2021 Risk Assessment Mitigation Phase (RAMP) Workshop: SDG&E Wildfire Risk
August 13, 2021

Agenda

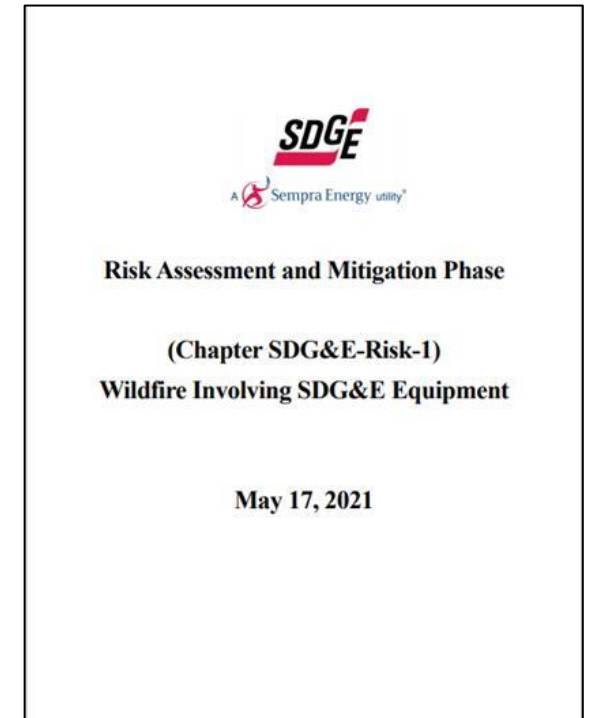| 9:00	9:15	Introduction
9:15	10:15	Role of Public Safety Power Shutoffs (PSPS) in Wildfire Risk Analysis
10:15	10:30	Methodology for Calculating Wildfire Risk Consequences
10:30	10:45	Methodology for Assessing PSPS Impacts on Customers
10:45	11:00	Break
		Role of Climate Change in Wildfire Risk Analysis
11:00	11:15	Vegetation Management Practices ~~Related to Mitigations~~
11:15	11:30	Grid Hardening Mitigation Impacts on Vegetation Management Mitigations/Practices
11:30	12:00	Wrap-Up

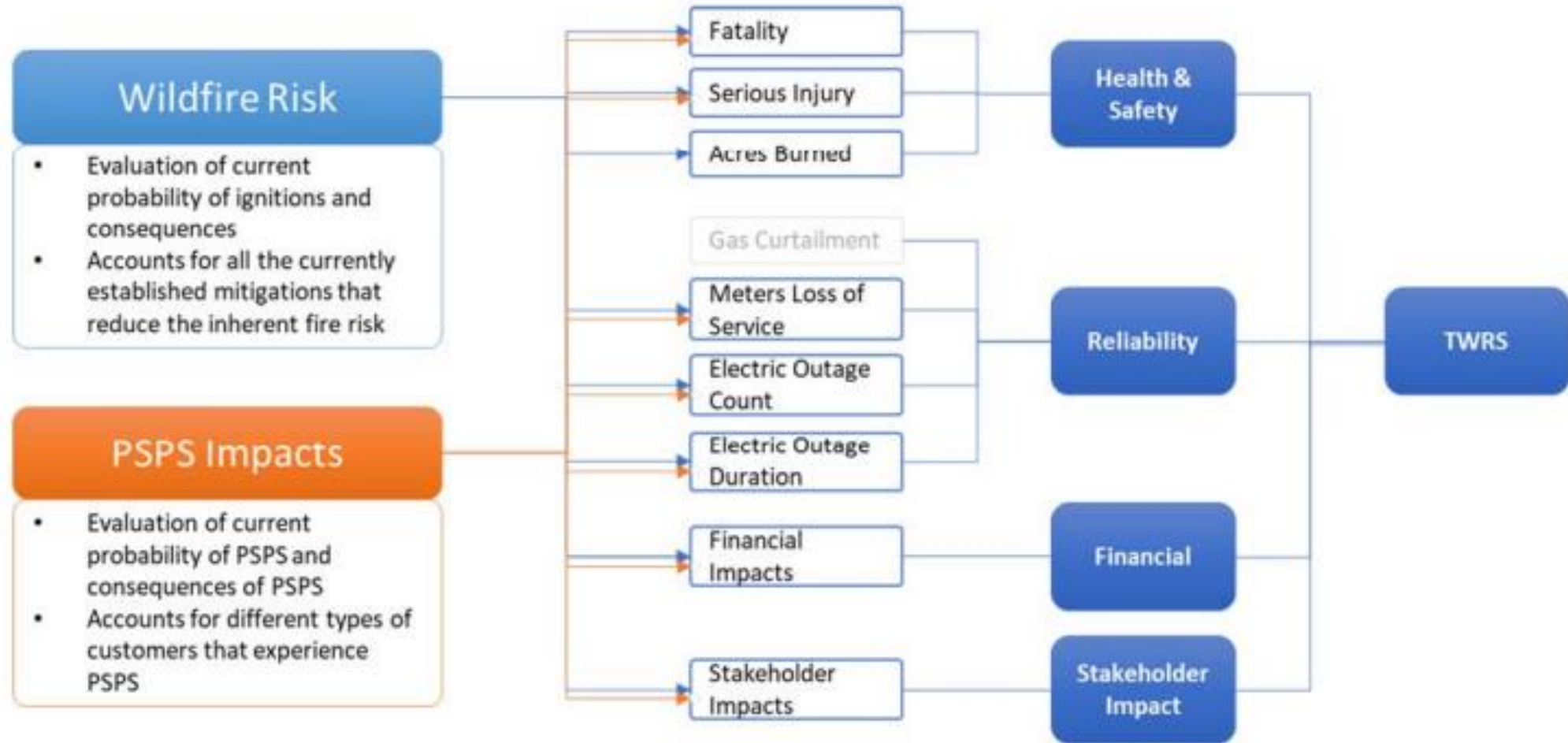# Role of Public Safety Power Shutoffs (PSPS) in Wildfire Risk Analysis
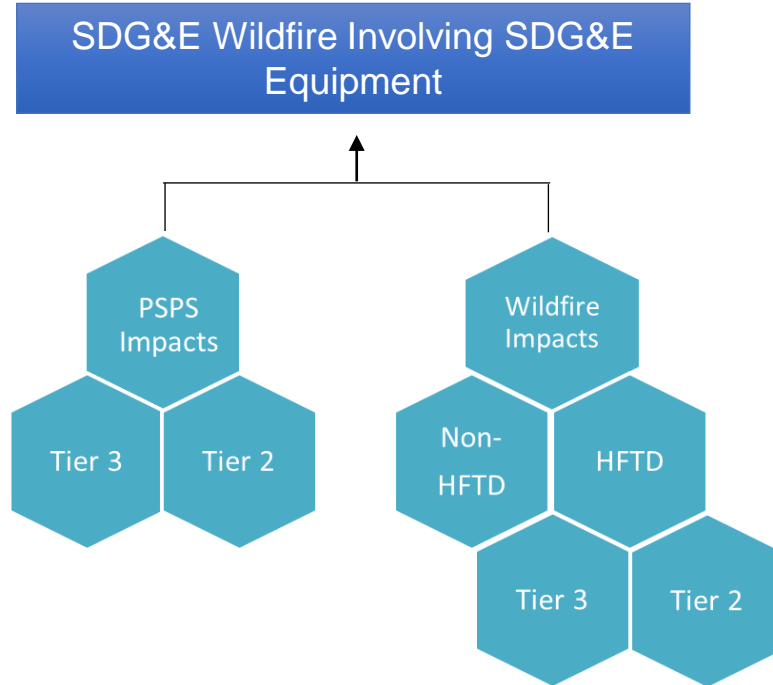
Wildfire and PSPS Risk Overview

