PACIFIC GAS AND ELECTRIC COMPANY
Wildfire Mitigation Plans Discovery 2023
Data Response

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DRU Index #:		Requester:	Colin Russell Lang

SUBJECT: REGARDING THE PG&E FRAMEWORK FOR PSPS RISK

QUESTION 012

The sections that relate to models PSPS-L, PSPS-C, PSPS-V and PSPS-R do not sufficiently describe the calculations that ultimately result in a PSPS Risk Score. The Guidelines for section 6.2 Risk Analysis Framework require detailed discussion of likelihood, consequence, exposure potential and vulnerability for Public Safety Power Shutoffs (PSPS) Risk:

6.1.1 Overview

> The electrical corporation must provide a brief narrative describing its methodology for quantifying its overall utility risk of wildfires and Public Safety Power Shutoff (PSPS).

6.2.2.1 Likelihood

> The electrical corporation must discuss how it calculates the likelihood that its equipment (through normal operations or failure) will result in a catastrophic wildfire and the resulting likelihood of issuing a PSPS.

6.2.2.2 Consequence

> The electrical corporation must discuss how it calculates the consequences of a fire originating from its equipment and the consequence of implementing a PSPS event.

In order to understand PG&E's step-by-step calculations that ultimately result in the PSPS Risk Score, please provide the following, including via Excel file as applicable:

a. Regarding PSPS Likelihood:
   i. Provide details on the inputs to the PSPS-L model, and calculation.
      (a) Is the LoRE framework (depicted in Figure 6-2-1) used to calculate likelihood of a PSPS event?
   ii. The PSPS Likelihood section briefly discusses applying current PSPS protocols against historical climatological data set informed by FPI and IPW models, and refers to the WTRM data flow in Figure 6.2.2-3.
      (a) Explain how PSPS protocols, FPI and IPW models and the WTRM data flow are combined to produce the likelihood of a PSPS event.

(b) In particular, how the historical backcast is used to predict future likelihood of a PSPS event

b. Regarding PSPS Consequence:

i. Provide details on the inputs to the PSPS-C model.

ii. Provide explanation on the PSPS Consequence schemata, Figure 6.2.1-3.

(a) How is Enterprise PSPS Consequence Risk Score calculated?

(b) Describe the output of the PSPS lookback (provide an example of "12-year customer distribution").

iii. How does Customer Classification & Weighting affect the results?

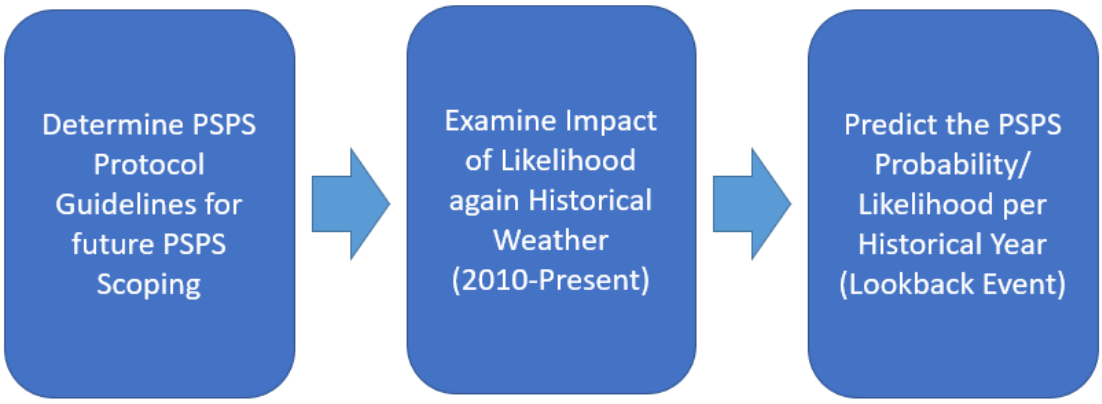
iv. Provide more detailed schematics similar to the CoRE Process Steps (Figure 6.2.2-5) to illustrate model flow.

v. Please provide a PSPS Consequence section with a similar level of detail as the Wildfire Consequence section; integrating figures and tables for transparency (using common keys etc).

