PG&E RAMP Proceeding (A.20-06-012) Post-SPD Evaluation Report Workshop

Safety Policy Division
California Public Utilities Commission
December 8, 2020

California Public Utilities Commission

PG&E Risk Assessment and Mitigation Phase (RAMP) Proceeding (A.20-06-012)

- 2020 RAMP application was filed in accordance with schedule in latest Rate Case Plan.
- First PG&E RAMP following terms of S-MAP Settlement Agreement.
- 2020 RAMP covers years 2023-2026
- 2020 RAMP includes top safety risks
- 2020 RAMP filed in connection with TY2023 GRC, anticipated in June/2021.

Pre-RAMP application workshops (3 workshop days)

- **Nov. 14, 2019. Pre-filing workshop 1:**
  - Reviewed feedback from prior (TY2020) RAMP.
  - Reviewed PG&E's implementation of the SMAP Settlement Agreement.

- **Jan. 13, 2020. Pre-filing workshop 2:**
  - PG&E presented Step 1A (Building MAVF) and Step 3 (Mitigation analysis for risks) of SMAP Settlement Agreement.

- **February 4, 2020. Pre-filing workshop 3:**
  - PG&E gathered input from stakeholders on PG&E's selection of risks to be included in upcoming TY2023 RAMP application.

Post-RAMP Application Workshops (3 workshops over 5 days)

July 14, 2020 and July 24, 2020 (Post-filing workshop 1 Day 1 and Day 2):

PG&E presented:

1. RAMP risk selection
2. PG&E's MAVF
3. Risk analysis and RSE methodology

July 30, 2020. Post-filing workshop 2: Wildfire risk

Aug. 26 and Aug. 27, 2020 (Post-filing workshop 3, Day 1 and Day 2)

- Day 1: Presentation of non-wildfire risks
- Day 2: Continuation of non-wildfire risks, and continuation of wildfire risk

Sensitivity/Scenario Analyses Meetings

Four Parties in addition to SPD staff requested PG&E to perform sensitivity/scenario analyses:

- Cal PA, FEITA, MGRA, TURN, and SPD staff
- Eight meetings from Sept. 2 to Oct. 28
- PG&E re-ran models based on changes specified by the four parties and SPD staff
- Based on PG&E's scenario run results, the four parties submitted informal comments to interpret the results.

PG&E RAMP Proceeding Schedule

- June 30, 2020 – PG&E filed 2020 RAMP application.
- Nov. 25, 2020 – SPD released evaluation report.
- Dec. 8, 2020 – Workshop to discuss SPD report.
- Jan. 15, 2021 – Opening comments on RAMP report and SPD report.
- Jan. 29, 2021 – reply comments.
- First half of 2021 – PG&E incorporates RAMP feedback into its TY 2023 GRC filing.
- June 30, 2021 – PG&E files TY 2023 GRC.

PG&E 2020 RAMP Risks

TABLE 1: RAMP Risks Ordered by Multi-Attribute Risk Score

Risk Score	LoRE (Events/Yr)	CoRE	RAMP Risks
24,343	443	55	Ch 10: Wildfire
944	3,417	0.3	Ch 15: Third-Party Safety Incident
526	24,834	0.02	Ch 11: Failure of Electrical Overhead Assets
289	1.9	155	Ch 07: Loss of Containment on Gas Trans Pipeline
99	29,590	0.003	Ch 08: Loss of Containment on Gas Dist. Main or Service
97	8.2	12	Ch 14: Real Estate & Facilities Failure
94	185	0.5	Ch 17: Contractor Safety Incident
90	603	0.15	Ch 16: Employee Safety Incident
70	0.015	4,739	Ch 13: Large Uncontrolled Water Release
16.6	713	0.02	Ch 18: Motor Vehicle Safety Incident
13	5.6	2	Ch 09: Large Over-Pressure Event Downstream of Gas Measurement & Control Facility
7	10.2	0.6	Ch 12: Failure of Network Assets

High Level Findings in SPD Report

- Tranches lack sufficient granularity and do not have homogeneous risk profiles.
- RSEs were not calculated for controls.

Other Overall Observations

- Estimates provided as point estimates with no consideration for uncertainties.
- Weights blending PG&E's data with industry data were selected without justification.
- Non-linear, risk-averse scaling function, along with high safety weight, can result in non-cost-effective mitigations, e.g. implied cost of $100 Million to prevent one statistical fatality.
- Power law distributions may be more appropriate functions to model wildfires.

Chapter 10: Wildfire

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Chapter 10 Slide Color Key

Orange slides: SPD observations

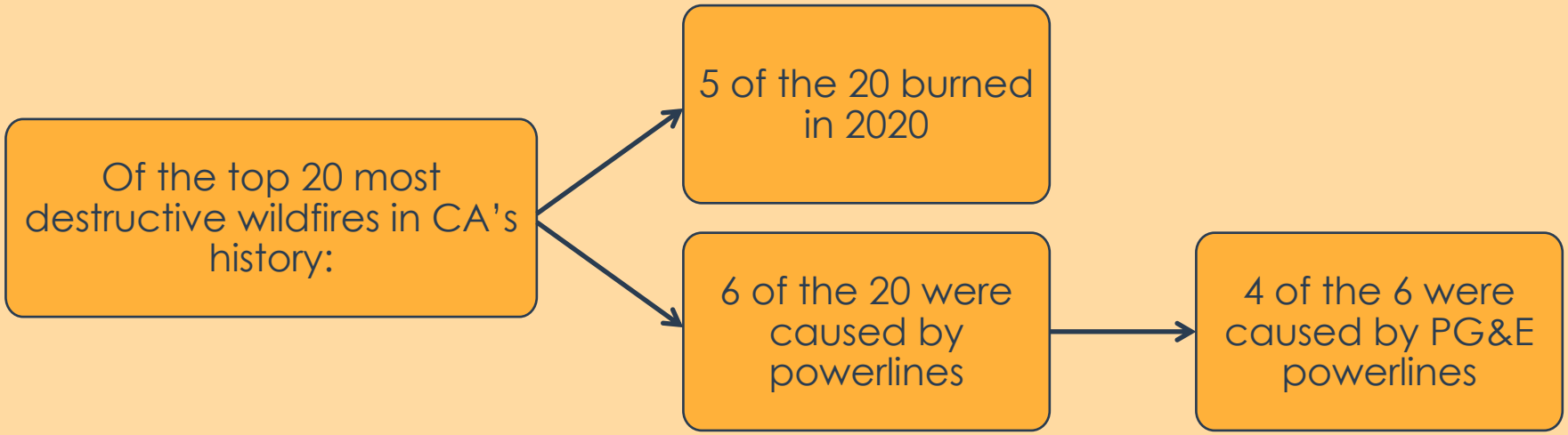
White Slides: summary of info primarily from PG&E RAMP

Wildfire Risk Description

Definition	PG&E assets or activities that may initiate a fire that is not easily contained and endangers the public, private property, sensitive lands or the environment
Not within scope	fire ignitions & associated impacts unrelated to PG&E electric system assets
99,000	OH primary circuit miles in PG&E's electric transmission & distribution system are potential sources of wildfire ignition
>30%	of PG&E assets are in HFTDs
15/20	of the most destructive wildfires in CA's history have occurred since 2000, including 10 since 2015
50%	of PG&E's 5.5 million electric customers across a service territory of 70,000 square miles are within HFTDs

Wildfire Risk Description: Observations

Wildfire risk is appropriately the top safety risk for PG&E's 2020 RAMP and continues to grow in California:



Wildfire Risk Bowtie

- Based on WF exposure risks in PG&E's entire T&D OH electric system.
- WF MARS for the entire OH electric system is 25,127:
  - Far surpasses the 2nd and 3rd highest risks, Third-Party Safety (944) & DOH assets (526).
  - Wildfire MARS is 25,008 for portion of the system in HFTD areas.
- Forecasts 442 annual risk events (ignitions), including 141 in HFTD for TY2023.