- SDG&E's Enterprise Risk Registry contains a single risk related to wildfire – SDG&E Wildfire Involving SDG&E Equipment.

- In the RAMP, all PSPS impacts are contained in that single risk chapter.

- SDG&E believes that keeping wildfire and PSPS risk analysis together allows for:

  - The ability to consider all impacts from PSPS and Wildfire, for all situations

  - Simplifies analysis due mitigations that affect both PSPS and Wildfire

- A goal of wildfire mitigation programs is to reduce the Total Wildfire Risk Score (TWRS), which is a sum of the Wildfire and PSPS components

SDGE

A Sempra Energy utility®

Risk Assessment and Mitigation Phase

(Chapter SDG&E-Risk-1)
Wildfire Involving SDG&E Equipment

May 17, 2021

Total Wildfire Risk Score (TWRS)

Risk Score Walkthrough – Wildfire

LoRE - Wildfire Impacts

Incident Type	Expected Value	Source
Tier 3	5.13	2015 – 2019 ignition data, SME inputs
Tier 2	6.84	2015 – 2019 ignition data, SME inputs
Non-HFTD	9.20	2015 – 2019 ignition data, SME inputs

LoRE - PSPS Impacts

Incident Type	Expected Value	Source
Tier 3	4.00	Internal reliability data
Tier 2	4.00	Internal reliability data

$$\sum_{i=1}^{n} LoRE_i$$

LoRE - Wildfire Impacts = 5.13+6.84+9.20= 21.17

LoRE - PSPS Impacts = 4

PSPS Likelihood (LoRE)

- Using recent PSPS information
  - Estimate number of unique PSPS events
    - 4 events per year
  - Estimate number of customers affected by each event
    - 12,000 customers per event
  - Estimate average duration of each customer's PSPS
    - 32 hours

PSPS Event definition

An event is considered a single PSPS event whenever SDG&E customers are concurrently PSPS'd.

It begins with the first customer group and remains a single event while at least one customers is still out of service.