ANSWER 012

a. (i) The details on the inputs to the PSPS-L model are shown in Appendix B figures PG&E-B-3 and PG&E-B-4 and full documentation provided as part of "WMP-Discovery2023_DR_OEIS_001-Q007Atch03CONF.pdf," submitted to the Office of Energy Infrastructure and Safety on April 10, 2023.

The LoRE framework used to calculate likelihood of a PSPS event is conceptually similar to WMP Figure 6-2-1 as shown below. While they are conceptually similar, the inputs into the LoRE calculation for PSPS (shown in the figure below) are different from the inputs into the wildfire LoRE calculation.



(ii)(a) During an operational event, if the conditions forecasted in the FPI and IPW models exceed the threshold conditions to consider PSPS, based on the established PSPS protocols, the preparation for a PSPS event begins. These models are updated throughout the days leading to a projected PSPS event to see if the conditions still warrant PSPS. The PSPS protocols are described in

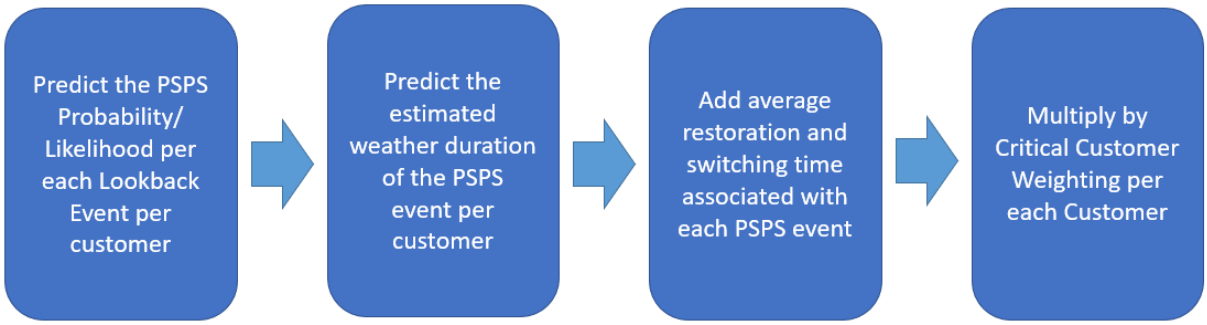
the documentation provided as part of WMP data request "WMP-Discovery2023_DR_OEIS_001-Q007Atch04CONF.pdf."

For planning purposes, we evaluate the likelihood of initiating a PSPS event in a historical period, by analyzing the weather and fuel conditions to determine if they meet the thresholds for initiating a PSPS event. This historical analysis is referred to as a lookback event. From a planning model perspective, the historical analysis allows PG&E to understand how often PSPS would have been used by looking back at a historical period and helps us to better identify the circuits and customers that may be impacted by various weather events. The WTRM model does not impact PSPS likelihood.

(ii)(b) Historical backcast does not predict the future likelihood of a PSPS event. The historical backcast is a representation of the expected number of PSPS events per year based on historical weather conditions. This PSPS likelihood allows PG&E to better plan and prioritize locations and customers expected to be most impacted by a PSPS event based on looking back on historical conditions.

(i) The details about the inputs into the PSPS Consequence (PSPS-C) model are shown in WMP Appendix B, figures PG&E-B-3 and PG&E-B-4 and in the PSPS model documentation provided as part of data request "WMP-Discovery2023_DR_OEIS_001-Q007Atch03CONF.pdf."

The CoRE framework used to calculate likelihood of a PSPS event is conceptually similar to WMP Figure 6-2-2 as shown below. While they are conceptually similar, the inputs into the CoRE calculation for PSPS (shown in the figure below) are different from the inputs into the wildfire CoRE calculation.



(ii) The PSPS consequence model is a planning model that allows us to compare PSPS and Wildfire risk using the same risk scores (MAVF) as described in Section 6.2.1. Due to the changes in PSPS event data since 2019, PG&E uses the estimated impact of current PSPS protocols against a historical period to reflect the expected impacts of PSPS moving forward.

In Figure 6.2.1-3 schematic, 4 inputs/variables are integrated to develop the PSPS consequence model, with 1 output.

1) PG&E lists out the 2021 PSPS protocol lookback as an impact to the estimated number of customers affected by analyzing time periods from 2010-

present. The lookback includes the duration of the weather event, the average restoration time, and the switching time are included.