Wildfire Risk Bowtie: Observations

- MARS ranking is appropriate – WF is PG&E's top safety risk and 26 times greater than second-ranked Third Party Safety Incident MARS.

- Since HFTD areas account for 99.5% of the wildfire Multi-Attribute Risk Score, PG&E must ensure that MAVF modeling, along with input data and subjective assumptions, are utilized to sufficiently focus risk analysis on these areas.

25,127 — MARS for entire OH electric system

25,008 — MARS for portion of system in HFTD areas only

→ **99.5%** of wildfire risk is in HFTD areas

Wildfire Exposure

Systemwide:

81,000 miles

Distribution primary overhead circuits

18,000 miles

Transmission overhead circuits

HFTD:

30,936 miles

Distribution primary overhead circuits

- 25,400 distribution circuit miles
- 5,525 transmission OH circuit miles
- 203 substations (1 circuit mile each)

51%

of all CA IOU HFTD Tier 3 exposure

76%

of all CA IOU HFTD Tier 2 exposure

Wildfire Tranches

HFTD Areas

Distribution: Hardened
n=171 circuit miles
<1% of system mileage

Distribution: to be Hardened
n=6,929 circuit miles
7% of system mileage

Distribution: Remainder
n=18,310 circuit miles
19% of system mileage

Transmission
n=5,525 circuit miles
6% of system mileage

Substation
n = 1 circuit mile
203 of 942 total substations
(22%)

Non-HFTD Areas

Distribution
n=55,300 circuit miles
56% of system mileage

Transmission
n=12,600 circuit miles
13% of system mileage

Substation
n=1 circuit mile
739 of 942 substations
(78%)

Wildfire Tranches

HFTD Areas

Distribution: Hardened
n=171 circuit miles
<1% of system mileage

→ Hardened in 2019

Distribution: to be Hardened
n=6,929 circuit miles
7% of system mileage

→ Lines To Be Hardened in System Hardening Program (2020-2026)

Distribution: Remainder
n=18,310 circuit miles
19% of system mileage

→ Outside scope of System Hardening Program

Wildfire Tranches: Observations

HFTD Areas

Transmission
n=5,525 circuit miles
6% of system mileage

5.6% of exposure risk
6.5% of the MARS

Distribution: to be Hardened
n=6,929 circuit miles
7% of system mileage

7% of exposure risk
45% of the MARS

Distribution: Remainder
n=18,310 circuit miles
19% of system mileage

19% of exposure risk
47% of the MARS

3 HFTD Tranches:

98.93% of the total wildfire Risk Score

30,000 circuit miles

30% of PG&E's total overhead Distribution and Transmission circuit miles

Wildfire Tranches: Observations – *SMAP Settlement Agreement*

A tranche is "a logical disaggregation of a group of assets (physical or human) or systems into subgroups with like characteristics for purposes of risk assessment."

- IOUs must "strive to achieve as deep a level of granularity as reasonably possible."

Recommendation: PG&E should provide as much granularity as reasonably possible for the TY2023 GRC filing.

- **PG&E should consider how to model the three highest risk scored HFTD wildfire risk tranches with more granularity and significantly fewer circuit miles per tranche.**

Wildfire Tranches: Observations – *Findings from Prior Comments*

- All 5 HFTD tranches should be minimally separated into T3 and T2 tranches
- Having only 3 T&D tranches– encompassing 30,000+ circuit miles– is insufficient for risk analysis since risk profiles within these tranches lack homogeneity
- Prioritization modeling for vegetation management, equipment maintenance and replacement, and circuit prioritization for conducted covered conductors could be used to divide tranches
- Tranches utilized in other electric operations RAMP risks provide examples of existing tranches that could be used to develop more granular tranches
- Regionalized/ localized tranches would result in more localized wildfire mitigations

Wildfire Tranches: Observations *(Continued)*

Multiple-Attribute Risk Scores by Tranche

Tranche	Aggregated	Electric Reliability	Financial	Safety	Percent Risk Score	Percent Exposure
HFTD : Distribution- Hardened	150.07	5.65	85.80	58.62	0.60%	0.17%
HFTD : Distribution- to be Hardened	11,411.04	422.45	6,455.65	4,532.95	45.41%	7.01%
HFTD : Distribution- Remainder	11,811.48	444.81	6,763.12	4,603.55	47.01%	18.53%
HFTD : Transmission	1,635.13	60.27	938.86	636.00	6.51%	5.59%
HFTD : Substation	0.00	0.00	0.00	0.00	0.00%	0.00%
Non- HFTD : Distribution	114.35	15.64	74.79	23.92	0.46%	55.95%
Non- HFTD Transmission	4.35	0.62	2.87	0.86	0.02%	12.75%
Non- HFTD Substation	0.08	0.01	0.05	0.02	0.00%	0.00%

Total Multi-Attribute Risk Score (MARS) 25,127

Wildfire Tranches: Observations *(Continued)*

Multiple-Attribute Risk Scores by Tranche

Tranche	Aggregated	Electric	Financial	Safety	Percent Risk Score	Percent Exposure
HFTD : Distribution- Hardened	150.07				0.60%	0.17%
HFTD : Distribution- to be Hardened	11,411.04				45.41%	7.01%
HFTD : Distribution- Remainder	11,811.48				47.01%	18.53%
HFTD : Transmission	1,635.13	60.27	938.86	636.00	6.51%	5.59%
HFTD : Substation	0.00	0.00	0.00	0.00	0.00%	0.00%
Non- HFTD : Distribution	114.35	15.64	74.79	23.92	0.46%	55.95%
Non- HFTD Transmission	4.35	0.62	2.87	0.86	0.02%	12.75%
Non- HFTD Substation	0.08	0.01	0.05	0.02	0.00%	0.00%

All hardened in 2019– likely to be homogenous

Unlikely to be homogenous

Total Multi-Attribute Risk Score (MARS) 25,127

Wildfire Tranches: Observations – *Suggestions for Developing more Granular HFTD Tranches*

Recommendations For PG&E's HFTD Distribution Tranches:

1. First, divide PG&E's distribution into risk tranches by asset categorization

- Divide assets by system voltage and/or scheme of connection (i.e. radial, loop, network, multiple or series) and number of conductors (2-wire, 3-wire, 4-wire, etc).
- Divide assets by load types (residential, commercial, street lighting, railways, etc.) in instances where this could help further tranche assets.

2. Then, divide PG&E's distribution by circuits or line sections

- HFTD Distribution overhead circuit lines could be tranched by types of primary circuits or line sections if the risk profiles of the feeder(s) and/or circuit segment(s) is deemed to be homogenous.
- If the feeder is deemed to have varying degrees of risk profiles, then a feeder (i.e. asset) could be divided into its line sections for allocating its sections to appropriate individual Tranches.
- Or, alternatively, tranche circuits by groups of 'zones of protection' rather than line sections if there are a definitive clear endpoint for each zone.

Wildfire Tranches: Observations – *Suggestions for Developing more Granular HFTD Tranches*

Recommendations For PG&E's HFTD Transmission Tranche:

1. **Use a similar approach as suggested for Distribution Tranche**
   - Divide assets into geographic sections by circuits, line sections, or line segments for individual tranches with similar risk profiles for well-defined areas.
   - If these are too granular, group circuits or line sections by similar risk profiles.
2. **Look at examples from power engineering industry**
   - Transmission line segments have been analyzed by type of construction or by type of failure for purposes of reporting and analyzing failure and exposure data.

Once PG&E further divides transmission and distribution assets, they can develop more specific MA risk scores and assess outcomes based on mitigations or conditions of each line section.

Wildfire Tranches: Observations – *Additional Reccomendations for Increasing Granularity*

1. Consider whether additional granularity is needed for substation assets, since mitigations could be installed at substations to reduce risks for T&D assets.

