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Transmittal via email: wildfiresafetydivision@cpuc.ca.gov and R.18-10-007 service list

RE: MUSSEY GRADE ROAD ALLIANCE COMMENTS ON 2020 REMEDIAL COMPLIANCE PLANS OF SDG&E, PG&E, AND SCE

Dear Director Thomas Jacobs:

The Mussey Grade Road Alliance (MGRA or Alliance) serves these comments pursuant to the WSD Guidance letter of July 17, 2020,[1] which authorizes public comment on Remedial Compliance Plans (RCPs) and Quarterly Reports (QRs).

The following Alliance comments were prepared by MGRA's expert witness, Joseph W. Mitchell.

MUSSEY GRADE ROAD ALLIANCE COMMENTS ON 2020 REMEDIAL COMPLIANCE PLANS OF SDG&E, PG&E, AND SCE

As a general note, the Remedial Compliance Plans (RCPs) contain much subject material, and are accompanied by additional data. There is insufficient time to do a proper analysis of these submissions in a two week timeframe, so the following notes comments be regarded as a cursory review. WSD should take the opportunity to do additional analysis on the IOU submissions and open them up during future review and WMP cycles. Some issues may require more urgent attention by WSD, and these are noted below.

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[1] Guidance on the Remedial Compliance Plan & Quarterly Report Process Set Forth in Resolution WSD-002; Caroline Thomas Jacobs; July 17, 2020.

1. WSD-002; CONDITION GUIDANCE-3: LACK OF RISK MODELING TO INFORM DECISION-MAKING

1.1. SDG&E

In contrast to fairly extensive discussions of risk modelling by SCE and PG&E, SDG&E's is abbreviated and lacks detail. It provides only a high-level overview of programs, during which it discusses a new initiative called WiNGS (Wildfire Next Generation System), which builds upon the Risk Spend Efficiency (RSE) methodology from RAMP. Of particular concern is the fact that SDG&E envisions this new program as a mechanism that "determines each segment's wildfire and PSPS risk level based on the segment's unique characteristics that are driven by its location."[2] No methodology for determining the risk from power shutoff to the public has yet been accepted by WSD or the Commission, however, and in fact WSD has explicitly warned the IOUs against using RSEs to justify PSPS.[3]

Recommendations:

- WSD should require additional detail from SDG&E regarding its risk estimation programs. SDG&E's offering is inadequate.
- WSD should set up a public design review for SDG&E's WiNGS initiative in order to ensure that it will meet the requirements of WSD and the Commission. We have observed numerous instances in the 2019 and 2020 WMP process where IOUs have carried out detailed, extensive, and sometimes expensive programs only to have flaws found by reviewers during the WMP process. An early design review will help to ensure that SDG&E's new program will meet regulator and public expectations.
- If SDG&E intends WiNGS to reduce PSPS risks, it will need to demonstrate how it is modeling these risks.

1.2. PG&E[4]

1.2.2. Additional Detail in PG&E's Response

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[2] SDG&E RCP; p. 3.
[3] WSD-002; p. 20.
[4] PACIFIC GAS AND ELECTRIC COMPANY 2020 WILDFIRE MITIGATION PLAN; REMEDIAL COMPLIANCE PLAN; RULEMAKING 18-10-007; JULY 27, 2020. (PG&E RCP)

PG&E has submitted a fairly detailed description of its risk modelling. We recommend that WSD request some additional information about these issues:

- In Table 1, PG&E states that for system hardening (SH), its capabilities for risk estimation for distribution circuits look at relative risk of circuit segments while estimation for transmission circuits look at probability of failure as a function of wind speed. It is not clear from this whether PG&E looks at wind speed with regard to its distribution circuit risks, as it should.
- On page 5, of its RCP, PG&E discusses its Distribution Vegetation model, which uses "a multi-variable regression algorithm to forecast the annual probability of ignitions, outages and wire-down events at a 100m x 100m pixel level…" PG&E should be asked to present this algorithm for review in a future filing or its 2021 WMP.

1.2.3. Errors in PG&E's Outage Producing Winds (OPW) Model

PG&E presents its Outage Producing Wind model (OPW) in a separate supporting document for its risk modeling section, in which it describes the meteorological and fire risk considerations that go into its shut-off decisions.[5] During the 2020 WMP review, PG&E did not wish to disclose details of its OPW as a public document,[6] and MGRA did not review it at that time. The OPW is important in that it is a primary tool that PG&E uses to set its de-energization thresholds. In its Fire Risk document, PG&E discusses the OPW in some technical detail, and apparent flaws in the model are evident even in a cursory review.

