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August 10, 2022 VIA ELECTRONIC FILING

Office of Energy Infrastructure Safety
California Natural Resources Agency
715 P Street, 20th Floor
Sacramento, CA 95814

RE: MUSSEY GRADE ROAD ALLIANCE COMMENTS ON PG&E RESPONSES TO 2022 WILDFIRE MITIGATION PLAN REVISION NOTICES

The Mussey Grade Road Alliance (MGRA or Alliance) files these comments pursuant to the Office of Energy Infrastructure Safety Issuance of Revision Notice for Pacific Gas and Electric Company's 2022 Wildfire Mitigation Plan Update and Notice of Extension of Office of Energy Infrastructure Safety's Determination Per Public Utilities Code 8389.3(a),[1] requiring PG&E to respond to all issues by July 26, 2022, and allowing stakeholder comments by August 10, 2022. PG&E responded timely to these revision notices with a number of filings that are addressed in the following comments.

The Alliance reply comments are authored by the Alliance expert, Joseph W. Mitchell, Ph.D.

Respectfully submitted this 10th day of August, 2022,

By: /S/ ***Diane Conklin***

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[1] 2022-WMPS; Office of Energy Infrastructure Safety Issuance of Revision Notice for Pacific Gas and Electric Company's 2022 Wildfire Mitigation Plan Update and Notice of Extension of Office of Energy Infrastructure Safety's Determination Per Public Utilities Code 8389.3(a); May 26, 2022. (Revision Notice)

MUSSEY GRADE ROAD ALLIANCE COMMENTS ON PG&E RESPONSES TO 2022 WILDFIRE MITIGATION PLAN REVISION NOTICES

The Mussey Grade Road Alliances' (MGRA or Alliance) comments on PG&E's response to Office of Energy Infrastructure Safety (Energy Safety or OEIS) revision notices are authored by Joseph W. Mitchell, Ph.D.[2]

1. INTRODUCTION

Energy Safety's revision notices cover a number of general topics, including Risk Assessment and Mapping, Grid Design and System Hardening, Asset Management and Inspections, Vegetation Management and Inspections, Grid Operations and Protocols including EPSS, and Resource Allocation Methodology.[3] MGRA's comments on PG&E's responses are divided into two sections, the first dealing with themes that are reflected in multiple issues raised by OEIS and the second dealing with specific PG&E Revision Notice responses.

2. ISSUES

2.1. Failure to Adequately Incorporate Extreme Winds in Planning Models

As previously noted in its Wildfire Mitigation Plan (WMP) Reply Comments,[4] MGRA identified issues with utility models during the 2021 Wildfire Mitigation Plan cycle.[5] MGRA's 2021 work was to provide evidence that the majority of catastrophic fires in California were wind-driven, and that specifically the faults that ignited them were wind-driven. MGRA continued its analysis with the 2022 WMPs.[6] To briefly summarize MGRA's findings:

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[2] M-bar Technologies and Consulting, LLC; http://www.mbartek.com; Email: jwmitchell@mbartek.com. Dr. Mitchell is also a board member of the Mussey Grade Road Alliance.

[3] Revision Notice; pp. 2-3.

[4] 2022-WMPs; MUSSEY GRADE ROAD ALLIANCE REPLY TO STAKEHOLDER COMMENTS ON THE 2022 WILDFIRE MITIGATION PLANS; April 18, 2022; p. 1.

[5] 2021-WMPs; MUSSEY GRADE ROAD ALLIANCE COMMENTS ON 2021 WILDFIRE MITIGATION PLANS OF PG&E, SCE, AND SDG&E; March 29, 2021; pp. 14-38.

[6] 2022-WMPs; MUSSEY GRADE ROAD ALLIANCE COMMENTS ON 2022 WILDFIRE MITIGATION PLANS OF PG&E, SCE, AND SDG&E; April 11, 2022; pp. 17-43.

- All three major utilities use time-aggregated synoptic weather data to measure conditions at geographic points used in risk analysis, rather than time-specific event data.
- Utility planning models also use "worst case" weather day for fire spread modeling of catastrophic fire events.
- None of the utility planning models incorporates a conditional probability that a common driver accounts for both outages and resulting catastrophic fire spread.
- Utility operational models, however, clearly show an extreme wind dependency on outage rates.
- Utility models show an outsized contribution from external agent ignitions (vehicle collisions, animals, balloons, and 3rd party contact) that is not represented in catastrophic fire histories.
- By incorrectly assessing risk from some drivers, the additional risk of catastrophic fires from ignition in areas prone to fire weather winds will be underestimated.