2. Consider other tools and data used to model circuit mile prioritization for system hardening, vegetation management, and equipment maintenance and replacement.

3. Consider insights from SME proposed initiatives to mitigate wildfire risk to understand how PG&E already prioritizes certain assets by common risk characteristics.

4. Use machine learning and/or artificial intelligence data techniques to identify more narrow and homogenous risk profiles.

5. Consider tranches utilized in PG&E's Electric Operations Overhead Assets Risks Analysis (Chapter 11) for insights.

6. Consider regions or localities of PG&E's territory, especially in HFTD areas, that could be utilized for tranching PG&E's system.

Relevant Tranche Scenario Analysis

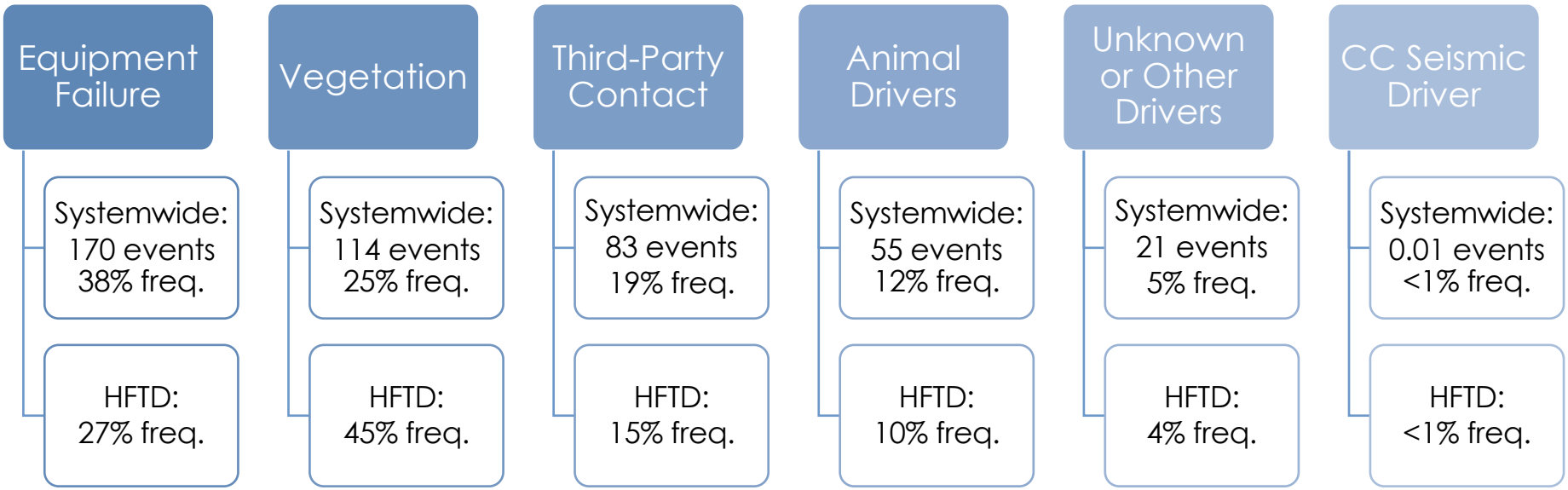
- TURN asked PG&E to break down the two highest HFTD Distribution MA Risk Scored tranches into 12 tranches, for a total of 18 tranches (instead of the 8).
- Based on data from PG&E's 2019 GRC filing, 60% of the risk for the Distribution- To Be Hardened tranche is found in approximately 2,300 circuit miles, or about 30% of the 6,900 miles in that tranche.
- TURN states that even the level of granularity reflected in this analysis is not ideal because the LoRE and CoRE values for each circuit within each of these tranches differ.
  - For example, TURN states PG&E undoubtedly knows that particular locations within HFTDs are more susceptible to fire weather conditions or high fuel content than other HFTD areas.
- TURN suggests that PG&E consider designing tranches based on the specific characteristics of individual equipment types that tend to increase the likelihood of occurrence of wildfires.
  - These differences could be used to create separate equipment-specific tranches.
  - In Chapter 11 of its RAMP filing, PG&E discusses failures of DOH assets by equipment type and has created tranches based on reliability performance; TURN believes some of these failures can lead to wildfires.

Relevant Tranche Scenario Analysis: Observations

- SPD finds that TURN's requested Tranche Scenario Analysis appears to support that more granular tranches allow PG&E to more accurately reflect the risk reduction benefits of mitigation work that is expected to be completed ***before*** the next GRC period starts in 2023, resulting in a significantly lower baseline TY2023 wildfire MA Risk Score.
- SPD finds that TURN's requested Tranche Scenario Analysis appears to makes a strong case for the need for further granularity to be achieved in PG&E's wildfire risk 'tranching,' especially in HFTD areas.

Risk Drivers & Associated Frequencies and Associated Risks

6 risk drivers account for a forecasted **443 risk events systemwide** in TY 2023; **141 risk events in HFTD**:



Risk Drivers & Associated Frequencies and Associated Risks: Observations

Importance of percentage of associated risk:

- Equipment failure is highest frequency risk driver systemwide at 38%, but is 27% of the associated risks.
- Vegetation is second highest frequency risk driver systemwide at 25%, but is 44% of the associated risk.

Recommendation: PG&E should model Operational Failure as a risk driver for TY2023 GRC.

- TURN identified need to include risk driver of Operational Failures; SPD agrees.

Recommendation: PG&E should anticipate the impacts of regionalization efforts on operational risks.

Wildfire Cross-Cutting Factors

8 cross-cutting factors included in the 2020 RAMP

4 cross-cutting factors quantified in Wildfire Risk Model:

1. Climate Change (modeled on the consequence side by correlating projected future changes in PG&E territory burned with the change in frequency of ignitions that occur during RFWs)
2. Emergency Preparedness & Response
3. Records & Information Management
4. Seismic

Wildfire Cross Cutting Factors: Observations

- Three Cross Cutting Factors (CCFs) are especially relevant to PG&E's wildfire risk modeling for the TY2023 GRC: Change, Emergency Preparedness & Response (EP&R), and Records & Information Management (RIM).
- PG&E integrated Climate Change into its long-term wildfire risk outlook, specifically for wildfire consequences.
- PG&E is projecting to utilize Emergency Preparedness & Response as a Mitigation to substantially reduce WF risk.

Wildfire Consequences

10 Outcomes modeled based on combination of:

- **Fire size/ destructiveness** – Catastrophic/ Destructive; Large or Small
- **Red Flag Warning** (RFW) – Yes or No
- **Seismic event**

TY2023 Aggregated Consequence of Risk Event (CoRE) is 57;

Individual CoREs range between 0.1 and 17,094

RFW Catastrophic Fires are 76% of outcomes

PG&E states its decision to invest in PSPS, which is targeted at reducing ignitions when RFW conditions occur – mitigating the highest projected risk

Non-RFW Catastrophic Fires are 12% of outcomes

11% of the Wildfire Risks event consequences are due to RFW Destructive Fires (7%) and Non-RFW Destructive Fires (4%.

Wildfire Consequences: Observations

- **Highest Frequency Outcome**: Non-RFW Small Fires at 91%, which is only 0.12% Projected Risk Outcomes.
- **Second Highest Frequency Outcome**: RFW Small Fires at 7.8%, which is only 0.01% Projected Risk Outcomes.

Recommendation: PG&E should consider how to focus its MAVF analysis more heavily on conditions that lead to large, destructive, and catastrophic fires.

