PACIFIC GAS AND ELECTRIC COMPANY

ELECTRICAL UNDERGROUNDING PLAN

ATTACHMENT B

WP020

EUP PSPS V1 RISK MODEL DOCUMENTATION

EUP PSPS Risk Model
v1 Documentation



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1 Executive Summary

The Public Safety Power Shutoff (PSPS) Risk Model provides the dollarized risk of PSPS outages on circuit segments, including the risk associated with downstream outages. It is used as a component of the overall Outage Risk Model, which is used by the Electrical Undergrounding Plan (EUP) project for prioritizing high risk circuit segments for undergrounding. The PSPS Risk model is a deterministic mathematical model derived from the customer-experienced outage risk on each circuit segment. In order to reflect the full risk (and thus the value of undergrounding) for each circuit segment, the model incorporates several factors: the segment's historical likelihood of appearing in a PSPS event polygon, its exposed length in miles, the geometry of both its upstream and downstream circuit segments, and the customer base served by all of these interrelated segments.

This model was developed to meet the requirements of SB884, which governs the EUP project. It also serves as a component of PG&E's broader strategy to mitigate wildfire risk while maintaining continuous and reliable electrical service to its customers.

2 Introduction

2.1 Model Overview

The PSPS Risk Model estimates the dollarized risk of PSPS outages at the circuit segment level, accounting for both direct customer impacts and the risk of causing downstream outages. The model uses outage durations that include patrol and restoration time as provided by the PSPS team, and it incorporates only PSPS events with a distribution footprint (Dx-only or Dx+Tx), excluding transmission-only events. The seven-year lookback period combines the formal PSPS Lookback Study (2018–2022) with SCADA-captured PSPS events from 2023-2024, scoped under Plan C (PSPS event used for analysis as defined by the PSPS team).

The PSPS Risk Model is used as a component of the Outage Risk Model during wildfire-season planning and regulatory reporting to assess the tradeoff between wildfire mitigation and customer reliability impacts. It is a deterministic mathematical model with no machine-learning component. PSPS risk on a given circuit segment is modeled as a nonlinear function of likelihood and consequence factors. Likelihood factors include historical presence within a spatiotemporal PSPS event polygon, minutes of resulting outage, miles of exposed circuit, and circuit geometry both upstream and downstream. Consequence factors include the number of customers affected by historical outages, customer segmentation factors, and the service cost for each affected customer.

Along with the EPSS Risk Model, the PSPS Risk Model is one of two models that feed into the Outage Risk Model. These models evaluate the risk associated with circuit segments using a circuit-based, “source-based” approach, quantifying the dollar value of risk that could be avoided if a circuit segment were undergrounded and thereby removed from exposure to the two preventative service-outage programs.

2.2 Document Suite

This document is part of the documentation suite for the Outage Risk Model developed in support of the EUP project:

- Outage Risk Model v1.1 Documentation
- PSPS Risk Model v1.3 Documentation (this document)
- EPSS Risk Model v1.3 Documentation

3 PSPS Risk Model Derivation

This section outlines the PSPS Risk Model, which serves as an input to the broader Outage Risk Model. The current model provides a dollarized risk and outage prediction on each circuit segment based on their historical likelihood of being present in a geo-temporal PSPS event polygon. The model outputs three key predictions for each circuit segment:

1. Dollarized PSPS Circuit-Based Risk
2. Annual PSPS Customer Minutes of Interruption (CMI)
3. Annual PSPS Likelihood

As stated in previous sections, the PSPS Risk Model is a deterministic mathematical model. It uses a rule-based formulation to compute the expected number of sustained outages based on circuit geometry, aggregated customer value-of-service data, and historical PSPS event polygons. The PSPS Risk Model does not involve simulation, machine learning, or statistical inference.

It is also a nonlinear model. Unlike customer-experienced risk, which can be expressed as the product of a separable Likelihood model and Consequence model, there is no possible separable standalone Consequence model for PSPS risk. Instead, Derived Consequence may be used as an equivalent.