While PG&E made a number of improvements in version 3 of its Wildfire Distribution Risk Model (WDRM), these still do not correctly incorporate the increased likelihood of an outage resulting in a catastrophic fire under high wind condition, and in fact introduce additional bias. By incorrectly assessing risk from wind, PG&E's WDRM planning model also fails to address a key driver of low-cycle fatigue failure. Issues resulting from failure to correctly address extreme wind conditions therefore have consequences for Issues RN-PG&E-22-01, RN-PG&E-22-03, and RN-PG&E-22-04.

2.1.1. PG&E fails to address low-cycle fatigue (RN-PG&E-22-01)

RN-PG&E-22-01 notes that:

"Several of the fires in PG&E's service territory had similar causes over a relatively short time interval, such as the failure to remove idle facilities, low cycle fatigue, and issues associated with line terminations."

"PG&E did not explain what actions, including timelines, it is taking to address low cycle fatigue and issues associated with line terminations, both of which were factors in the cause of the Kincade Fire."[7]

MGRA review has not found anywhere in PG&E's Revision Notice responses where low-cycle fatigue is directly addressed. This in itself is an insufficiency in the PG&E response. This issue is further aggravated by the strong dependency of low cycle fatigue on wind speeds.

All utilities observe a dramatic increase in outage rates as wind speed increases.[8] As described in Mitchell 2009,[9] this relationship can be driven by a number of physical causes. One of the potential contributors is fatigue failure of materials comprising components of the electrical infrastructure. As derived in the cited reference, as components approach their point of failure they will enter the plastic regime, and as this occurs will show a probability of failure per unit time with the following relationship to wind speed:

$$dP(v)/dt \sim v^{-2/b}$$

where b is 0.5 – 0.7 for most metals. Therefore, the rate of fatigue failure is expected to vary as a power of 3 to 4 of wind speed.

Failure to account for wind speed distributions across the landscape in planning models will therefore lead to incorrect deployment of resources needed to address areas where infrastructure is most at risk from fatigue failure.

2.1.2. PG&E Risk Models Mis-Weight Catastrophic Wildfire Drivers (RN-PG&E-22-01)

As noted in MGRA's 2022 WMP Comments, SCE and SDG&E have enterprise and planning risk models that predict a large contribution from external agent ignitions: 3rd party,

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[7] Revision Notice; p. 4.
[8] MGRA 2022 WMP Comments; pp. 38-39.
MGRA 2021 WMP Comments; pp. 20-25.
[9] Mitchell, J.W., 2009. Power lines and catastrophic wildland fire in Southern California, in: Proceedings of the 11th International Conference on Fire and Materials. Citeseer, pp. 225–238. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.469.2877&rep=rep1&type=pdf

animals, balloons, and vehicles.[10] PG&E's enterprise risk model likewise predicts a significant contribution from 3rd party and animal contact:

