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Via Electronic Mail

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Subject: Wildfire Risk Modelling Working Group: Workplan Guidelines

Pursuant to the Office of Energy Infrastructure Safety ("Energy Safety") workplan guidelines for the Wildfire Risk Modelling Working Group, Bear Valley Electric Service, Inc. ("BVES") submits this expanded explanation to the presentation held on October 5, 2021.

The details below respond to the requested prompts regarding each of BVES's current risk models and their associated data.

Risk Safety Model Approach for Small and Multi-Jurisdictional Utilities ("SMJUs")

On April 25, 2019, the California Public Utilities Commission ("CPUC or Commission") issued Decision 19-04-020, which initiated the second phase in adopting risk spending accountability report requirements and safety performance metrics for investor-owned utilities ("IOUs"). The Commission also adopted a Safety Model Approach for SMJUs, of which utilize the 7x7 Logarithmic Risk Matrix. BVES utilizes its Risk Register to produce analyses that inform risk-based decision-making for the utility. See BVES's 2021 Wildfire Mitigation Plan ("WMP") for additional detail.

Model Data Used:

The scale, geographical context, and topography associated with this risk register model is illustrated through BVES's 32-square mile service territory, which covers rural and mountainous terrain at approximately 7,000 feet within the San Bernardino Mountains. Vegetation conditions include a heavily forested environment with mostly dry climatological conditions spanning 80.5% of the service area. Fuel conditions include coniferous trees such as ponderosa, jeffrey, sugar, coulter, and lodgepole pines with minimal cheatgrass and shrubs. BVES's territory is entirely within the High Fire Threat District ("HFTD") with mostly Tier 2 and a small percentage in Tier 3. Additionally, the entire service territory is located within the Heavy Loading District (greater than 3,000 feet).

This risk model includes to the top asset-related risks to the service territory and electrical infrastructure, which guides additional mitigation strategies beyond those already in place. The 7x7 Logarithmic Risk Matrix identifies the frequency of hazardous events and the possible consequences and impacts. The identified impacts include those associated with reliability, compliance, quality of service, safety, and environmental damage. The quality of historical outages, faults, and ignition data influences the development of the Risk Matrix along with periods or project terms, including all vegetation management activities. BVES equipment and operations have not ignited any fires in recent years, though, the potential for such ignitions and their consequences are considered in the data. Additionally, BVES has not initiated a Public Safety Power Shutoff ("PSPS") event, but the consequential outcomes of such are also considered within the model. BVES performs quality checks for data inputs semi-annually, especially prior to WMP updates and performs an annual calibration event.

Not Applicable or Considered Elements:

Detailed climate conditions and forecasted periodic cases (e.g., 50-year or 100-year conditions) are not currently addressed in BVES' Risk Register.

Due to lack of ignition events and activated PSPS protocols, BVES has not integrated potential ignitions avoided due to PSPS into its Risk Register.

Model Descriptions for Ignition, Consequence, and PSPS Models:

The Risk Register and risk-based decision-making methodology includes weighted score indices to perform the calibrations of frequency and impact. Frequency is defined as "number of events per unit of time." It is a measure of how often a risk event has occurred or is likely to occur. The frequency measured is the approximate frequency of the worst reasonable case of a specific risk event.

The potential impacts of the worst reasonable scenario across the six impact categories are scored between 1 and 7, with 7 as the greatest severity. Once the impact is articulated, frequency is established based on data and a subject matter expert is assigned to each scenario. The risk register then applies a formula to create a score between 0 and 1,000,000,000. Direct impacts of climate change are considered, as well as invasive species and other impacts such as the recent bark beetle infestation, which resulted in a high number

of dead, diseased, and dying trees. The Risk Register calculates a total risk score from the data collected in risk analysis.

There have been no significant modelling changes since the 2021 WMP filing. which identified in-depth model data descriptions. During BVES' annual calibration of its Risk Register, participants question assumptions and other inputs to risk scores. Once the calibration is complete, organizations are allowed to re-score any risk that has been successfully challenged. The Risk Register is interlinked with the Fire Safety Circuit Matrix (described below), which values risk score methodology by circuit.

Not Applicable or Considered Elements:

This model does not include machine learning capabilities.

Ingress or egress routes are not directly applicable to this risk model.