Mitigations in WMP that have PSPS Impact

ID	Control/Mitigation Name
SDG&E-Risk-1-C7/M2-T1	Overhead Distribution Fire Hardening – Covered Conductor (HFTD Tier 3)
SDG&E-Risk-1-C9/M4-T1	PSPS Sectionalizing (HFTD Tier 3)
SDG&E-Risk-1-C9/M4-T2	PSPS Sectionalizing (HFTD Tier 2)
SDG&E-Risk-1-C10/M5-T2	Microgrids (HFTD Tier 2)
SDG&E-Risk-1-C13/M8-T1	Resiliency Grant Programs (HFTD Tier 3)
SDG&E-Risk-1-C13/M8-T2	Resiliency Grant Programs (HFTD Tier 2)
SDG&E-Risk-1-C14/M9-T1	Standby Power Programs (HFTD Tier 3)
SDG&E-Risk-1-C15/M10-T1	Resiliency Assistance Programs (HFTD Tier 3)
SDG&E-Risk-1-C15/M10-T2	Resiliency Assistance Programs (HFTD Tier 2)
SDG&E-Risk-1-C16/M11-T1	Strategic Undergrounding (HFTD Tier 3)
SDG&E-Risk-1-C16/M11-T2	Strategic Undergrounding (HFTD Tier 2)

Resiliency Grant Programs (HFTD Tier 3)

SDG&E-Risk-1-C13/M8-T1

Mitigation intended to reduce PSPS impact to specific customers by providing backup generation to the customer's premise.
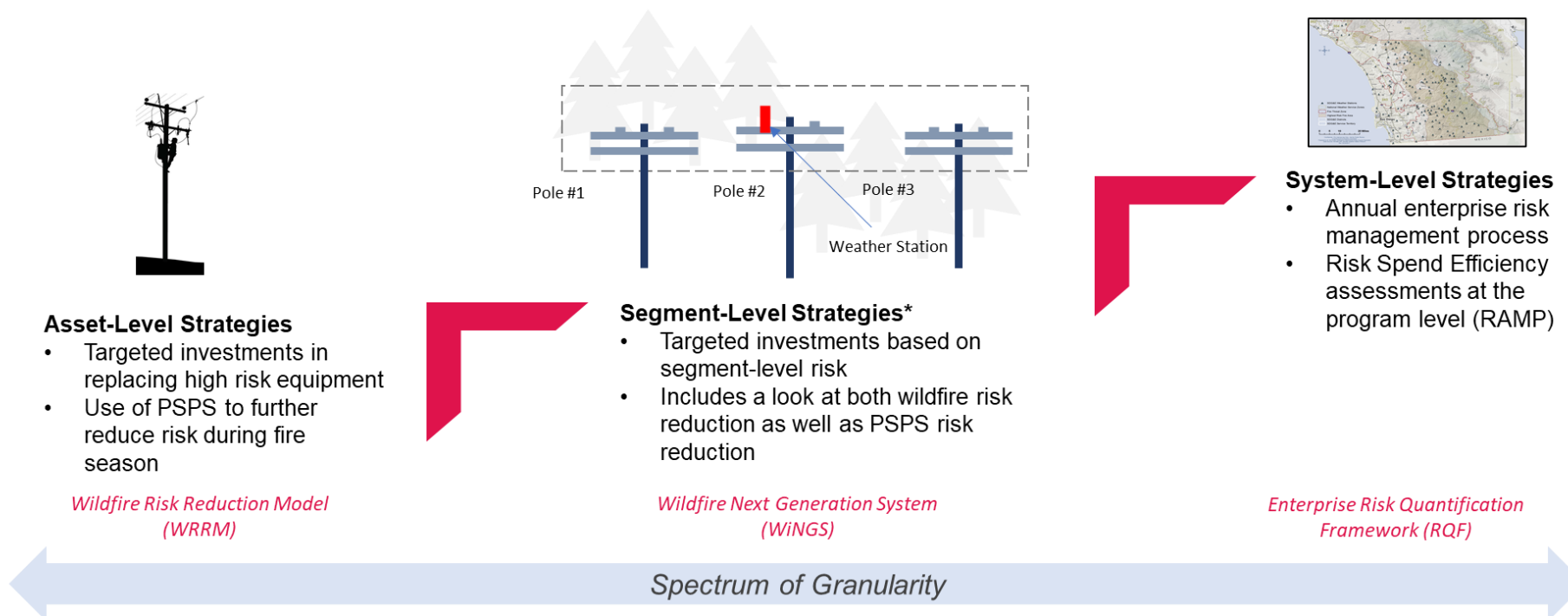
Assumptions:
- 2,000 customers identified due to Medical Baseline.
- Generator will serve 40% of household throughout entire PSPS event.
- Each customer averages 1 PSPS per year
- Generator life 10 years

Name	Value	Source
Res. / Ind. / Comm. (non-MBL)	0	Forecast
Medical Baseline (MBL)	2000	Forecast
PSPS Risk Reduction	70.66	Calculation
Cost	$7.9M	Forecast
RSE	76.3	Calculation

Wildfire – WiNGS Model Overview

Developed WiNGS to assess segment-level risk with the objective of reducing PSPS and wildfire risk

Pole #1 Pole #2 Pole #3

Weather Station

Asset-Level Strategies
- Targeted investments in replacing high risk equipment
- Use of PSPS to further reduce risk during fire season

Wildfire Risk Reduction Model (WRRM)

Segment-Level Strategies*
- Targeted investments based on segment-level risk
- Includes a look at both wildfire risk reduction as well as PSPS risk reduction

Wildfire Next Generation System (WiNGS)

System-Level Strategies
- Annual enterprise risk management process
- Risk Spend Efficiency assessments at the program level (RAMP)