Wildfire Controls & Mitigations

- 17 controls
- 11 mitigations

Wildfire Controls

17 Controls		
#	**Control**	**Mapping to 2017 RAMP/ 2020 GRC**
C1	Patrols and inspections – Distribution Overhead	Part of C1- 2017 RAMP
C2	Patrols and inspections – Transmission Overhead	Part of C1- 2017 RAMP
C3	Patrols and inspections – Substation Overhead	Part of C1- 2017 RAMP
C4	Vegetation Management – Distribution Overhead	Part of C2- 2017 RAMP
C5	Vegetation Management – Transmission Overhead	Part of C2- 2017 RAMP
C6	Vegetation Management – Substation Overhead	Part of C2- 2017 RAMP
C7	Vegetation Management – CEMA	C3- 2017 RAMP
C8	Equipment Maintenance & Replacement – Distribution Overhead	Part of C8- 2017 RAMP
C9	Equipment Maintenance & Replacement – Transmission Overhead	Part of C8- 2017 RAMP
C10	Equipment Maintenance and Replacement – Substation&	Part of C8- 2017 RAMP
C11	Animal Abatement	C6- 2017 RAMP
C12	Pole Programs	C9- 2017 RAMP
C13	Transmission Structure Maintenance and Replacement	
C14	System Automation and Protection	C7- 2017 RAMP; M15-2020 GRC
C15	Reclose Blocking	M1 and part of M2- 2017 RAMP; M14- 2020 GRC
C16	Design Standards	C11- 2017 RAMP
C17	Restoration, Operational Procedures, and Training	C12- 2017 RAMP

Wildfire Mitigations

PG&E's 4 Broad Strategies
1. **Reduce risk through several asset management programs**, including a long-term program to harden the distribution system in HFTD areas to lower ignition risk and improve fire resilience.
2. **Reduce risk from the vegetation driver** by expanding vegetation management activities in HFTD areas beyond compliance requirements.
3. **Target the highest risk wildfire conditions** through the PSPS Program. PG&E is making significant investments to reduce the impact of future PSPS events on customers.
4. **Enhance situational awareness** with improvements in meteorology, high definition cameras for fire monitoring, field weather stations and satellite monitoring for better weather tracking and forecasting, and sensors in HFTD areas.

11 Mitigations		
#	**Mitigation**	**Mapping to 2017 RAMP/ 2020 GRC**
M1	Enhanced vegetation management (EVM)	M16- 2020 GRC
M2	System hardening	M12- 2020 GRC
M3	Non-exempt surge arrester replacement	M5- 2017 RAMP
M4	Expulsion fuse replacement	C4- 2017
M5	PSPS	M13- 2020 GRC
M6	PSPS Impact Reduction Initiatives	Incld. 2020 GRC M10 & M15; Foundational
M7	Situational Awareness and Forecasting Initiatives	Incld. 2020 GRC M18, M19, M20, M21, M23, M24; Foundational
M8	Safety and Infrastructure Protection Teams (SIPT)	M25- 2020 GRC; Foundational
M9	CWSP PMO	M28 2020 GRC; Foundational
M10	Additional System Automation and Protection	Foundational
M11	Remote grid	Implemented for 2020-22 Mitigation Plan

Wildfire Mitigations *(Continued)*

Mitigation Forecasted Costs, RSE, and Risk Reduction, 2023-2026

PSPS & System Hardening have highest RSE scores; highest total risk reduction scores

PSPS cost includes the cost of PG&E programs to reduce the footprint/ shorten restoration times for PSPS

Program	Expense ($000s)	Capital ($000s)	Risk Score Reduction	Risk Spend Efficiency
M1-EVM	2,211,877		4,156	2.6
M2-Harden		3,400,802	17,893	7.3
M4-Fuse Repl.		24,711	18	1.0
M5-PSPS	763,334		16,284	13.8
M6-PSPS Impact Reduction	522,243		Combined w/M5	Combined w/M5

Controls & Mitigations: Observations

- PG&E only calculated RSEs for 6 non-foundational WF mitigations and for cross-cutting mitigation programs.
- Of the 7 mitigation programs, PSPS has the highest associated risk reduction score for every year between 2020-2026, followed by System Hardening and Enhanced Vegetation Management.
- No other WF mitigations shown to substantially reduce risk.

Program	Risk Reduction
PSPS	5,649-5,972 for 2020-2026, respectively
Cross-cutting Mitigation Programs	189-920 for years 2020-2026, respectively
System Hardening	105-1,394 for years 2020-2026, respectively
Enhanced Vegetation Management	50-228 between 2020-2026, respectively.

Controls & Mitigations: Observations *(Continued)*

- Several critical wildfire controls and mitigations could be more disaggregated for Risk Reduction and corresponding RSE analysis.
- All controls and all foundational mitigations lack RSE modeling and the results to support controls/foundational mitigations as continuing mitigations and/or to provide insight into effectiveness to reduce wildfire risks.
- Aggregation of wildfire initiatives into programs creates the challenge that ineffective elements of broad programs cannot be determined and future considerations of initiatives within programs can only be analyzed collectively (reiterates WSD-002 Deficiency– Guidance-5, Class B).

Recommendation: PG&E should provide RSE calculations or estimates for its controls and include more individual initiatives for RSE analysis to understand the effectiveness of specific controls and mitigations.

Controls & Mitigations: Observations – *M5, PSPS*

- PSPS listed as a mitigation tool, despite being a tool of last resort and the action of shutting off electric utility service for public safety (i.e. Public Safety Power Shutoff) inherently being a measure with its own risks to PG&E's customers.
- PG&E's use of PSPS as a mitigation justified by RSE was identified as a Wildfire Safety Division compliance deficiency: "RSE is not an appropriate tool for justifying the use of PSPS."
- SPD requested PG&E conduct a Scenario Analysis removing PSPS as a Mitigation in the Wildfire Mitigation Portfolio.

Controls & Mitigations: Observations – *M5, PSPS (Continued)*

In the Scenario Analysis WITHOUT PSPS:

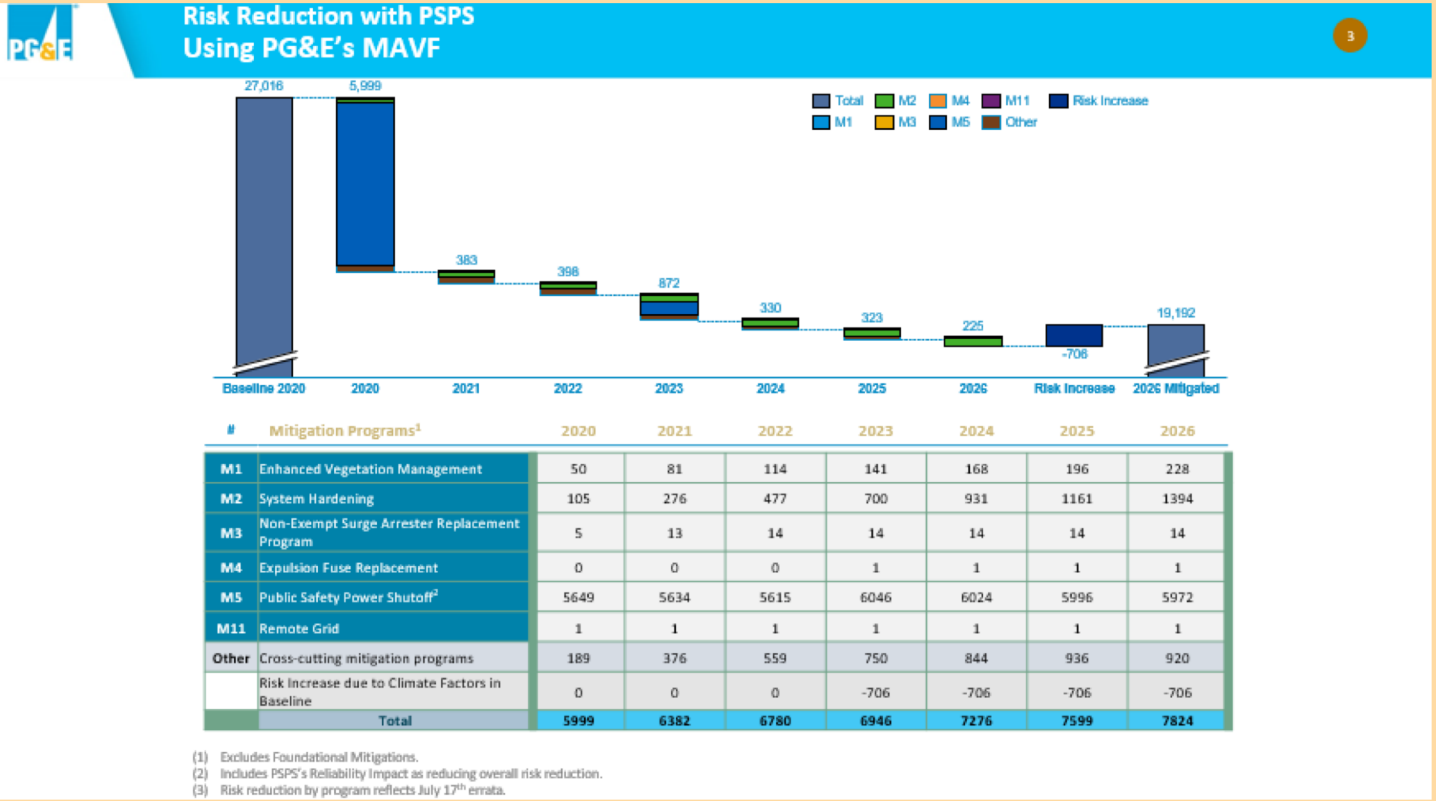
- The top three system-wide wildfire mitigations in order of highest total annual wildfire MA Risk Reduction Scores are:
  - Cross Cutting Mitigations: 44-48% in 2020-2022; 54% in 2023
  - System Hardening: 26-37% in 2020-2022; 50% in 2023
  - Enhanced Vegetation Management (EVM): 17-24% in 2020-2022; 20% in 2023
- There is a 25% MA Risk Score Increase due to climate change
- Allows for refinement to evaluate non-PSPS Mitigations risk reduction benefits and impacts of PG&E's assumptions related to wildfire risks for the entire 2023-2026 GRC cycle
- Impacts/ relationships between CC Mitigations, System Hardening, EVM, and Increased Climate Change Risk are easier to analyze when PSPS is excluded than when it is included

Recommendations:

- **PG&E should remove PSPS as a mitigation for the TY2023 GRC filing**
- **PG&E should consider alternative methodologies to analyze PSPS in its WF risk analysis for the TY2023 GRC**

Controls & Mitigations: Observations – *M5, PSPS (Continued)*

FIGURE 10-1. Risk Reduction with PSPS using PG&E's MAVF

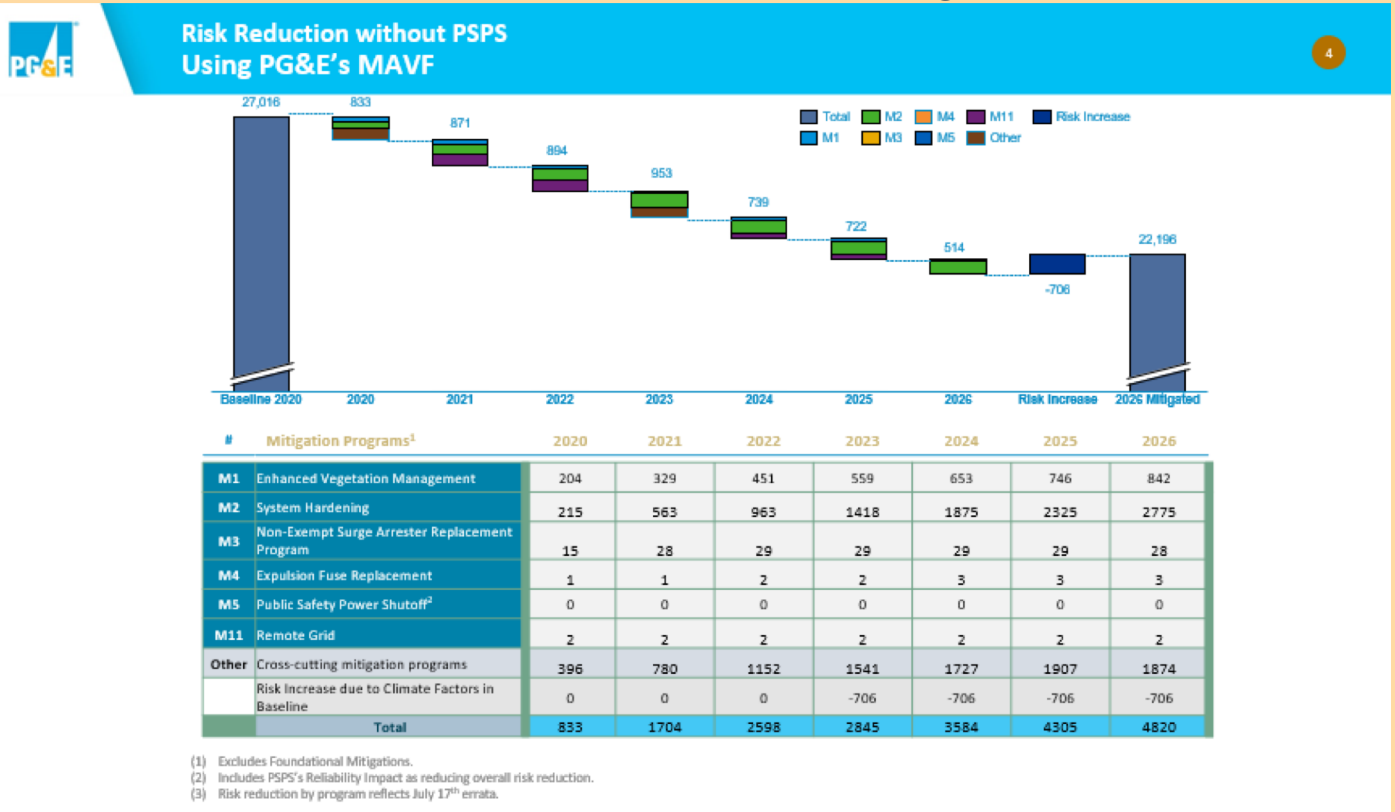


#	Mitigation Programs[1]	2020	2021	2022	2023	2024	2025	2026
M1	Enhanced Vegetation Management	50	81	114	141	168	196	228
M2	System Hardening	105	276	477	700	931	1161	1394
M3	Non-Exempt Surge Arrester Replacement Program	5	13	14	14	14	14	14
M4	Expulsion Fuse Replacement	0	0	0	1	1	1	1
M5	Public Safety Power Shutoff[2]	5649	5634	5615	6046	6024	5996	5972
M11	Remote Grid	1	1	1	1	1	1	1
Other	Cross-cutting mitigation programs	189	376	559	750	844	936	920
	Risk Increase due to Climate Factors in Baseline	0	0	0	-706	-706	-706	-706
	Total	5999	6382	6780	6946	7276	7599	7824

(1) Excludes Foundational Mitigations.
(2) Includes PSPS's Reliability Impact as reducing overall risk reduction.
(3) Risk reduction by program reflects July 17th errata.

Controls & Mitigations: Observations – *M5, PSPS (Continued)*

FIGURE 10-2. Risk Reduction without PSPS using PG&E's MAVF



#	Mitigation Programs[1]	2020	2021	2022	2023	2024	2025	2026
M1	Enhanced Vegetation Management	204	329	451	559	653	746	842
M2	System Hardening	215	563	963	1418	1875	2325	2775
M3	Non-Exempt Surge Arrester Replacement Program	15	28	29	29	29	29	28
M4	Expulsion Fuse Replacement	1	1	2	2	3	3	3
M5	Public Safety Power Shutoff[2]	0	0	0	0	0	0	0
M11	Remote Grid	2	2	2	2	2	2	2
Other	Cross-cutting mitigation programs	396	780	1152	1541	1727	1907	1874
	Risk Increase due to Climate Factors in Baseline	0	0	0	-706	-706	-706	-706
	Total	833	1704	2598	2845	3584	4305	4820

(1) Excludes Foundational Mitigations.
(2) Includes PSPS's Reliability Impact as reducing overall risk reduction.
(3) Risk reduction by program reflects July 17th errata.