FIGURE 10-2
RISK BOW TIE – HFTD ONLY

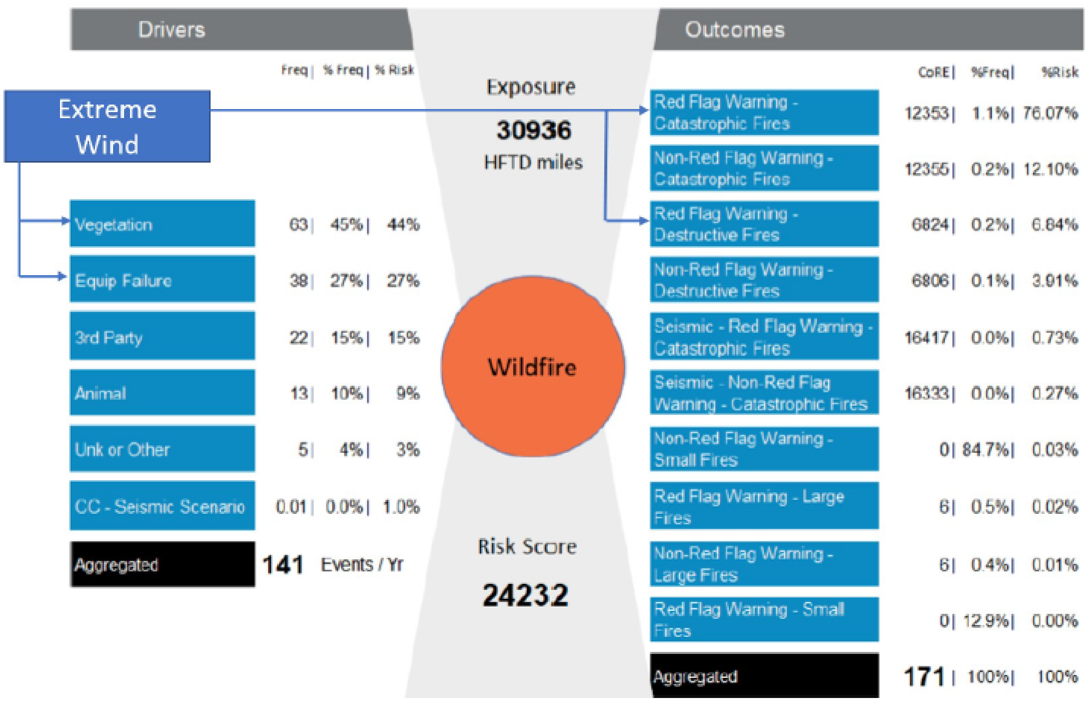

Figure 1 - MGRA version of PG&E's RAMP bow tie diagram, which shows a significant contribution of 3rd party and animal ignition drivers.[11]

As was demonstrated by PG&E's execution of a sensitivity analysis for MGRA as part of the RAMP proceeding, PG&E demonstrated that risk drivers are in fact wind-dependent:

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[10] MGRA 2022 WMP Comments; pp. 31-37.

[11] CPUC A.20-06-012; MUSSEY GRADE ROAD ALLIANCE COMMENTS ON THE PACIFIC GAS AND ELECTRIC COMPANY 2020 RISK ASSESSMENT AND MITIGATION PHASE REPORT AND THE SAFETY POLICY DIVISION STAFF EVALUATION REPORT; January 15, 2021; p. 13. (MGRA PG&E RAMP Comments)