Enterprise Risk Quantification Framework (RQF)
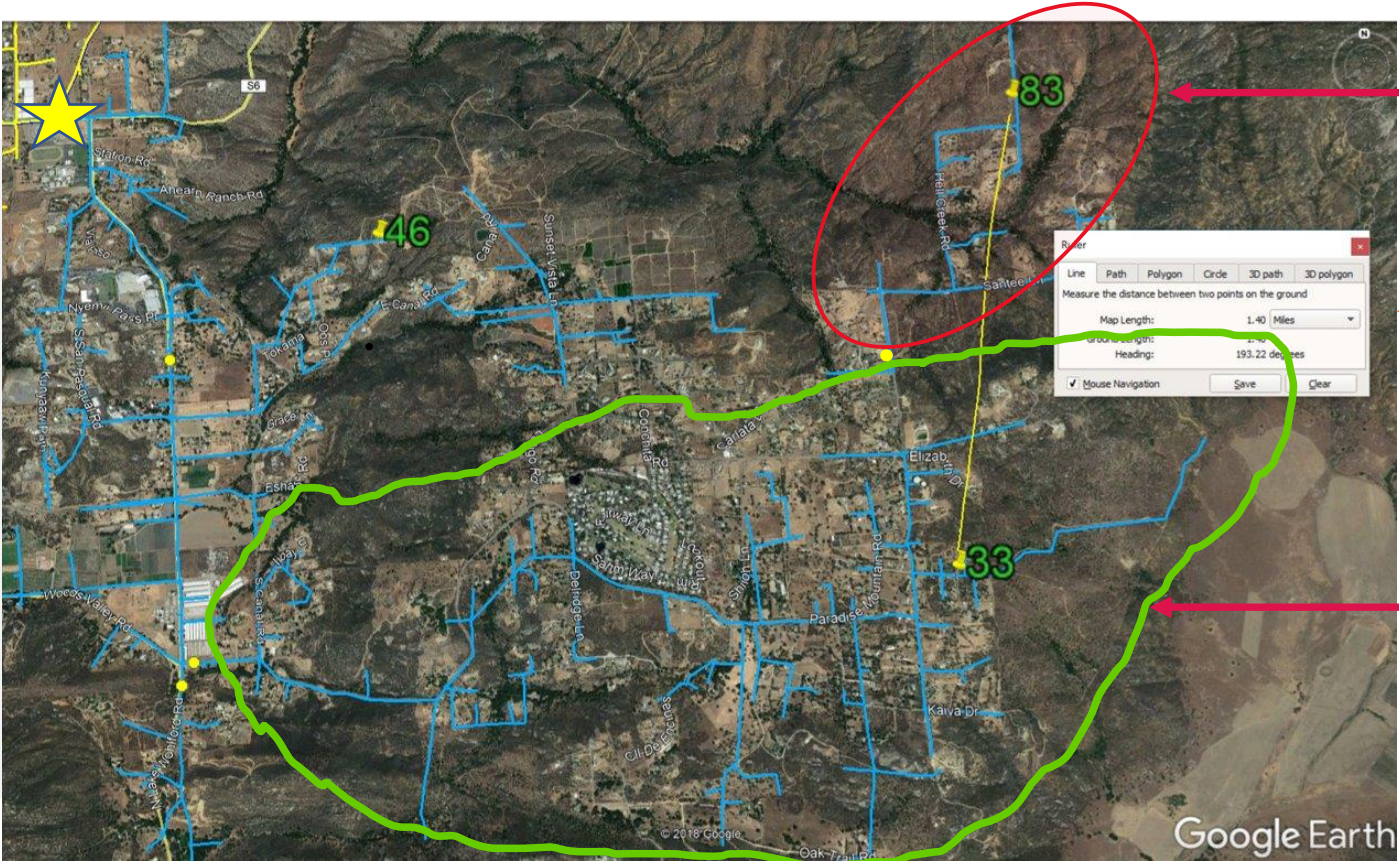
Spectrum of Granularity

*Segments are comprised of multiple spans and structures between two isolation points and are typically thought of in terms of how SDG&E operates PSPS

Example: Weather Station & Distribution Segment

*Segments are comprised of **multiple spans and structures between two isolation points** and are typically thought of in terms of how SDG&E operates PSPS*

Isolating Switch

Weather Station

30 Customers Served

1.4 miles between weather stations

470 Customers Served

Customer Information at Circuit / Segment Level

Circuit 222 Connectivity

PSPS Impacts and Wildfire Risk are Inextricably Linked

- Eleven (11) of SDG&E's wildfire mitigations affect PSPS

- Four (3) of those eleven also have wildfire risk reduction (~65% of total RAMP chapter $)

- The large capital expenses move both WF and PSPS scores, and generating a single RSE is simplified through the TWRS method.

- The benefits of these programs can be more easily understood when the combined benefits of both WF and PSPS are in a single formula.

Combining PSPS and Wildfire Risk does not lose resolution

- Specific WF or PSPS information can still be gathered

- Reductions in WF or PSPS scores can easily be discussed

- Generated with separate LoRE and CoRE analysis

If broke up into separate sections, would still need to combine for proper effectiveness scoring

Methodology for Calculating Wildfire Risk Consequences

Wildfire Risk Assessment (The Big Picture)

- Currently, SDG&E uses a "top-down" model for WF risk assessment.