Controls & Mitigations: Observations – *M5, PSPS (Continued)*

TABLE 10-4. Comparison of MA Risk Reduction Scores with PSPS and without PSPS

Rounding of whole MA Risk Reduction Scores slightly impacted some of the Total Annual Risk Reduction Scores.

SPD Calculations of Associated % of Total Annual Risk Reductions for each Mitigation Annually

PG&E RAMP Wildfire Mitigation Portfolio with PSPS (Slide 3) for Baseline Comparison

		PG&E RAMP MA Risk Reduction Scores							Associated % of Total Annual Risk Reductions						
		2020	2021	2022	2023	2024	2025	2026	2020	2021	2022	2023	2024	2025	2026
M1	EVM	50	81	114	141	168	196	228	1%	1%	2%	2%	2%	3%	3%
M2	System Hardening	105	276	477	700	931	1161	1394	2%	4%	7%	10%	13%	15%	18%
M3	Non-Exempt Surge Arrestor	5	13	14	14	14	14	14	0%	0%	0%	0%	0%	0%	0%
M4	Expulsion Fuse	0	0	0	1	1	1	1	0%	0%	0%	0%	0%	0%	0%
M5	PSPS	5649	5634	5615	6046	6024	5996	5972	**94%**	**88%**	**83%**	**87%**	**83%**	**79%**	**76%**
M11	Remote Grid	1	1	1	1	1	1	1	0%	0%	0%	0%	0%	0%	0%
	Cross Cutting Mitigations	189	376	559	750	844	936	920	3%	6%	8%	11%	12%	12%	12%
	Risk Increase due to CC	0	0	0	-706	-706	-706	-706	0%	0%	0%	-10%	-10%	-9%	-9%
Total Annual Risk Reduction		**5999**	**6381**	**6780**	**6947**	**7277**	**7599**	**7824**	100%	100%	100%	100%	100%	100%	100%

PG&E's Results for SPD WITHOUT PSPS Scenario Analysis in the Wildfire Mitigation Portfolio from 10/2/2020 Slide 4

		Revised PG&E Risk Reduction Scores							Associated % of Total Annual Risk Reductions						
		2020	2021	2022	2023	2024	2025	2026	2020	2021	2022	2023	2024	2025	2026
M1	EVM	204	329	451	559	653	746	842	24%	19%	17%	20%	18%	17%	17%
M2	System Hardening	215	563	963	1418	1875	2325	2775	26%	33%	37%	50%	52%	54%	58%
M3	Non-Exempt Surge Arrestor	15	28	29	29	29	29	28	2%	2%	1%	1%	1%	1%	1%
M4	Expulsion Fuse	1	1	2	2	3	3	3	0%	0%	0%	0%	0%	0%	0%
M5	PSPS	0	0	0	0	0	0	0	0%	0%	0%	0%	0%	0%	0%
M11	Remote Grid	2	2	2	2	2	2	2	0%	0%	0%	0%	0%	0%	0%
	Cross Cutting Mitigations	396	780	1152	1541	1727	1907	1874	48%	46%	44%	54%	48%	44%	39%
	Risk Increase due to CC	0	0	0	-706	-706	-706	-706	0%	0%	0%	-25%	-20%	-16%	-15%
Total Annual Risk Reduction		**833**	**1703**	**2599**	**2845**	**3583**	**4306**	**4818**	100%	100%	100%	100%	100%	100%	100%

Controls & Mitigations: Observations – *M2, System Hardening*

Findings:

- System Hardening (SH) was provided as an example of a mitigation that was insufficiently analyzed because it aggregated many separate mitigations including:
  - The two largest system hardening programs: Covered Conductor and Undergrounding
  - Several other programs: Pole Replacements, Fuse/Cutouts & Switch Replacements, CalFIRE Certified Low Risk Equipment, and Transformer Replacements with Fire Resistant FR3 Insulation Fluid
- Calculated an RSE for the aggregated mitigation

Recommendations:

- SPD should divide M2 into individual initiatives, and only include programs directly related to Covered Conductor and Undergrounding in Risk Reduction and RSE for these individual SH Programs
- Other initiatives that are not required as part of Covered Conductor or Undergrounding should be separated into unique Mitigations with their own Risk Reduction and RSE calculations
- PG&E should provide appropriate mitigations associated with other SPD observations, findings, and recommendations for its wildfire MAVF model changes in its TY2023 GRC

Controls & Mitigations: Observations – *Wildfire Cross Cutting Mitigation Programs*

Findings:

- Largest reduction in risks: attributed to Emergency Operations Center (EOC) Enhancements (75%)
- Second largest reductio in risks: attributed to Mutual Aid Enhancements (20%)
- Unclear why CC-mitigation risk reduction benefits are not higher in 2020/ 2021 compared to later years
- REFCL technology is suitable to many of PG&E's operations

Recommendation:

PG&E should reassess how CCF Mitigation will reduce risk year by year especially if they are not capital projects that normally can take longer for implementation

Controls & Mitigations: Observations – *FERC Transmission Mitigations*

Recommendations:

- SPD recommends PG&E provide information on certain wildfire safety mitigation work in FERC proceedings in their GRC filing.

- SPD recommends that PG&E include FERC Transmission project information, identified in their FERC Stakeholder Transmission Asset Review (STAR) process, and clearly explain its wildfire risk analysis justifying work in non-HFTD and HFTD areas for its transmission assets in its RAMP update in its upcoming TY 2023 GRC filing, even if funding for transmission assets are requested in FERC proceedings.

Wildfire Alternatives Analysis

- One alternative, A3, does not replace its existing base wire, but focuses on system modifications to reduce the potential for outages that could result in ignitions.
- Another alternative is a package of system modifications that falls somewhere between the existing M2 System Hardening and the A3 alternative.

Wildfire Alternatives Analysis: Observations

Findings – Rapid Earth Fault Current Limiter (REFCL):

- Recently implemented in Australia to mitigate wildfire risks
- Most of the equipment installation occurs at the substation (does not require replacement of overhead powerlines)
- PG&E reported that REFCL will be operational for 160 HFTD circuit miles for two medium voltage Calistoga circuits; results expected by March 2021
- Cost: $12M; Risk Reduction Score: 1,511
- Estimated 92% mitigation effectiveness for line-to-ground faults
- Estimated 58% mitigation effectiveness for all ignition risks
- PG&E has 5,700 Tier 3 and 16,000 Tier 2 circuit miles where REFCL could mitigate ignition risks

Estimated RSE:126 – highest of all wildfire mitigations

Recommendation:

PG&E should consider REFCL, Early Fault Detection, and other proposed alternatives to address more granular tranches with associated RSE calculated to compare many alternatives for each tranche

Questions?