Detailed climate conditions and forecasted periodic cases (e.g., 50-year or 100-year conditions) are not applicable for these present conditions, however, risk events may occur once every 10, 30, of 100+ years, which forms the frequency approach in consequence rating. However, as discussed above, impacts of climate change, to the extent known, are considered.

How Model Outputs are Analyzed and Utilized:

BVES performs an initial analysis on selected risk events to determine risk impact value with high value risks are selected for a full analysis. BVES then develops a basis document, which captures the assumptions and rationale behind the assigned risk score. Outliers and existing controls are analyzed, which leads to a calibration session to review the total risk score.

Once risk events are scored, the risk team conducts an internal calibration session with a broad set of subject-matter experts ("SMEs"). The session focuses on outlier risks or areas where the SME may question the accuracy of the score. Confidence levels are determined over the internal calibration meeting with consideration of SME insight. The SME or Risk Manager for each risk presents the material contained in the Basis Document and offers attendees the opportunity to discuss the risk scoring.

The risk event scores are plotted on a heat map. BVES uses a 7 x 7 heat map matrix, which is consistent with leading practice in the utility industry to reveal the determination of highest risk areas based on the model outputs. Outliers and uncertainties are noted and influence risk-based decision-making. BVES aligns these anomalies with highest risk areas within the service area to develop a reasonable case of the evaluation. This is based on plotting a range of outcomes along a distribution line and, for purposes of the risk discussion, choosing a scenario that identifies a reasonably probable worst-case outcome.

Not Applicable or Considered Elements:

This model does not describe precise confidence ranges for uncertainty; however, outliers do result from the analysis and are broadly discussed over internal calibration meetings with SME input.

Additional systems are not applicable to verify model outputs. The Risk Manager and SME insight provide quality assurance checks over the annual calibration determinations.

Description of any Collaborations Previously Undertaken Among the Utilities, as well as Details on Consistency Across Utilities:

As a SMJU, BVES is not subject to detailed modeling requirements as described in the Risk Assessment Mitigation Phase reporting structure and Safety Model Assessment Proceeding. BVES is not currently directly engaged in any collaborations with other utilities beyond information sharing.

BVES is familiar with the REAX Engineering modeling and the use of Technosylva by other utilities. BVES continues to follow developments across and outside of California to identify wildfire risks through modeling. Additionally, BVES is interested in employing the best modelling practicable for understanding its wildfire risk.

BVES declines to engage in speculation about which modelling approaches have the potential for more consistency and how approaches would benefit from consistency.

Description of any collaborations previously undertaken and/or ongoing with other entities:

BVES is not currently directly engaged in any collaborations with other utilities beyond information sharing.

Anticipated changes to any of the models between now and the 2022 WMP Update:

BVES does not foresee any changes to the model between now and the 2022 WMP Update. Annual calibrations have taken place in the third quarter. This update will be described in the next WMP update. BVES is currently focusing its efforts on the Advanced Ignition Probability and Forecast Model that will be discussed later in this report.

Attachments of any internal or third-party validations completed, and description of any peer review utilized:

N/A

Fire Safety Circuit Matrix

The purpose of the BVES Fire Safety Circuit Matrix model is to determine circuit-level risk under current and planned mitigation activities intended to reduce ignition potential. The model informs the planning of the WMP by considering changes to the risk profile through mitigations executed over time. Outputs from the Risk Register and risk-based decision-making approach contributed significantly and are integrated in the model outputs of this matrix.

Model Data Used:

The scale, geographical context, and topography associated with this risk model is illustrated through BVES's service territory, described above.

The Fire Safety Circuit Matrix incorporates inputs from BVES's mitigation efforts and applies them to the risk drivers that drive the potential ignition likelihood and consequences. The matrix utilizes an algorithm with over 20 data inputs, which assess the risk of BVES's circuits using the risk factors and status of executed mitigation measures described in the WMP. This also incorporates electrical and vegetation inspection results with localized vegetation density along the circuit quantified from LiDAR survey results. Localized weather conditions are based on historical data, which are used to determine wind intensity factors for each circuit.

Not Applicable or Considered Elements:

Detailed climate conditions and forecasted periodic cases (e.g., 50-year or 100-year conditions) are not currently addressed in the Fire Safety Circuit Matrix.