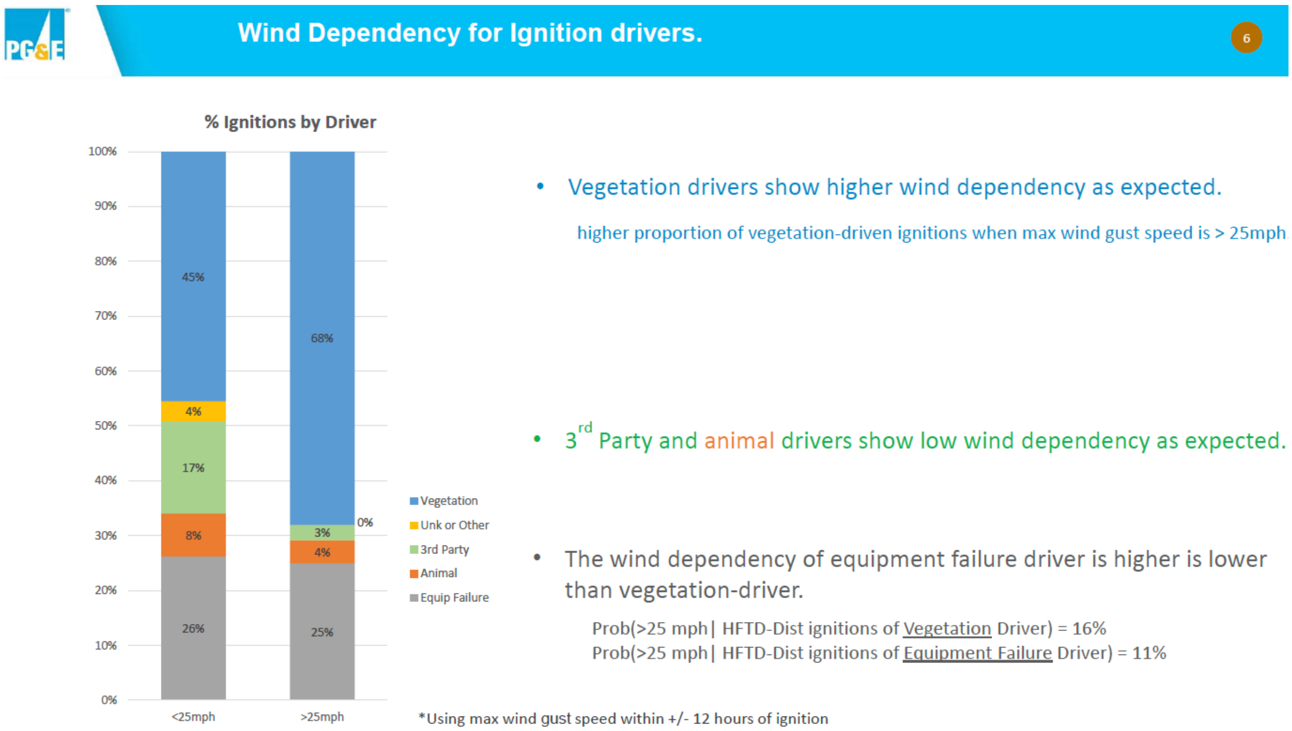

Figure 2 - Results of a PG&E RAMP sensitivity analysis showing that ignition drivers are wind-dependent.[12]

In its response RN-PG&E-22-01, PG&E provides details for all wildfires over 500 acres linked to electrical equipment between 2017 and 2021, including detailed cause information.[13] Of the 23 wildfires attributed to its equipment, 15 were associated with vegetation, 6 were associated with equipment, 1 was associated with an animal, 1 was unknown, and 1 was due to a 3rd party.

Looking at the ignition frequency, it is evident that ignitions from vegetation contacts are slightly overrepresented while ignitions from external agents are underrepresented in the large fire sample, though the statistical significance is weak:

[12] MGRA PG&E RAMP Comments; Appendix B; p. 6.
[13] Pacific Gas and Electric Company 2022 Wildfire Mitigation Plan Response to Revision Notice RN-PG&E-22-01 RN-PG&E-22-06 RN-PG&E-22-07 RN-PG&E-22-08 RN-PG&E-22-10 RN-PG&E-22-11 RN-PG&E-22-13; June 26, 2022; pp. 2-10. (PG&E June 26 RN Response)

Predicted and observed major fires for PG&E, 2016-2020

Driver	Ign Rate %	Observed	Expected	Chi2	Yates
Veg Contact	45	15	10.80	1.63	1.27
Other	4	1	0.96	0.00	0.22
Animal	9	1	2.16	0.62	1.28
3rd Party	15	1	3.60	1.88	2.67
Equipment	27	6	6.48	0.04	0.15
Total	100	24	24	4	6

P - Chi2	0.38331951
P - Yates	0.2326661

Table 1 - PG&E fires over 500 acres and their causes, compared to PG&E's risk model probabilities. Normal chi squared and chi squared with Yates correction were calculated. $\chi^2_{Pearson} = \sum (O - E)^2 / E$ where E is the expected number and O is the observed. Probabilities were calculated with the Excel function CHISQ.DIST.RT, using 5 degrees of freedom.

Results from SCE major fires are shown below for comparison.

Predicted and observed major fires for SCE, 2015-2020

Driver	Ign Rate %	Observed	Expected	Chi2	Yates
Vehicle	7	0	0.88	0.88	2.17
Balloon	13	0	1.52	1.52	2.69
Veg Contact	11	4	1.28	5.79	3.86
Other Contact	6	0	0.67	0.67	2.04
Animal	13	1	1.52	0.18	0.69
Wire Contact	5	2	0.55	3.85	1.65
Vandalism	5	0	0.55	0.55	2.00
Equipment	42	5	5.03	0.00	0.05
Total	100	12	12	13	15

P - Chi2	0.06213238
P - Yates	0.03409584

Table 2 - Pearson Chi-squared goodness of fit[14] comparing observed major fire causes against ignition probabilities. It can be seen that the probability that the observed pattern arises from the predicted distribution is low. Using the "Yates" correction used for sparse bins the hypothesis that the ignition probability distribution predicts catastrophic fire probability can be excluded with statistical significance ($P < 0.05$).

The SCE data shows somewhat more statistical significance regarding external agent-driven ignitions (3rd party, balloons, animals, vandalism, vehicle) versus potentially weather driven ignitions (equipment, vegetation).