    - Historical fires, with adjustments for updates that have occurred during the recent period

        - System Hardening, Climate Change, fire burn areas, operational enhancements (PSPS, sensitive settings)

    - Stochastic methods for historical and updates

        - Probability distributions for all inputs, and run Monte Carlo simulation for both Likelihood and Consequence

- WiNGS analyzes risk at segment level, then gets calibrated to fit the top-down model

- Future versions likely to include more emphasis on "bottom-up" analysis

Total Wildfire Risk Score – Wildfire Risk

	Tier 3	Tier 2	Non-HFTD	Wildfire Risk
Pre-Mitigation Risk Score	7229.61	4260.67	277.99	11768.27
LoRE	5.13	6.84	9.20	21.17
CoRE	1409.28	622.91	30.22	555.89

$$LoRE = 5.13 + 6.84 + 9.20 = 21.17$$

$$CoRE = (5.13 \times 1409.28 + 6.84 \times 622.91 + 9.20 \times 30.22) \div (5.13 + 6.84 + 9.20) = 555.89$$
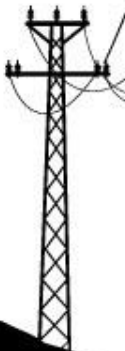
Total Wildfire Risk Score – Wildfire Risk

Significant Fire Risk Modeling – Frequency per year

Data considered was both from reportable ignitions (since 2014) and from large fire history (since 1970) reported. Changes were considered from the historic likelihood of fires. Changes from historic likelihoods are primarily due to a) system hardening programs, including PSPS; b) climate change; c) increased overhead miles relative to previous timeframes; and d) change in vegetation relative to previous timeframes.

The average of the likelihood values used in this step is approximately 0.069, which indicates that at least one large wildfire will occur in one out of every 15 years.

Some of the years that have at least one large wildfire will have multiple large wildfires in that year. The total number of large wildfires that the model produced was 935 over 10,000 runs. Generated from Max (1, Poisson(1))
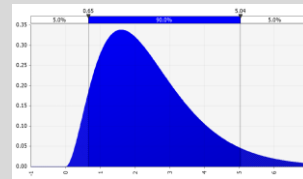
Total Wildfire Risk Score – Wildfire Risk

Significant Fire Risk Modeling – Consequences per year

Consequences were also modeled by using historical fires to create or "fit" a probability distribution from large fires considering financial loss. The probability distribution is SDG&E's estimation of the types of financial losses that may occur if a large utility associated wildfire occurs. The probability distribution that is currently used is not permanent and will be modified as new information becomes available.

Financial

Gamma (3,0.8)

Minimum	0
Maximum	+∞
P5	$0.65 billion
P50	$2.14 billion
P95	$5.04 billion

$225 Million per year

Safety

Based on subject matter interpretation of historical data, for each $1 billion loss due to wildfire, it was assumed that 4.25 safety units would occur.

0.96 safety units per year

Reliability

Data was extracted from SDG&E's internal reliability database for fire-related outages to determine reliability impacts.

0.04 Reliability Index per year

Total Wildfire Risk Score – Wildfire Risk

CoREs by Tier 3, Tier 2 and Non-HFTD | Wildfire Risk Consequences are from Significant fire only.

Financial	Safety	Reliability	Stakeholder Satisfaction
• $225 Million per year • CoRE = $225 ÷ 0.0935 = $2,409 Million • Adjustment factor: 5%, based on SME interpretation of 2021 Mitigation. • CoRE-Tier 3 = 2409.4 × 0.0935 × (1 − 5%) × 63.16% ÷ 5.13 = 26.35 • CoRE-Tier 2 = 2409.4 × 0.0935 × (1 − 5%) × 36.84% ÷ 6.84 = 11.53	• 0.96 safety units per year, 100,000 acres burned per significant fire • CoRE = 0.96 ÷ 0.0935 + 100,000 × 0.00005 = 15.24 • CoRE-Tier 3 = 15.24 × 0.0935 × (1 − 5%) × 63.16% ÷ 5.13 = 0.07 • CoRE-Tier 2 = 15.24 × 0.0935 × (1 − 5%) × 36.84% ÷ 6.84 = 0.17	• 0.04 Reliability Index per year • CoRE = 0.04 ÷ 0.0935 = 0.43 • CoRE-Tier 3 = 0.43 × 0.0935 × (1 − 5%) × 63.16% ÷ 5.13 = 0.005 • CoRE-Tier 2 = 15.24 × 0.0935 × (1 − 5%) × 36.84% ÷ 6.84 = 0.002	• CoRE = 80 per significant fire

Methodology for Assessing PSPS Impacts on Customers

PSPS Consequence (The Big Picture)

- Like Wildfire risk, PSPS impacts are estimated for each MAVF attribute, and are processed through standard RAMP methods: LoRE and CoRE

- It is important to understand the impact of PSPS events for two main purposes:

  - Long term planning. Mitigations that will have lasting reduction to PSPS.

  - Real-time PSPS consideration. Incorporating the impact of PSPS into the available data during fire weather events.

- Consequences from PSPS are largely based on subject matter expert data, and efforts are underway by all IOUs to improve their understanding of how PSPS events affect customers

- Similar to standard Electric Reliability notions, PSPS events have many dimensions: duration, time of day, repetition, customer characteristics, estimated restoration time, etc. Future versions of PSPS consequence analysis will attempt to incorporate more of these dimensions.