Due to lack of ignition events and activated PSPS protocols, BVES has not integrated potential ignitions avoided due to PSPS into its Risk Register.

Model Descriptions for Ignition, Consequence, and PSPS Models:

This matrix model includes a risk score algorithm that accounts for the scoring criteria described above. The performed initiatives are subtracted with the risk score if execution schedules are behind, issues for completion are found, or other periodic incidents where these mitigation measures are delayed. This matrix is interdependent on the Risk Register construct and risk-based decision-making methodology described above.

Not Applicable or Considered Elements:

This model does not have any automatization nor include machine learning capabilities at this time.

Detailed climate conditions and forecasted periodic cases (e.g., 50-year or 100-year conditions) are not applicable for these present conditions, however, risk events may occur once every 10, 30, of 100+ years, which form the frequency approach in consequence rating. Additionally, as discussed above, the impacts of climate change, to the extent known, are considered.

How Model Outputs are Analyzed and Utilized:

In conjunction with the modeling description above, BVES evaluates enterprise risk using a risk-based decision-making framework to prioritize identified wildfire risk and evaluate wildfire risk mitigation. The combination of these methods allows for both a comprehensive analysis of enterprise-wide safety risk and wildfire related assessment to generate an effective proxy wildfire ignition risk assessment. BVES Risk-Based Decision-Making Framework and resulting Risk Register effectively targets circuits and assets to assure initiatives that provide the greatest mitigation benefits are properly prioritized.

Accordingly, BVES is working with REAX Engineering to develop a model to better quantify ignition risk drivers and associated probabilities to assist in determining which initiative mitigations to targeted circuits and assets that will provide the greatest benefit to wildfire risk reduction. This is discussed in the model details below.

Not Applicable or Considered Elements:

This model does not include any direct confidence ranges for each modeling component and uses the base weighted scoring mechanism to determine the risk range, score, and circuit prioritization for wildfire mitigation efforts.

BVES does not use direct Subject Matter Expert (SME) review to verify results but does work with staff and consultants to interpret the outputs as it relates to future WMP updates.

Systems in place to verify outputs directly correspond to WMP measure metrics, which are tracked on a quarterly basis.

Description of any collaborations previously undertaken among the utilities, as well as details on consistency across utilities, including:

BVES is not currently directly engaged in any collaborations with other utilities beyond information sharing. BVES is familiar with the REAX modeling and the use of Technosylva by other utilities. BVES continues to follow developments across and outside of California to identify risks through modelling. Additionally, BVES is interested in employing the best modelling practicable for understanding its wildfire risk.

BVES declines to engage in speculation about which modelling approaches have the potential for more consistency and how approaches would benefit from consistency.

Description of any collaborations previously undertaken and/or ongoing with other entities:

BVES is not currently directly engaged in any collaborations with other utilities beyond information sharing.

Anticipated changes to any of the models between now and the 2022 WMP Update:

BVES has recently updated the matrix as presented in the October 5, 2021 risk modeling workshop and does not foresee any changes to the model between now and the 2022 WMP Update. BVES is currently focusing its efforts on the Advanced Ignition Probability and Forecast Model that will be discussed below.

Attachments of any internal or third-party validations completed, and description of any peer review utilized:

N/A

Advanced Ignition Probability and Risk Modeling

Model Data Used:

Publicly-available utility ignition data reported to CPUC and overhead electrical network filed with WMP's were analysed to quantify ignition rate (ignitions / 100 pole miles / hour) as a function of wind gust speed, fuel moisture, and temperature. Weather conditions at ignition location and time of ignition determined from gridded meteorological data and normalized by historical values that the entire overhead network "sees". Ignition rate was found to be an exponential function of wind gust speed, fine dead fuel moisture content, and fuel temperature.

Climate conditions for 2021 are derived from the Real Time Mesoscale Analysis (RTMA) product from the National Oceanic and Atmospheric Administration / National Center for Environmental Prediction. This provides hourly gridded (2.5 km) fields of weather conditions from 2011 to current. Future (2050) climate conditions are modeled using a downscaled global climate model developed by UCLA Department of Atmospheric and Oceanic Sciences. Specifically, the Weather Research and Forecasting (WRF) was used to dynamically downscale global climate models (GCMs) from the 6th Coupled Model Intercomparison Project (CMIP6). BVES is using a 10-year block of this data (hourly, 3 km resolution) centered around 2050 in its fire ignition and spread modeling to quantify differences in fire ignition and spread between current (2021) and future (2050) climate conditions.