Re-binning the PG&E data into agent/non-agent classifications allows slightly more statistical significance to be assigned:

Driver	Ign Rate %	Observed	Expected	Chi2	Yates
Non-Agent	72	20	16.56	0.71	0.52
Agent	28	3	6.44	1.84	2.41
Total	100	23	23	3	3

P - Chi2	0.11014742
P - Yates	0.08681547

Table 3 – Statistical analysis of PG&E ignition data binned into Agent (balloon, 3rd party, vehicle, animal) and Non-Agent (vegetation, equipment) to improve statistical power. Probabilities were calculated with the Excel function CHISQ.DIST.RT, using 2 degrees of freedom.

It is also worth noting that if we look at *catastrophic* fires – causing fatalities or the loss of more than one home – then *all* of the drivers for these fires are "Agent" caused and none of them are "Non-Agent". However, using this as a basis for statistical analysis does not increase significance, since the number of overall number of observations is smaller and this limits statistical strength.

While the conclusions that can be drawn from the analysis of any individual utility or incident lack statistical power, it is the same story over and over again: Black Friday, 2009 – Ignition drivers all "non-agent", 2007 Southern California Fire Siege – 9 utility ignitions,[15] and the current (2022) utility contributions to the top 20 California fires listed by Calfire (measured by

[14] $\chi^2_{Pearson} = \sum(O - E)^2/E$ where E is the expected number and O is the observed. $\chi^2_{Yates} = \sum(O - E - 0.5)^2/E$. Probabilities were calculated with the Excel function CHISQ.DIST.RT, using 8 degrees of freedom.

[15] Mitchell, J.W., 2013. Power line failures and catastrophic wildfires under extreme weather conditions. Engineering Failure Analysis, Special issue on ICEFA V- Part 1 35, 726–735. https://doi.org/10.1016/j.engfailanal.2013.07.006

deaths, structures lost, or acres burned) – all equipment or vegetation related. In aggregate, the evidence that agent-caused ignitions are under-represented in the utility risk models is substantial. For example, if we were to combine the expected and observed agent and non-agent related ignitions from the PG&E and SCE sample we would see a much more statistically significant effect:

Driver	Observed	Expected	Chi2	Yates
Non-Agent	31	24.09	1.98	1.71
Agent	4	10.91	4.38	5.03
Total	35	35	6	7

P - Chi2	0.01168126
P - Yates	0.00943576

Table 4 - Statistical analysis of combined SCE and PG&E ignition data binned into Agent (balloon, 3rd party, vehicle, animal) and Non-Agent (vegetation, equipment) to improve statistical power. Probabilities were calculated with the Excel function CHISQ.DIST.RT, using 2 degrees of freedom.

This is not to imply that agent-related causes cannot cause catastrophic fires, or that catastrophic fires can only be caused during high wind events – the Dixie and Butte fires provide examples of the latter. However, wind related drivers have been the predominant contributor to utility risk as represented by historical losses, and physical models lead us to expect to continue to be the greatest source of utility risk. Therefore accurate risk models must correctly take geographic dependency of wind-related drivers into account. The current utility planning models do not do so because they mis-weight the drivers. This needs to be remedied in upcoming model versions, and mitigation planning must take these uncertainties into account. No major spending programs that depend on results of PG&E's planning model should go forward until discrepancies are resolved.

Recommendations:

Utilities should investigate incorporating conditional probability per driver per consequence simulation, since this would allow current utility wind/outage models to be leveraged to provide the most accurate predictions.

Urgency: Class B – This approach will require development by the utilities. PG&E should be required to present a plan for incorporation of conditional probabilities in its next quarterly update.

2.2. PG&E Risk Models are Not Stable

While PG&E claims to have made many advances when moving from Version 2 to Version 3 of its WDRM, there are no reasons to believe that these improvements and modifications are final, or that the next version will not show equally divergent results for risk scores and rankings.