2) Additionally, to capture customers who could be affected but do not show up in the lookback, PG&E adds in potentially impacted customers based on system configuration. This data represents the set of customers who have some potential PSPS exposure given their relationship to devices and lines used to de-energize lines in the HFRA.

3) Customer Classification and Weighting recognizes that the impact of PSPS to customer types can vary and shows the weightings in Table PG&E-6.2.2-2. If a customer is in a higher category, its consequence impacts are multiplied by the customer weighting. See our responses to b.(iii), (iv), and (v) below for additional information regarding Customer Classification and Weighting.

4) The Enterprise PSPS Consequence Risk Score is the overall enterprise risk score of PSPS as compared to the other risks like Wildfire on PG&E's risk register and is computed in the units of Multi-Attribute Value Function (MAVF).

5) Model Output shows PSPS event frequency, outage duration, and risk scores at various granularities that the PSPS consequence planning model outputs for planning purposes.

(ii) (a) PG&E's Enterprise PSPS Risk Score is calculated by the overall MAVF framework. PG&E accounts for the consequence of PSPS in terms of Reliability, Safety, and Financial. Reliability is based on the number of customer minutes interrupted and is calculated from the annualized likelihood and duration of each PSPS event. Safety is calculated from the estimated Serious Injury or Fatality (SIF) / million customer minutes interrupted (CMI). Since PG&E does not have any data supporting SIFs due to PSPS events, PG&E includes long duration unplanned outage events across the US and includes this value to estimate a safety impact due to PSPS events. Financial consequences are based on the cost of operating a PSPS event.

Documentation about calculating the PSPS risk score is provided as part of data request "WMP-Discovery2023_DR_OEIS_001-Q007Atch03CONF.pdf."

A screenshot of the Total Risk Score as shown in "WMP-Discovery2023_DR_OEIS_001-Q007Atch03CONF.pdf.", is provided below.