At this time an update schedule for the dataset used in the Advanced Ignition Probability and Risk Model has not been determined. BVES is still evaluating options and is weighing input from the other utilities.

Not Applicable or Considered Elements:

Integration of potential ignitions avoided due to PSPS is not applicable as both consequences have not resulted in significant data findings for BVES at this time due to lack of ignition events and activated PSPS protocols.

Impacts of Routine and Enhanced vegetation management activities (including tree-trimming, tree-removal, inspections, etc.) are not considered in this model.

Asset data (including asset age, health, inspection results, type, etc.) are not currently incorporated into this model.

Impacts of system hardening and other initiative efforts are not currently incorporated into this model.

Model Descriptions for Ignition, Consequence, and PSPS Models:

AI/machine learning is not currently used. Ignition modeling is a correlation based on historical ignitions and weather data. Consequence modeling is based on ELMFIRE[1], additional details can be found in publication[2]:

Weather Research and Forecasting (WRF) was used to dynamically downscale global climate models (GCMs) from the 6th Coupled Model Intercomparison Project (CMIP6). A 10-year block of this data (hourly, 3 km resolution) centered around 2050 is used in fire ignition and spread modeling to quantify mid-century conditions.

[1] Lautenberger, C., "Wildland Fire Modeling with an Eulerian Level Set Method and Automated Calibration," Fire Safety Journal 62: 289-298 (2013).

[2] Lautenberger, C., "Mapping Areas at Elevated Risk of Large-Scale Structure Loss Using Monte Carlo Simulation and Wildland Fire Modeling," Fire Safety Journal 91: 768-775 (2017)

At this time an update schedule for the Advanced Ignition Probability and Risk Model has not been determined. BVES is still evaluating options and is weighing input from the other utilities.

Not Applicable or Considered Elements:

Ingress or egress routes are not directly addressed by this risk model.

Modeling components, linkages, and interdependencies

Automatization implemented

How Model Outputs are Analysed and Utilized:

In consequence modeling, uncertainty is addressed using large-scale Monte Carlo fire spread modelling to model hundreds of thousands of fires under past and future weather/climate scenarios. Risk is the product of probability and consequence. Ignition modeling directly quantifies probability. Fire spread modeling quantifies consequence as impacts to structures and acres burned. These are multiplied together to quantify risk. All modeling of this type is inherently uncertain, BVES understands this but can still determine relative risks from the models, prioritize those risks more likely to occur or cause catastrophic outcomes, and work to reduce and mitigate those risks.

The Advanced Ignition Probability and Risk Model is being developed in conjunction with REAX. REAX are industry experts with experience developing similar models for other utilities.

Not Applicable or Considered Elements:

BVES does not currently have confidence information for each modeling component, including how such confidences were determined.

Systems used to verify the model outputs, including verifier (subject matter experts, third-party) and description of implementing lessons learned – Upon completion of said model BVES will evaluate the need to verifying systems, with staff or through the use of a third-party verifier (Third Party SME).

Description of any collaborations previously undertaken among the utilities, as well as details on consistency across utilities, including:

BVES is not currently directly engaged in any collaborations with other utilities beyond information sharing. BVES is familiar with the REAX modeling and the use of Technosylva by other utilities. BVES continues to follow developments across and outside of California to identify risks through modeling. Additionally, BVES is interested in employing the best modelling practicable for understanding its wildfire risk.

BVES declines to engage in speculation about which modeling approaches have the potential for more consistency and how approaches would benefit from consistency.

Description of any collaborations previously undertaken and/or ongoing with other entities:

BVES is not currently directly engaged in any collaborations with other utilities beyond information sharing.

Anticipated changes to any of the models between now and the 2022 WMP Update:

BVES and REAX Engineering will finalize the work underway, that it presented on October 5, 2021. BVES anticipates few changes, and is aiming to complete this work before December 2021, with some refinement and limited additional data.

Attachments of any internal or third-party validations completed, and description of any peer review utilized:

BVES's understanding is that the Advanced Ignition Probability and Risk Model has not been peer review, however, REAX's approach has been replicated across multiple utilities across the West.