Total Wildfire Risk Score – PSPS Impact

	Tier 3	Tier 2	PSPS Impact
Pre-Mitigation Risk Score	3283.47	1407.20	4690.67
LoRE	4	4	4
CoRE	820.87	351.80	1172.67

$LoRE = 4$ The number of 2019 PSPS activations

$CoRE = (4 \times 820.87 + 4 \times 351.80) \div 4 = 1172.67$

Total Wildfire Risk Score – PSPS Impact

Customer Impacts by Type

SDG&E uses three categories to represent different types of customers as follows:

- Critical: This includes urgent customers whose mission supports regional emergency response (e.g., police, fire department, hospitals) as well as essential customers who are essential to public health, safety, and security as defined by the CPUC

- Medical Baseline: Residential and other customers with a qualifying medical condition or medical device usage

- Non-Critical: All other customers that do not fall in either the critical or medical baseline categories.

Customer Type	Data Assumptions / Proxys	Safety			Financial			Reliability			Stakeholder Impact
		Initial Score	Impact Multiplier	Total Impact	Initial Score	Impact Multiplier	Total Impact	Initial Score	Impact Multiplier	Total Impact	Total Impact
Non-Critical	**Assumption**: 80% Residential, 10% Commercial, 10% Industrial	1	1	1	1	1	1	1	1	1	1
Critical	**Proxy**: Communications Tower	20	1	20	10	1	10	30	1	30	30
Medical Baseline		5	1	5	1	1	1	1	1	1	5

Total Wildfire Risk Score – PSPS Impact

CoREs by Tier 3 and Tier 2

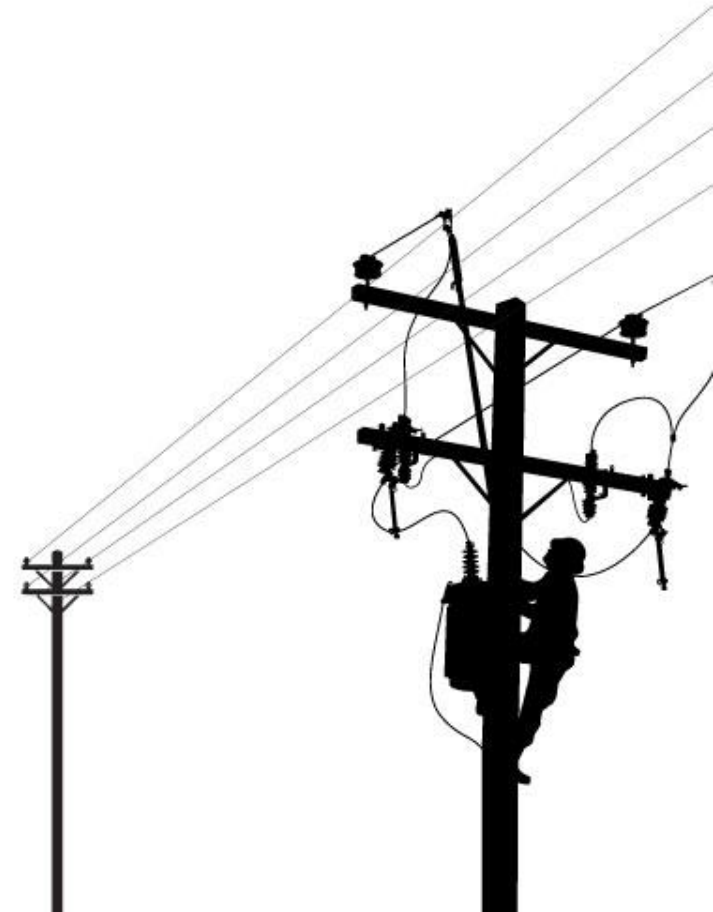| Financial	Safety	Reliability	Stakeholder Satisfaction
• $4.61 million per incident • CoRE-Tier 3 = $4.61 * 0.7 = \$3.23\ million$ • CoRE-Tier 2 = $4.61 * 0.3 = \$1.38\ million$	• 0.004 safety units per incident • CoRE-Tier 3 = $0.004 * 0.7 = 0.003$ • CoRE-Tier 2 = $0.004 * 0.3 = 0.001$	• SAIDI= 13.44 per incident • SAIFI=0.01 per incident • CoRE = $\frac{13.44}{100} * 0.25 + 0.01 * 0.25 = 0.036$ per incident • CoRE-Tier 3 = $0.036 * 0.7 = 0.025$ • CoRE-Tier 2 = $0.036 * 0.7 = 0.011$	• 10 per incident