As part of its 60 Day Revision Notice Response,[16] PG&E compared WDRM risk scores and rankings for version 2 and version 3. The results have been collected and plotted below:

[16] TN11183_20220726T095911_Attachment_to_PGE’s_2022_WMP_–_60Day_Revision_Notice_Response_–Projects.xls

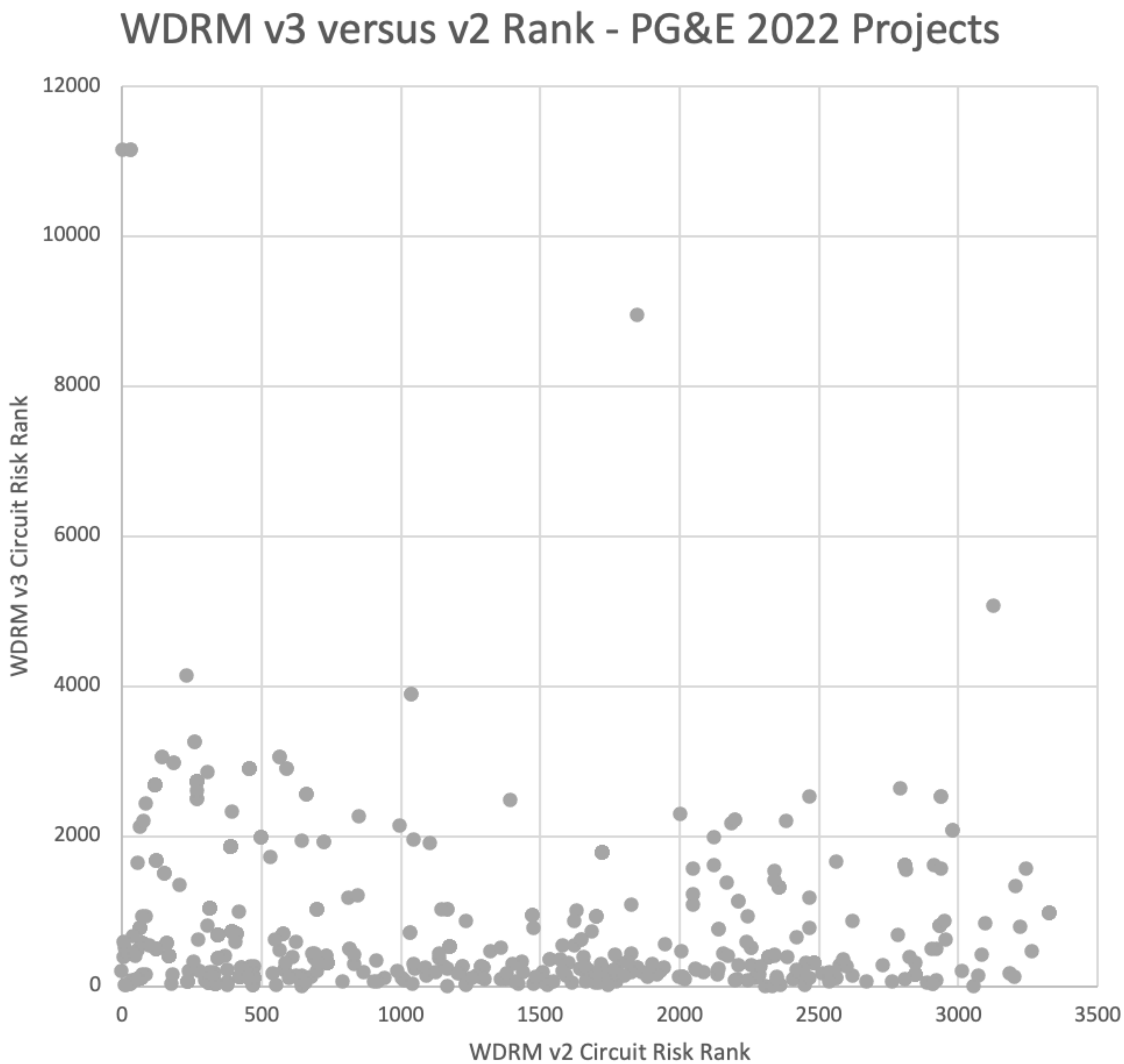

Figure 3 - PG&E circuit risk rankings as determined by WDRM v2 and WDRM v3, as shown by data in PG&E's 60 day revision response.