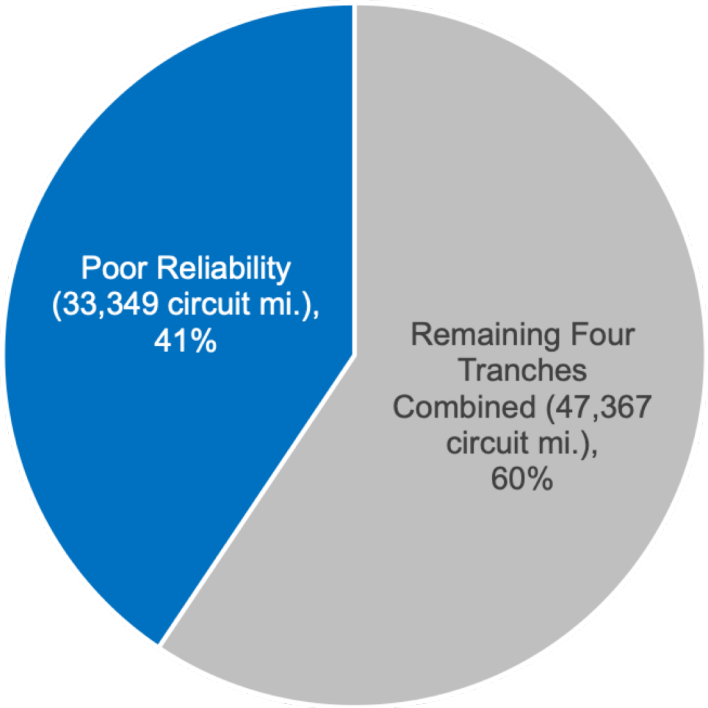
Chapter 11: Electric Distribution Overhead Assets

- Findings and Recommendations
  - Tranches
  - Risk Drivers
  - Mitigations
  - Risk Description

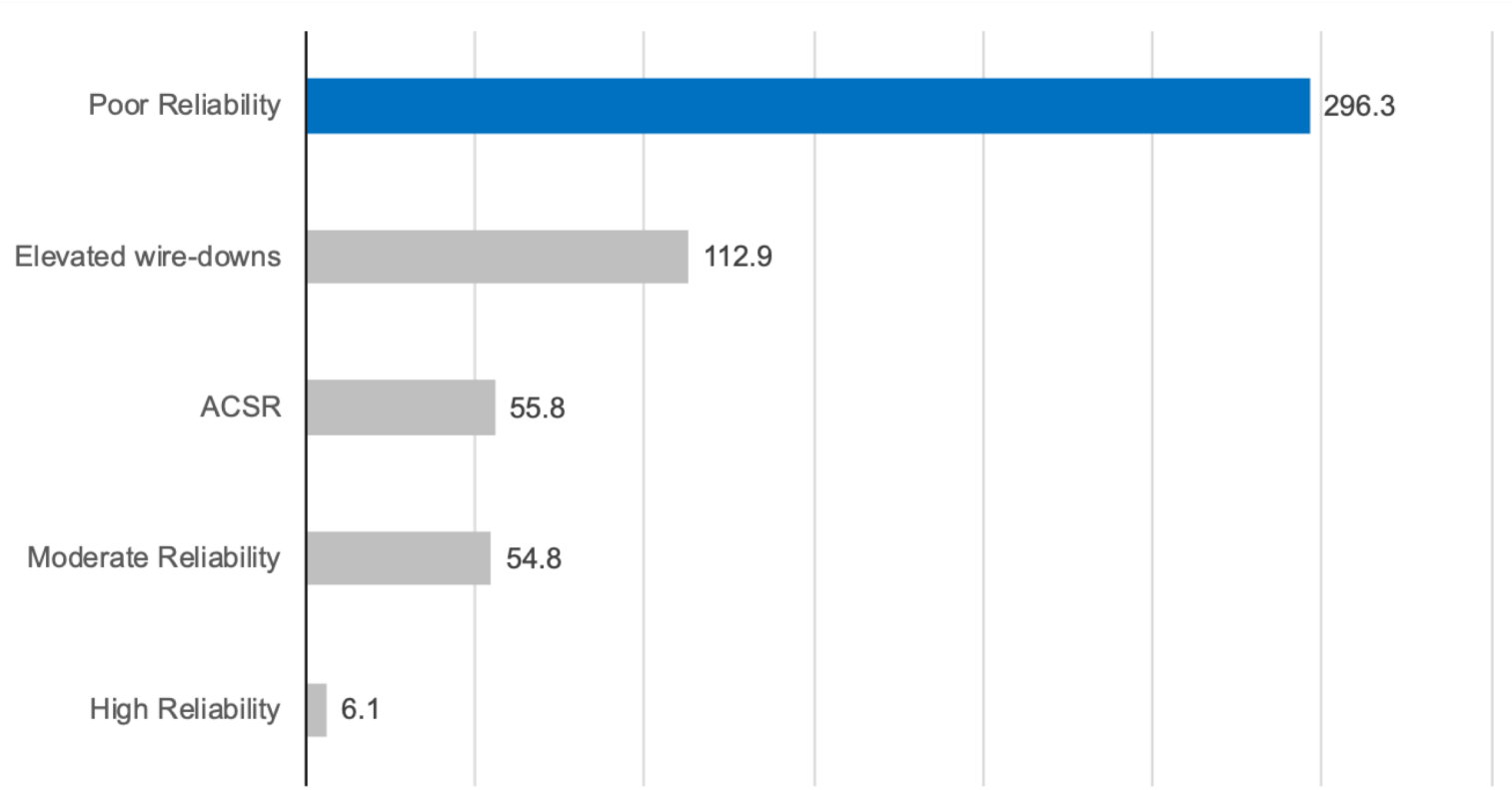
Chapter 11: Tranche Findings

- Tranches are not adequately granular, particularly the Poor Reliability Performance tranche.
- The Poor Reliability Performance tranche misleadingly represents the most vulnerable DOH circuit miles partly due to its size.
  - This tranche holds a disproportionate amount of circuit miles (41%).
  - This tranche has the highest Total Risk Score (TRS) among all tranches.
  - When evaluated as TRS per Circuit Mile (*1,000), this tranche ranks as the second (and not first) vulnerable tranche, after ACSR in Corrosion Zones, by nearly 3 points.

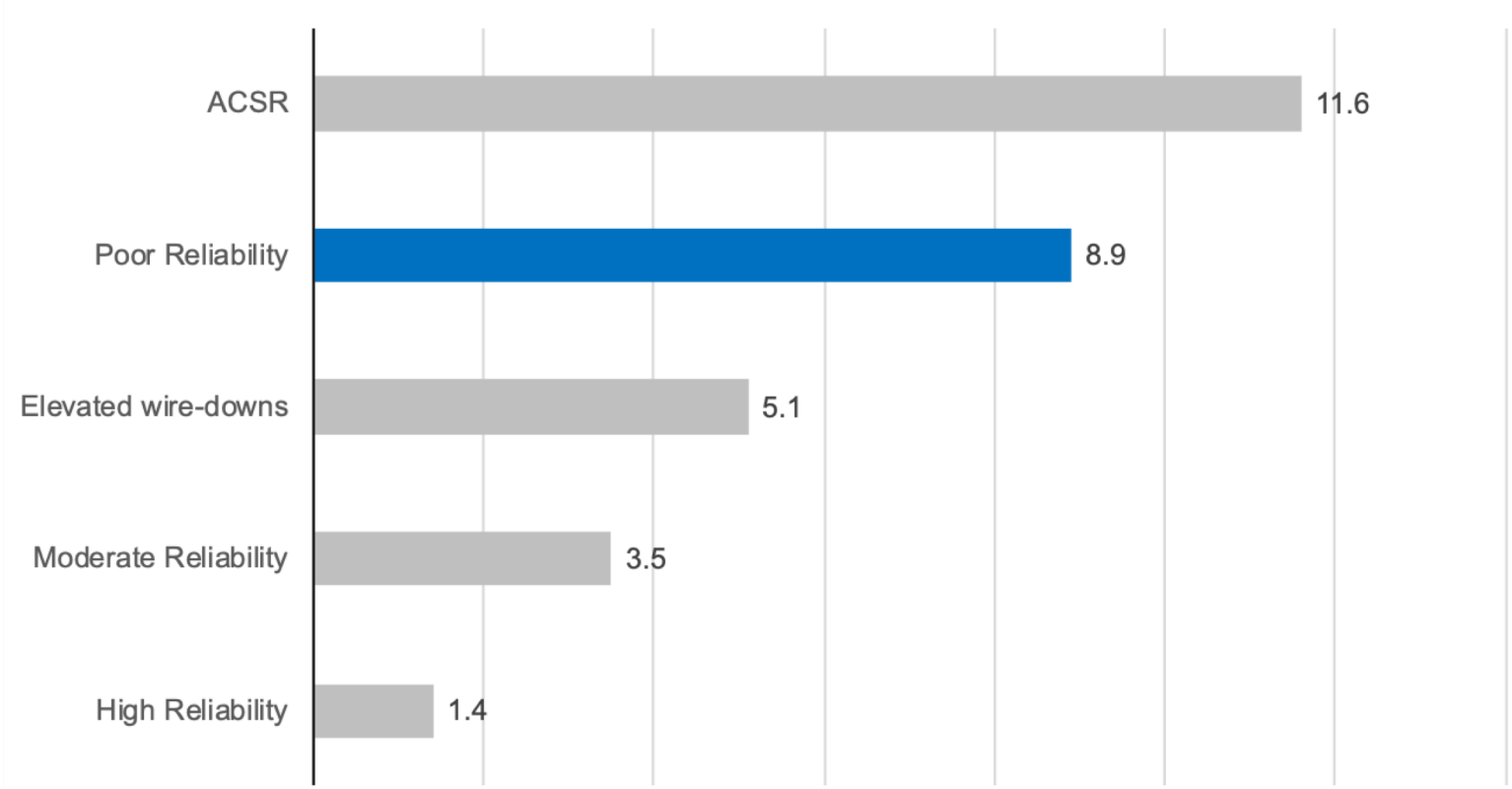
Ch. 11: Tranches, by Proportion of Circuit Miles