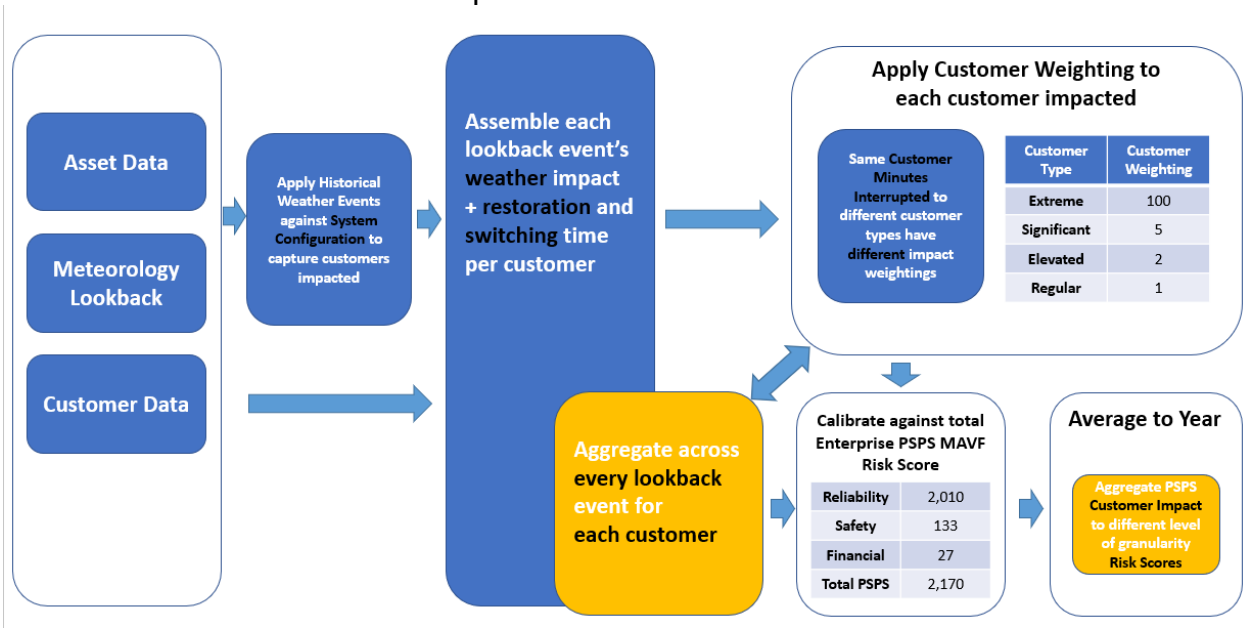
Table 2: Potential PSPS Risk

Component	Units	Percentage
Baseline MAVF Risk Score - Safety	133.32	6%
Baseline MAVF Risk Score - Reliability	2,010.34	93%
Baseline MAVF Risk Score - Financial	26.80	1%
Total	2,170.46	100%

(ii) (b) The output of the PSPS lookback provides the name of each lookback event name, circuit, and the device it impacts. Please reference "WMP-Discovery2023_DR_OEIS_001-Q003Atch03.xlsx."

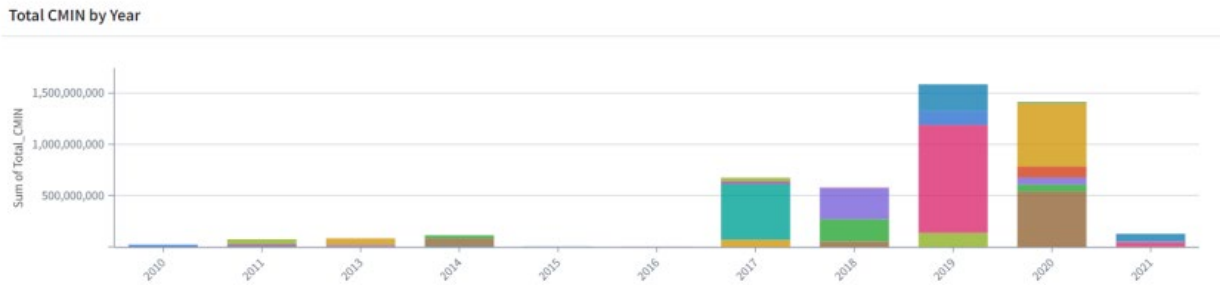
(iii) Customer Classification & Weighting is included as a multiplier to the CoRE. For example, if you had 2 customers, both with the same likelihood of a PSPS event, served by the same circuit and transformer, if Customer 1 was a regular customer and Customer 2 was a Critical Customer 1 (CC1) customer, Customer 2 would have a risk score 100 times greater than Customer 1.

(iv) Please see below and Appendix B figures PG&E-B-3 and PG&E-B-4 for more detailed CoRE Process Steps.



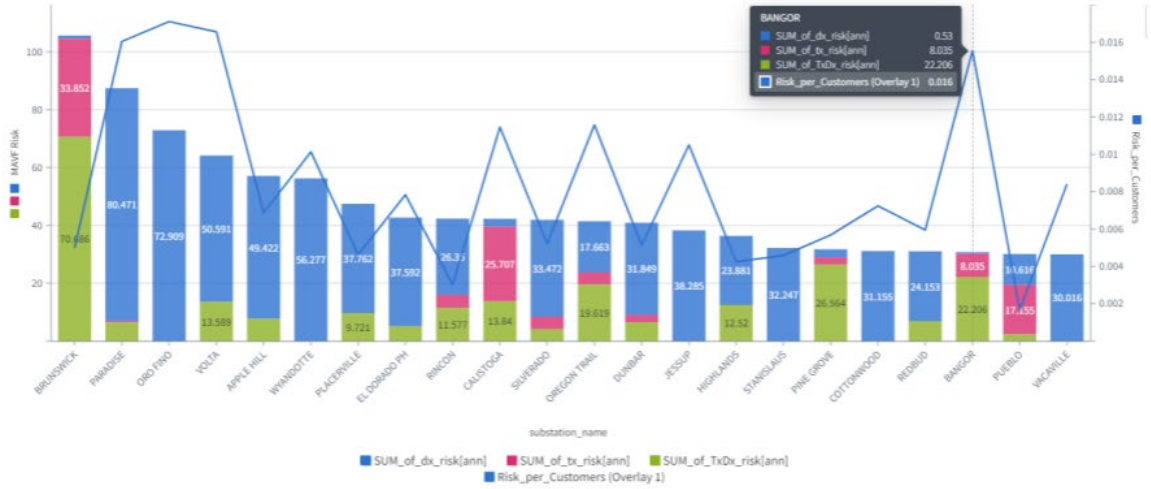
(v) PSPS Consequence is dependent on the number of customer minutes interrupted per lookback event. As you can see in the figure below from "WMP-Discovery2023_DR_OEIS_001-Q007Atch03CONF.pdf," the number of total outage duration minutes vary among years.