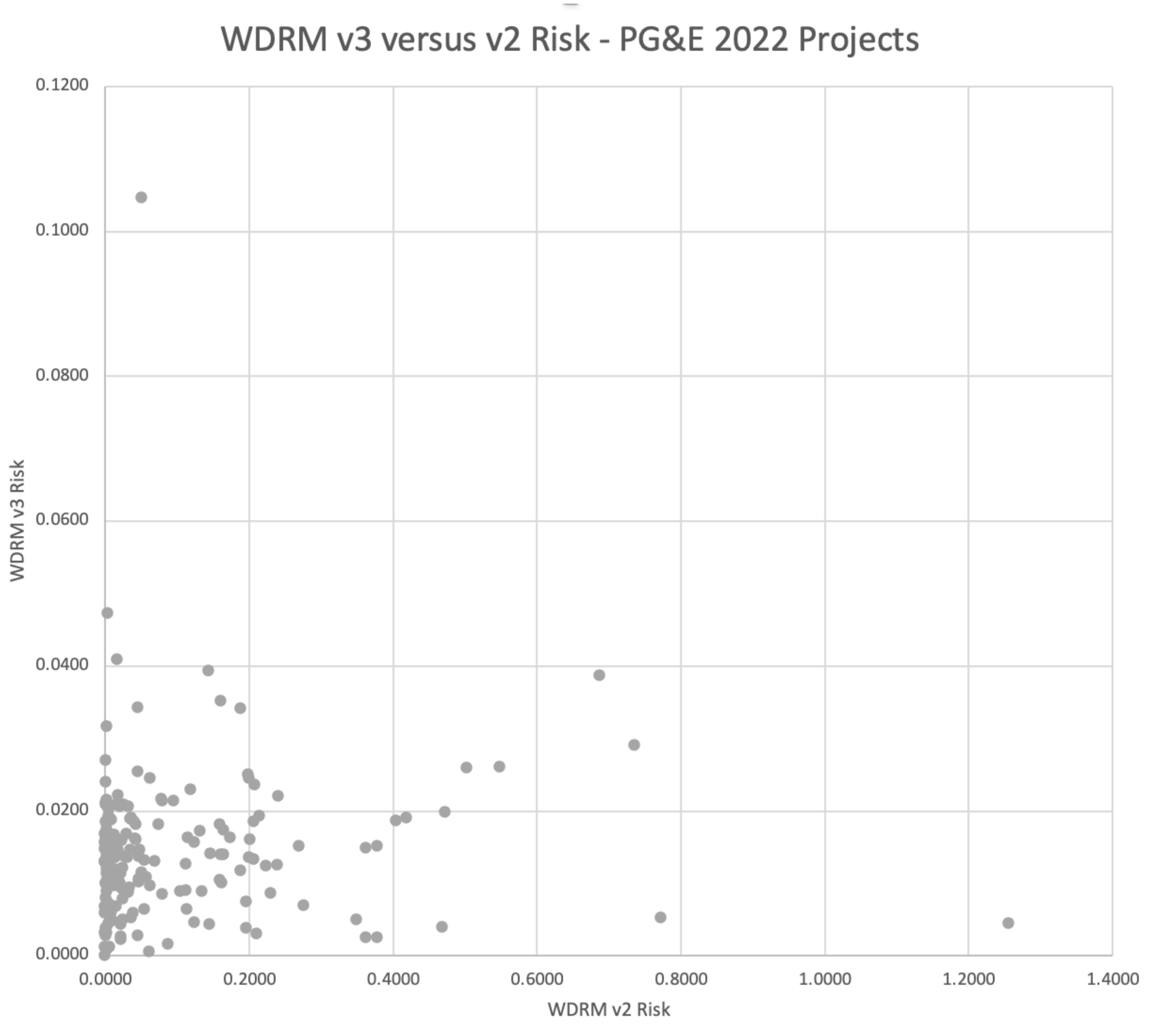

Figure 4 - PG&E risk values as determined by WDRM v2 and WDRM v3.

As seen in the figures above, the risk values and the relative risk ranking from WDRM v2 show little correlation with those of WDRM v3. While WDRM v3 is intended to be an improvement over v2, the comparison of these models show exactly how dependent PG&E's results are on modeling assumptions. MGRA's analysis has demonstrated that there are still a number of reasons to doubt the accuracy of some of PG&E's assumptions, so it is highly likely that 'v4', when it arrives, will derive significantly different risk scores and rankings than v3 currently provides.

These uncertainties shake the foundation of the assumption that PG&E can most effectively reduce risk by concentrating mitigation on areas that have the greatest risk as determined by its models. RN-PG&E-22-03 states that "PG&E is not adequately focusing grid hardening work, particularly undergrounding, on highest-risk areas based on risk model output."[17] To focus extremely expensive mitigation efforts on areas that may in fact not be at the highest risk is potentially counterproductive. Instead, expensive hardening efforts should be limited until utilities can make further headway in validating their risk models against historical loss data and properly incorporate known physical effects and contingent probabilities. In the meantime, utilities should improve operational countermeasures and increase funding of technological solutions.