3.1 Customer-Experienced vs Circuit-Based Risk

To understand the PSPS Risk model, it is important to make a distinction between *in situ* or "customer-experienced" risk versus source-based or "circuit-based" risk. Many PG&E circuit risk models predict risk from the customer's point of reference, at the location of a potential outage. This *in situ* risk's core relationship is simply the likelihood of an outage event at the location of a given circuit segment multiplied by the dollarized consequence of loss of service to the customers served by that segment. Therefore, the basic customer-experienced risk formula is:

$$Risk_{customer-experienced} = Likelihood \times Consequence$$

This relationship quantifies the predicted loss of value for a given circuit segment. If outages across circuit segments were entirely independent, this same relationship would also express the risk of each circuit segment as a distinct *source* since each segment could only be serviced-energized by its own unique risk factors.

However, circuit segment outages are *not* independent. An outage in an upstream segment will inevitably propagate to all downstream segments. Therefore, to accurately assess the risk reduction achieved by replacing or hardening any segment that may serve as a source of outages, the risk averted at downstream sites must also be factored in.

The PSPS Risk Model is designed to assign a risk value to each circuit segment as a potential *source* of outage, supporting prioritization decisions for undergrounding of circuit segments

and segment portfolios. Within a PSPS event, it is common for a circuit segment to have downstream segments, some included in the event region and others outside, that nonetheless experience outages due to upstream de-energization. The model attributes the customer-experienced risk of these downstream segments across their upstream segments. To avoid bias, this attribution is weighted by the length of exposed circuit upstream.

Attributing this downstream risk to upstream source segments adds nonlinearity to the model. Accordingly, risk is calculated holistically as a nonlinear function of historical likelihood data, circuit geometry, event polygon geometry, and the single-circuit consequence of the circuit segment and all subsequent downstream segments.

Certain circuit segments have zero customers yet intersect PSPS polygons. While they exhibit no onsite customer-experienced risk, they can still serve as upstream sources of downstream outages. These segments are included so their downstream risk can be properly attributed within the circuit-based model.

In addition, the consequence component incorporates updated customer-segmentation practices: Road/Highway SPIDs are excluded from risk and CMI computations, and ICE 2.0 value-of-service rates are unified into one system-wide Residential rate and one systemwide Non-Residential rate (shared by Small and Medium C&I customers), with no HFTD/HFRA split.

3.2 Data Sources

The data sources for this model include:

The PSPS Lookback Study, provided by the PSPS team. This dataset provides seven years of PSPS event data such as event polygons, outage duration in minutes, and affected circuit segments and SPIDS. Data includes a retrospective lookback for 2018-2022 data (scoped using late-2024 PSPS guidance applied to historical weather conditions), and actual PSPS events for 2023-2024 data (scoped using live guidance at the time of each event, filtered to SCADA-enabled devices). Customer impacts are based on Plan C scoping (the most comprehensive scoping plan, including both distribution and downstream transmission impacts), filtered to Dx-only or Dx-and-Tx events.

The Wildfire Distribution Risk Model (WDRM) V4, provided by the RaDA WDRM team and updated on a three-year cycle. The WDRM is the PSPS Risk Model's source of record for circuit segment geometry.

PG&E Customer Segmentation Data, which identifies the customer service classes and critical customer factors associated with the SPIDs affected by PSPS events.

3.3 Customer-Experienced PSPS Risk Derivation and Example Calculations

The derivation of the full circuit segment mileage-weighted PSPS Risk Model begins with the customer-experienced risk of a single event on a single circuit segment. This is defined as the circuit segment's likelihood of outage (in minutes) for that single event, multiplied by the customer consequence.

Specifically, the PSPS likelihood for a circuit segment during a single event is modeled as the total outage minutes for that event divided by the seven-year PSPS lookback period. In