Figure 6: 2010-2021 PSPS Total Outage Duration



The results of these events lead to different forms of consequence across the system circuits or can be aggregated to the substations most heavily impacted like the visual below.

Figure 7: Highest Substation Ranked Circuits with Event Type



Besides the impacts purely due to customer minutes, the types of customers impacted needed to be factored in. As such, critical customer weightings were introduced mainly to highlight these impacts.

Table 3: Customer Classification

Customer Type	Customer Weighting	Customer Category
Extreme	100	CC1
Significant	5	Life Support, Medical Baseline & Low Income, Life Support & Low Income
Elevated	2	CC2, CC3, CE1, CE2, CE3, EE, PR1, SC1, SC2, SC3, SE1, SE2, SE3, TE1, TE2, TT1, TT2, Medical Baseline, Self-Identified Vulnerable, Self-Identified Disabled, Low-Income
Regular Customer	1	Regular Customer

The introduction of critical customer weighting shifts the prioritization of the risk

substantially more towards critical customers. As seen in figure below, based on the number of customer events from the lookback, about 27% of customer events impact a critical customer. The overall detailed mix is 73% regular, with 21% elevated, 6% significant, and less than 1% extreme. Because the contribution of critical customers is significantly smaller, the introduction of critical customer weightings further drives prioritization towards those customers. As such, with the weightings applied, the contribution of critical customer PSPS risk changes from 28% to 54% of the overall risk.