BREAK

Vegetation Management Practices

Mitigating Vegetation Threats
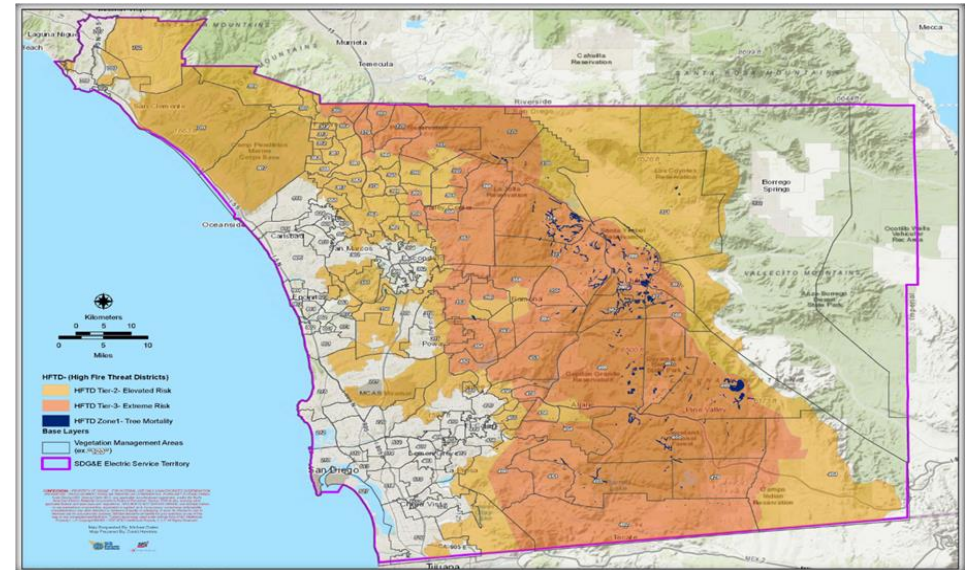

Tree Inspections

- robust database tracking nearly 460,000 trees
- twice-annual inspections of all trees located within the HFTD

Trimming Operations

- removal of all tree branches overhanging primary wire
- maximize post-trim clearances within HFTD (12-25ft)

Vegetation Risk Index (VRI)

- merging meteorology, tree inventory, outage data
- engaging supercomputing to develop risk analysis and predictive modeling

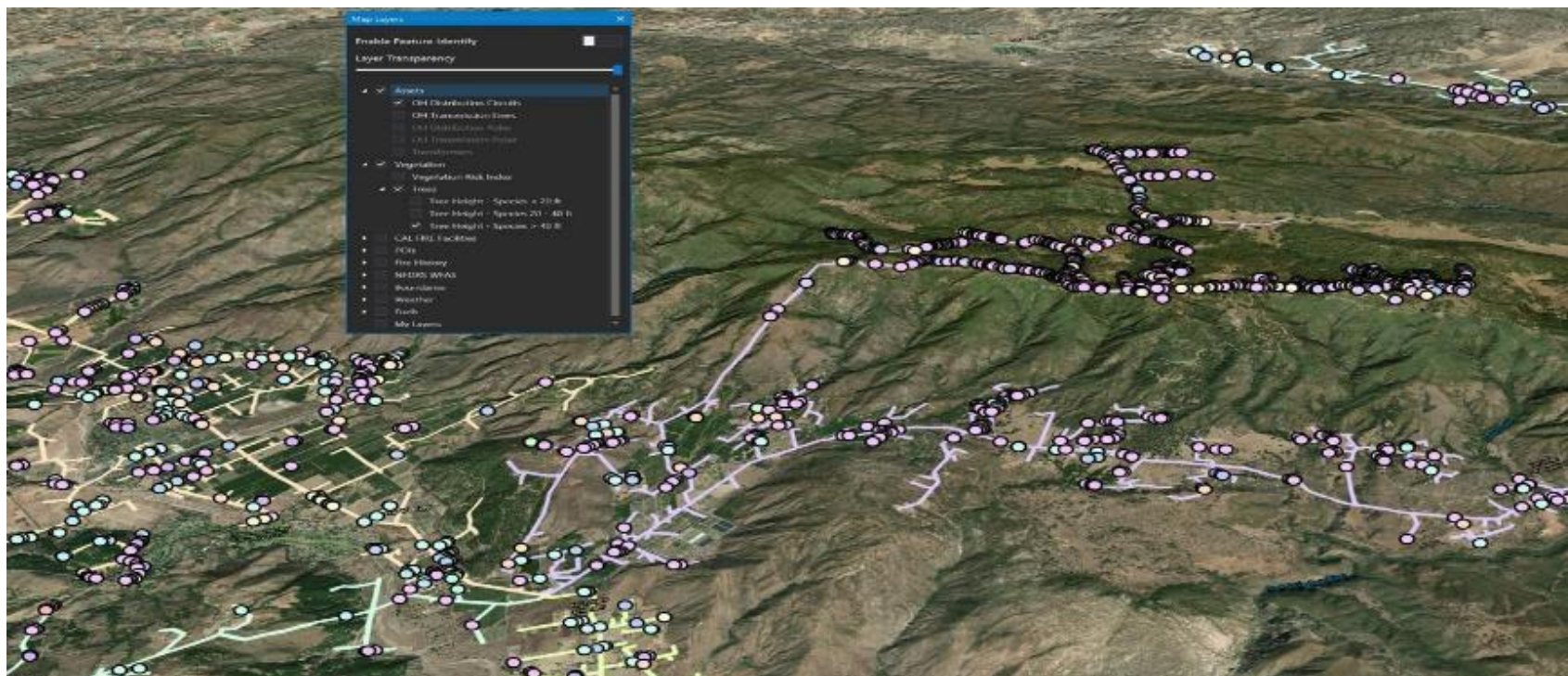**SDG&E Employs Contracted Certified Arborists to Perform Tree Inspections**

Each span is patrolled to assess trees for safety and compliance.