Ch. 11: Tranches, by TRS



Ch. 11: Tranches, by TRS per Circuit Mile (*1,000)



Chapter 11: Tranche Recommendations

- Develop more granular tranches for DOH assets, particularly the Poor Reliability Performance tranche
  - Re-examine available data
  - Consider application of machine learning techniques
  - Consider mitigations proposed by SMEs that would help the utility think about ways in which assets are prioritized according to common risk characteristics
  - Consider creating tranches (or sub-tranches) according to well-defined geographic areas, such as counties, if the circuits within each area largely represent homogenous risk profiles

Chapter 11: Risk Driver Findings

- PG&E's second largest risk driver for this risk section is "Other."
- Accounts for 7,348 (30 percent) of the 24,834 annual expected number of outages.
- Risk driver "Other" is define as "failure events without known causes."
- Controls and mitigations cannot be specifically targeted to address risk drivers without known causes.
- Efforts to mitigate "Other" could result in suboptimal safety spending efficiency.

Chapter 11: Risk Driver Recommendations

- Consider additional efforts to identify the root cause of the undetermined outages labeled "Other."
- Consider use of machine learning techniques or artificial intelligence to that could group or sort conditions or characteristics within the "Other" category to create more specific risk drivers.
- New tools and techniques, e.g., line sensors, enhanced infrared imaging, and other tools being used in HFTD areas.

Chapter 11: Mitigation Findings

- PG&E discussed three mitigations – M1-EVM, M2-System Hardening, and M4-Expulsion Fuse Replacement – that are only being implemented in the PG&E's HFTD areas.
- All three mitigations are primarily intended as mitigations for the Wildfire risk.
- PG&E applies the full expenditure value of these mitigations in the Wildfire section.

Chapter 11: Mitigation Recommendations

- Consider how DOH asset risk reductions and RSEs are being address specifically, particularly in HFTD areas, but also in non-HFTD areas.
- Consider RSE calculations on controls as well as mitigations.

Chapter 11: Risk Description – Findings and Recommendations

- **Finding:**
  - Include known safety risks to the public due to the interaction with any failed electric distribution overhead asset including energized wire-down powerlines.
- **Recommendation:**
  - Include risk analysis based on outage and wire-down data including whether the latter is energized versus non-energized.
  - If historical SIF data is lacking for this risk, then industry data may be an appropriate alternative to estimate risk outcomes.

Chapter 7: LoC Gas Transmission

- Chapter follows expected format.
- Not clear whether baseline frequency adjusted to 2023.
  - PG&E should clarify, and adjust outcomes if needed.
- Very low RSEs for high cost, especially compared to Wildfire.
  - Rate case should weigh investments.
- Consider adding operator alert to backhoe-mounted device for the alternative mitigation.
  - Could improve success of dig-in prevention.

Chapter 8: LoC Gas Distribution

- Chapter follows expected format.
- Number of gas risers vs number of customers.
  - PG&E should explain difference.
- Low RSE and high costs.
  - Compare investments in the rate case.
- Different risk profile for vintage plastic.
  - PG&E should attempt more granular tranches.

Chapter 9: Large Overpressure Downstream

- Chapter follows expected format.
- Scope of mitigation M4 is not clear.
  - Explain stations that cannot use slam-shut OPP?
- Downstream pipelines with different risk profiles.
  - Review more granular tranching.

Other Chapters: Findings and Recommendations

- **Chapter 12 – Electric Distribution Network Assets**

  SPD finds that a useful metric for prioritizing tranches within a risk but also across risks is by computing the TRS per circuit mile.

- **Chapter 13 – Large Uncontrolled Water Release (Dam Failures)**

  SPD recommends that PG&E revisit the model used to estimate fatalities and injuries for floods. While the model referenced by PG&E may be adequate, it was developed in the early 1990s. Since that time, a large body of work has examined and proposed alternatives and revisions to the model that warrant consideration by PG&E.

- **Chapter 14 – Real Estate and Facilities**

  SPD recommends that PG&E provide a full analysis of its relocation of SFGO buildings to Oakland, including any risks associated with the transition.

Chapter 15: Third Party Safety Incident

- **Risk divided into four tranches of equal exposures:**

1. Third-party interaction with electric operations assets and job sites;
2. Third-party interaction with gas operations assets and job sites;
3. Third-party interaction with PG&E managed land and water; and
4. Third-party interaction with power generation assets.

- **Main concern is the tranches are too broad and do not have homogeneous risk profiles.**

Chapter 16: Employee Safety Incident

- SPD finds that tranches lack sufficient granularity; PG&E should revisit tranches that encompass Field Employees to provide data applicable to different crew types and duties.
- 40% of employees are Field Employees (~82% of risk score) with Tranches that lack sufficient granularity.
- PG&E should revisit tranches that encompass field personnel to provide data applicable to different crew types.

  e.g. overhead electric distribution crew members, overhead electric transmission crew members, gas distribution crew members, and gas transmission crew members.

Chapters 17, 18, and 19

- **Chapter 17 – Contractor Safety Incident**
- **Chapter 18 – Motor Vehicle Safety Incident**
- SPD has no critical observations on Chapters 17 and 18.
- **Chapter 19 – Other Safety Risks:**

  PG&E should consider breaking out the Nuclear Core Damaging Event risk into its own risk chapter and providing a more thorough analysis along the lines of the more significant risks found in the other chapters of the 2020 RAMP, as it was a point of concern for multiple stakeholders.

Chapter 20: Cross-Cutting Factors

- Climate Change
- Cyber Attack
- Emergency Preparedness and Response (EP&R)
- Information Technology (IT) Asset Failure
- Physical Attack
- Records and Information Management (RIM)
- Seismic
- Skilled and Qualified Workforce (SQWF)

- Table 20-1 (impacts on likelihood) and Table 20-2 (impacts on consequence) seem to have a lot of questionable blank cells.
- Example, cyber attack only has impact on likelihood of the dam failure risk, but not on the likelihood of other risks.
- PG&E will continue to evaluate their impacts in second half of 2021 prior to filing GRC.

Thank you!

California Public Utilities Commission