Figure 8: 12-Year Lookback Critical Customer Count

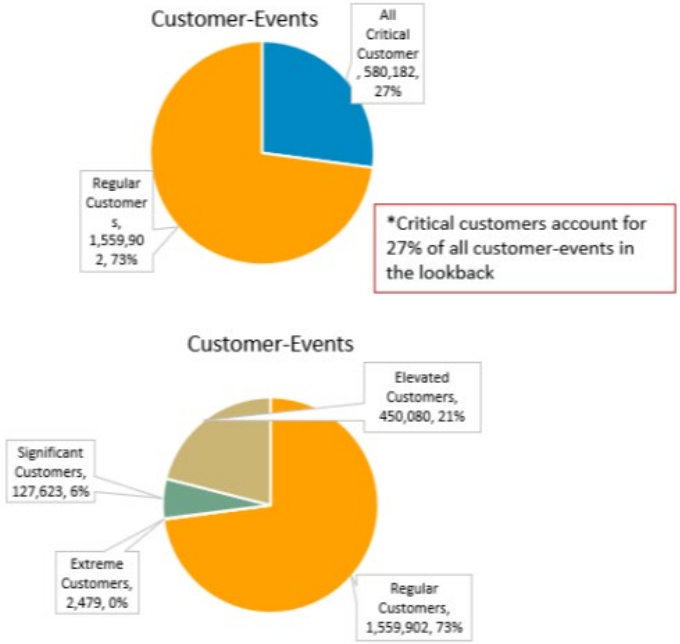
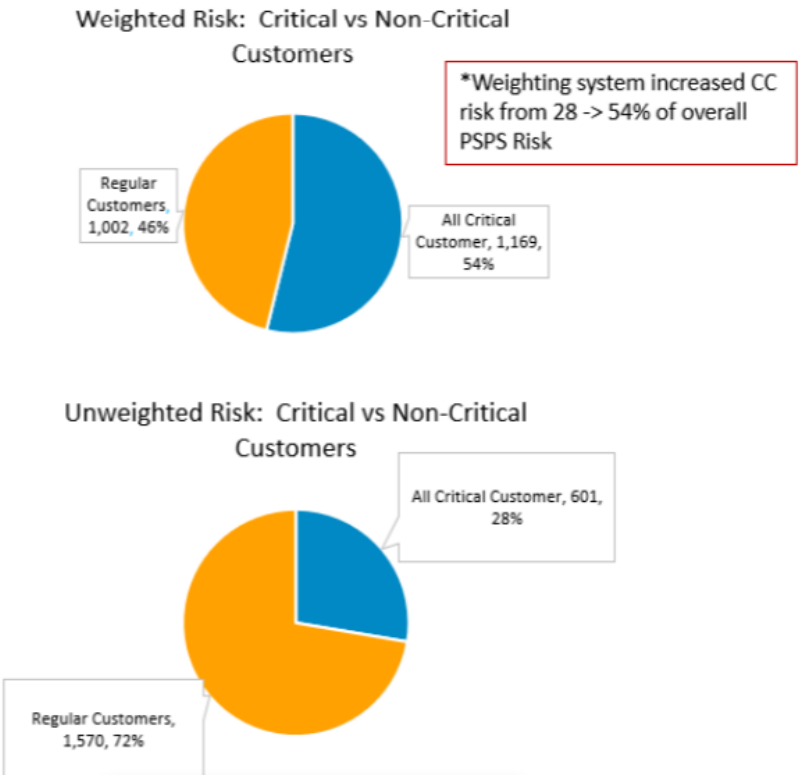
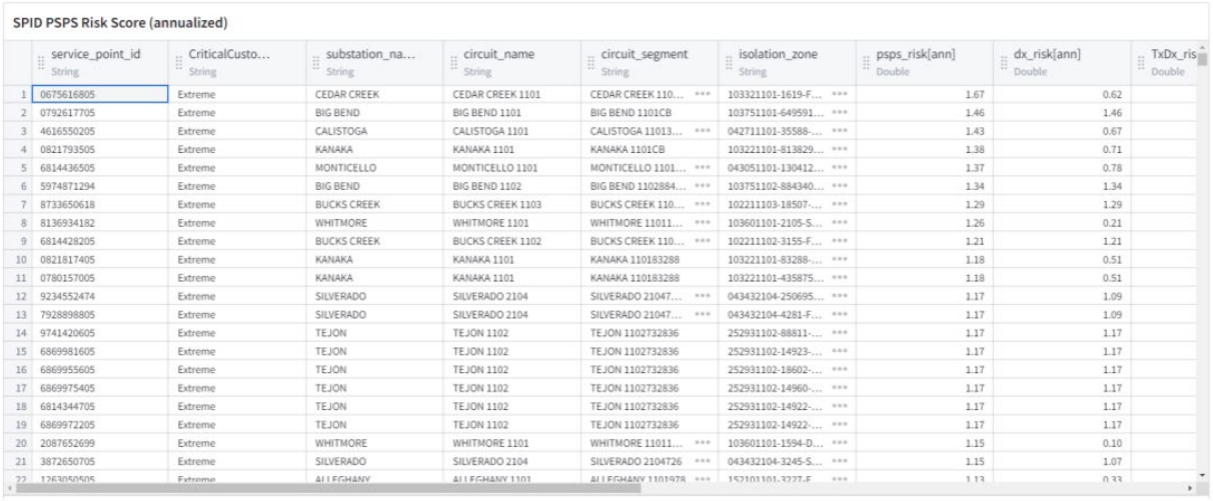


Figure 9: Critical Customer Weighting Risk Change



The output results can be aggregated to various levels of granularity such as customer or circuit segment levels. Each table provides information like the probability of experiencing a PSPS event, the duration, and the overall risk score attributed. See figures below.

