporation (NERC), Western Energy Coordinating Council (WECC), among others. Furthermore, SCE partners with academic research institutes such as the University of California, Los Angeles, Cal Poly San Luis Obispo, San Jose State University, and Texas A&M on various research projects related to wildfire mitigation.

F. <u>Anticipated changes to any of the models between now and the 2022 WMP Update</u>

See SCE's October 5-6 workshop presentation, slide 16. SCE expects to include updates to RSEs and Risk modeling approaches based on the collaborations undertaken through this and other working group efforts underway. Furthermore, SCE is refreshing the POI component of the WRRM to reflect latest asset information, and will include updated Technosylva Fire propagation refinements to the consequence component.

G. <u>Attachments of any internal or third party validations completed, and description of any peer review utilized</u>

SCE does not have any publicly available third-party validation documents. However, SCE is planning to conduct further third-party independent evaluations within the next year.

III. <u>Conclusion</u>

SCE appreciates the opportunity to participate in the Wildfire Risk Modeling working group meetings initiated by Energy Safety, and looks forward to further collaboration with stakeholders through this process. SCE understands that risk modeling is a complex, technical subject, and capturing the intricacies of the risk models employed by the utilities in a brief presentation and report is challenging. As such, SCE fully supports the working group approach as we advance towards the 2022 WMP Update.

Sincerely,

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Cc: Risk Modeling Group Service List
Wildfire Mitigation Plans Service List