All inventory trees are inspected and updated each year to determine growth and hazard potential. Database contains inspection and pruning history of each tree.
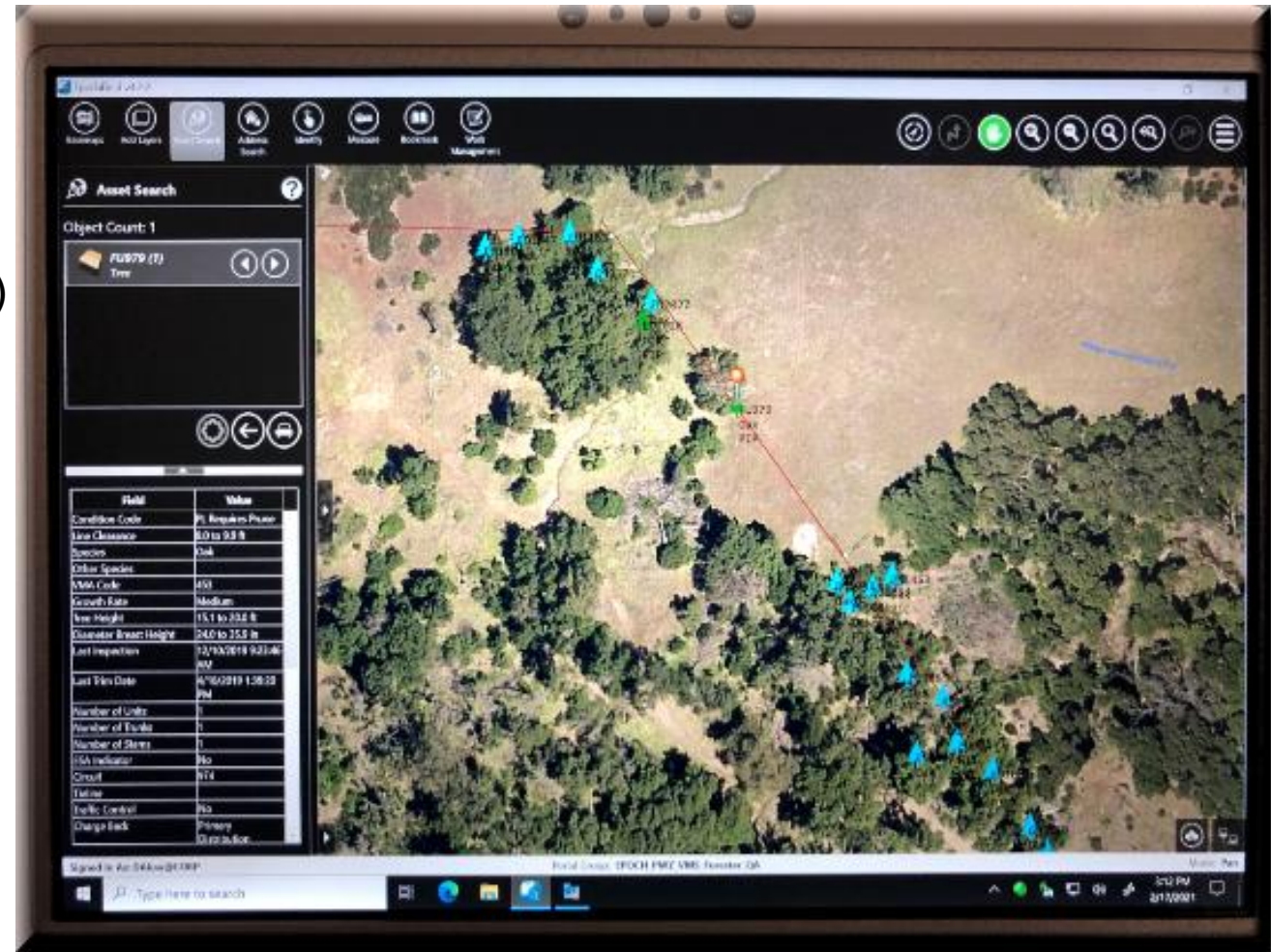
Hazard tree inspection includes assessment for dead, dying, diseased, and structurally defective trees.

Pre-Inspection Activity

Vegetation Management Tree Inventory Database

- All VM contractor work recorded and tracked electronically

- Data uploaded nightly to server; viewable to all users the following day

- 2021 - New work management system (EPOCH)

- Improved GIS mapping capabilities

- Accurate GPS positioning of each inventory tree

- Enhanced tree data capture for more granular analysis

- Updated information for improved customer notification and engagement

Grid Hardening Mitigation Impacts on Vegetation Management Mitigations/Practices

Fire Hardening and Vegetation Management

- Tree density, vegetation impacts, and biological/cultural constraints are components of fire hardening analyses

- Cost and environmental impacts associated with undergrounding may be prohibitive compared with continued vegetation management practices

- Covered conducted may not completely eliminate risk and impacts associated with tree failure

- Hardware replacement can offset the need to perform pole brushing activities

4-foot radial clearance required at all times