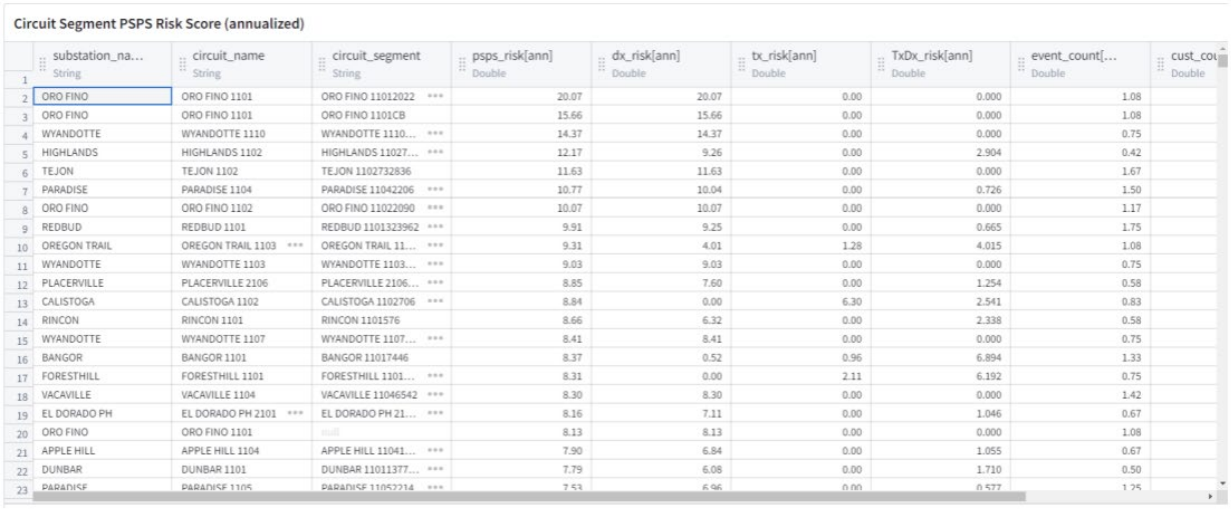
Figure 25: SPID Level Risk Score Snapshot



SPID PSPS Risk Score (annualized)

	service_point_id String	CriticalCusto… String	substation_na… String	circuit_name String	circuit_segment String	isolation_zone String	psps_risk[ann] Double	dx_risk[ann] Double	TxDx_ris Double
1	0675616805	Extreme	CEDAR CREEK	CEDAR CREEK 1101	CEDAR CREEK 110… ***	103321101-1619-F… ***	1.67	0.62	
2	0792617705	Extreme	BIG BEND	BIG BEND 1101	BIG BEND 1101CB	103751101-649591… ***	1.46	1.46	
3	4616550205	Extreme	CALISTOGA	CALISTOGA 1101	CALISTOGA 11013… ***	042711101-35588-… ***	1.43	0.67	
4	0821793505	Extreme	KANAKA	KANAKA 1101	KANAKA 1101CB	103221101-813829… ***	1.38	0.71	
5	6814436505	Extreme	MONTICELLO	MONTICELLO 1101	MONTICELLO 1101… ***	043051101-130412… ***	1.37	0.78	
6	5974871294	Extreme	BIG BEND	BIG BEND 1102	BIG BEND 1102884… ***	103751102-884340… ***	1.34	1.34	
7	8733650618	Extreme	BUCKS CREEK	BUCKS CREEK 1103	BUCKS CREEK 110… ***	102211103-18507-… ***	1.29	1.29	
8	8136934182	Extreme	WHITMORE	WHITMORE 1101	WHITMORE 11011… ***	103601101-2105-S… ***	1.26	0.21	
9	6814428205	Extreme	BUCKS CREEK	BUCKS CREEK 1102	BUCKS CREEK 110… ***	102211102-3155-F… ***	1.21	1.21	
10	0821817405	Extreme	KANAKA	KANAKA 1101	KANAKA 110183288	103221101-83288-… ***	1.18	0.51	
11	0780157005	Extreme	KANAKA	KANAKA 1101	KANAKA 110183288	103221101-435875… ***	1.18	0.51	
12	9234552474	Extreme	SILVERADO	SILVERADO 2104	SILVERADO 21047… ***	043432104-250695… ***	1.17	1.09	
13	7928898805	Extreme	SILVERADO	SILVERADO 2104	SILVERADO 21047… ***	043432104-4281-F… ***	1.17	1.09	
14	9741420605	Extreme	TEJON	TEJON 1102	TEJON 1102732836	252931102-88811-… ***	1.17	1.17	
15	6869981605	Extreme	TEJON	TEJON 1102	TEJON 1102732836	252931102-14923-… ***	1.17	1.17	
16	6869955605	Extreme	TEJON	TEJON 1102	TEJON 1102732836	252931102-18602-… ***	1.17	1.17	
17	6869975405	Extreme	TEJON	TEJON 1102	TEJON 1102732836	252931102-14960-… ***	1.17	1.17	
18	6814344705	Extreme	TEJON	TEJON 1102	TEJON 1102732836	252931102-14922-… ***	1.17	1.17	
19	6869972205	Extreme	TEJON	TEJON 1102	TEJON 1102732836	252931102-14922-… ***	1.17	1.17	
20	2087652699	Extreme	WHITMORE	WHITMORE 1101	WHITMORE 11011… ***	103601101-1594-D… ***	1.15	0.10	
21	3872650705	Extreme	SILVERADO	SILVERADO 2104	SILVERADO 2104726 ***	043432104-3245-S… ***	1.15	1.07	
22	1263050505	Extreme	ALLEGHANY	ALLEGHANY 1101	ALLEGHANY 1101978 ***	152101101-3227-F… ***	1.13	0.33	