3. REVISION NOTICE RESPONSES

3.1. PG&E'S EPSS Program is More Aggressive than Other Utilities (RN-PG&E-22-12)

In PG&E's second Revision Notice Response, it provides data from its EPSS program current as of June 2022.[18] In it, PG&E states that between January 1, 2022 and June 30, 2022, its system experienced 590 outages, affecting 511,500 customers and causing 100.3 million customer minutes of outage. PG&E claims that these settings have lowered its ignition rate by 80%.[19] As part of its response, PG&E also provided a benchmarking report from Applied Technology Services (ATS) comparing its EPSS program to the "fast trip" settings of other electric utilities.[20] This report lays out the technical details of how "fast trip" is implemented at each of the reporting utilities. While there are some technical differences from utility to utility regarding how fast trip is implemented, the goal of these programs is essentially the same: to reduce the probability of a high energy fault.

Where PG&E's program appears to be distinct, leading to both the benefits and harms of the program, is *when* the settings are implemented, not how. Both SCE and SDG&E require extreme weather conditions – Red Flag Warning or Fire Weather Threat (SCE)[21] or extreme FPI or forecasted PSPS events (SDG&E)[22], while PG&E has opted to trigger on HFTD circuits under much less severe weather conditions, including *any* (not all) of the following: FPI of R3 (out of 5),

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[17] Revision Notice; p. 7.
[18] TN11119_20220711T152358_20220711_PGE_2212_RNR_R2_Atch05_EPSS
[19] PG&E June 27 RN Response; p. 17.
[20] Utility Benchmarking of Fast Trip Schemes and Relay Technologies for Fire Mitigation; Applied Technology Services (ATS).
[21] Id; p. 11.
[22] Id; p. 13.

relative humidity below 20%, projected wind speeds over 25 mph, or dead fuel moisture less than 9%.

The question Energy Safety needs to ponder as it determines whether PG&E's EPSS program is admirable or abhorrent is not whether it dramatically reduces ignitions – it apparently does – but to what extent that it reduces the potential for *catastrophic* fire compared to other mitigations such as PSPS. This is in fact a general problem with utility approaches, as described in Section 2.1 – not all ignitions are equal in their potential for catastrophic damage. Reducing ignitions by 80% does not necessarily reduce residual fire risk by 80%. To date, none of the EPSS residual ignitions have resulted in fires over 100 acres.[23] This needs to be examined in more detail to determine the actual risk reduction achieved by the EPSS program.

Recommendation:

The CPUC's Safety Enforcement Division contracted with Technosylva to run simulations of potential damage from "PSPS damage" events found in post-shutoff patrols. While uncalibrated these cannot be directly used to determine avoided losses, the Technosylva reports dramatically demonstrate that utility power shutoff in 2019 likely averted major catastrophic fires.[24] Likewise, to validate EPSS effectiveness, PG&E should run match drop simulations for EPSS outages at the point of where the fault occurred, and under identical weather conditions.

Urgency:

This should be provided by PG&E by the end of 2022.

4. CONCLUSION

MGRA appreciates the opportunity to comment on PG&E's responses to Energy Safety's Revision Notice. Some issues noted by OEIS have at their root cause the same issue that MGRA has repeatedly raised in its comments both in OEIS and CPUC fora: specifically that utilities in general do not correctly incorporate driver-specific conditional probability linkages between

[23] 2022-WMPs; PG&E Data Request Response WMPDiscovery2022_ DR_MGRA_002-Q01Atch0 and WMP-Discovery2022_DR_MGRA_002-Q02; TN11119_20220711T152358_20220711_PGE_2212_RNR_R2_Atch05_EPSS.xlxs

[24] California Public Utilities Commission; Technosylva 2019 PSPS Event Wildfire Risk Analysis Reports https://www.cpuc.ca.gov/consumer-support/psps/technosylva-2019-psps-event-wildfire-risk-analysis-reports

outages and catastrophic outcomes. We plan to continue work within the Modeling Working Group to help utilities develop future models that will more accurately predict catastrophic fire risk.

Respectfully submitted this 10th day of August, 2022,

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