Figure 23: Circuit Segment Level Risk Score



Circuit Segment PSPS Risk Score (annualized)

	substation_na… String	circuit_name String	circuit_segment String	psps_risk[ann] Double	dx_risk[ann] Double	tx_risk[ann] Double	TxDx_risk[ann] Double	event_count[… Double	cust_co Double
2	ORO FINO	ORO FINO 1101	ORO FINO 11012022 ***	20.07	20.07	0.00	0.000	1.08	
3	ORO FINO	ORO FINO 1101	ORO FINO 1101CB	15.66	15.66	0.00	0.000	1.08	
4	WYANDOTTE	WYANDOTTE 1110	WYANDOTTE 1110… ***	14.37	14.37	0.00	0.000	0.75	
5	HIGHLANDS	HIGHLANDS 1102	HIGHLANDS 11027… ***	12.17	9.26	0.00	2.904	0.42	
6	TEJON	TEJON 1102	TEJON 1102732836	11.63	11.63	0.00	0.000	1.67	
7	PARADISE	PARADISE 1104	PARADISE 11042206 ***	10.77	10.04	0.00	0.726	1.50	
8	ORO FINO	ORO FINO 1102	ORO FINO 11022090 ***	10.07	10.07	0.00	0.000	1.17	
9	REDBUD	REDBUD 1101	REDBUD 1101323962 ***	9.91	9.25	0.00	0.665	1.75	
10	OREGON TRAIL	OREGON TRAIL 1103 ***	OREGON TRAIL 11… ***	9.31	4.01	1.28	4.015	1.08	
11	WYANDOTTE	WYANDOTTE 1103	WYANDOTTE 1103… ***	9.03	9.03	0.00	0.000	0.75	
12	PLACERVILLE	PLACERVILLE 2106	PLACERVILLE 2106… ***	8.85	7.60	0.00	1.254	0.58	
13	CALISTOGA	CALISTOGA 1102	CALISTOGA 1102706 ***	8.84	0.00	6.30	2.541	0.83	
14	RINCON	RINCON 1101	RINCON 1101576	8.66	6.32	0.00	2.338	0.58	
15	WYANDOTTE	WYANDOTTE 1107	WYANDOTTE 1107… ***	8.41	8.41	0.00	0.000	0.75	
16	BANGOR	BANGOR 1101	BANGOR 11017446	8.37	0.52	0.96	6.894	1.33	
17	FORESTHILL	FORESTHILL 1101	FORESTHILL 1101… ***	8.31	0.00	2.11	6.192	0.75	
18	VACAVILLE	VACAVILLE 1104	VACAVILLE 11046542 ***	8.30	8.30	0.00	0.000	1.42	
19	EL DORADO PH	EL DORADO PH 2101 ***	EL DORADO PH 21… ***	8.16	7.11	0.00	1.046	0.67	
20	ORO FINO	ORO FINO 1101	null	8.13	8.13	0.00	0.000	1.08	
21	APPLE HILL	APPLE HILL 1104	APPLE HILL 11041… ***	7.90	6.84	0.00	1.055	0.67	
22	DUNBAR	DUNBAR 1101	DUNBAR 11011377… ***	7.79	6.08	0.00	1.710	0.50	
23	PARADISE	PARADISE 1105	PARADISE 11052214 ***	7.53	6.96	0.00	0.577	1.25	