PG&E's OPW uses ten years of climatology data modeled on a 3 X 3 km grid by PG&E and compared to its historical outage data. PG&E then analyzed the probability of an outage based on wind speed.[7] It displays an example of its outage rate predictions for Redding, California in Figure 8:

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[5] Attachment 1-1; PACIFIC GAS AND ELECTRIC COMPANY; CALCULATING METEOROLOGICAL AND PG&E FIRE RISK; PG&E PSPS DECISION-MAKING; May 15,2020; REV.1; PG&E Emergency Preparedness & Response (EP&R) / PG&E Meteorology and Fire Science. (PG&E Fire Risk)
[6] MUSSEY GRADE ROAD ALLIANCE COMMENTS ON 2020 WILDFIRE MITIGATION PLANS OF SDG&E, PG&E, SCE; April 7, 2020; p. 61. (MGRA 2020 WMP Comments)
[7] Id; pp. 23-26.

Figure 8: Example wind to outage model fits for a location near Redding, CA

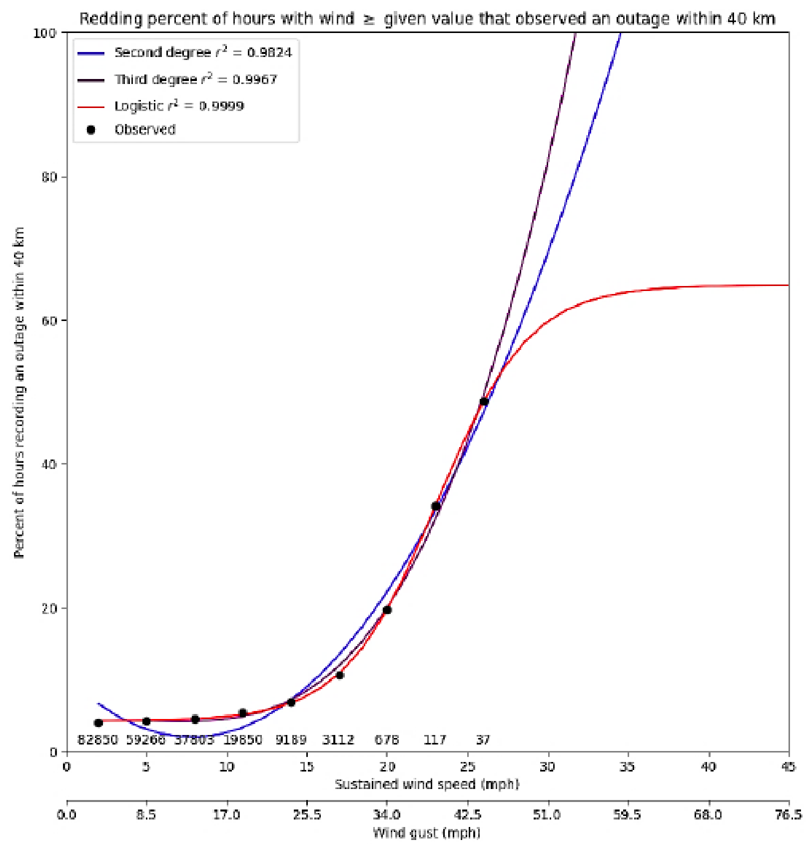

Figure 1 - Figure 8 from PG&E Fire Risk document; p. 25, showing percentage of hours recording an outage within 40 km of Redding, CA as a function of sustained and continuous gust speeds.

PG&E staff attempted several fits to the data, as shown above. It included a fit to velocity squared, based on the physical observation that force varies as velocity squared, a quadratic function, which fits better, and a logistic function, which has a saturation point at 60%. These approaches exhibit a variety of statistical and physical errors.

The most obvious observation is that the above graph is a "cumulative distribution function" (CDF), that shows the probability that an event will occur for a given condition. Fit to a v^2 function or higher-order quadratic function would *never* be appropriate for a CDF, because it will always be constrained by having a probability of 1.0 (100%) as an upper limit, and quadratic functions increase without bound. Even if the physical hypothesis of proportionality of failure rate to force were correct, plotting this relationship in a CDF would require converting the failure rate function to a cumulative function, which would have an upper limit of 100%.

Mitchell 2009[8] discusses some of the physical effects driving power line fire ignitions. Any contact due to elastic distention of equipment or trees would be proportional to wind force, which is proportional to wind speed squared, v^2. Fatigue failures might be expected to show a dependency of v^n where n is between 3 and 4. However, probably the greatest statistical effect is that all components are engineered, designed and maintained to certain tolerances, and as a system reaches a tolerance failure rates increase rapidly. A Weibull distribution is often used to characterize this failure rate. Lognormal distributions are sometimes also used to characterize stress-related failures.[9] *Mitchell 2013*[10] shows that for SDG&E outage data the curve outage rate versus wind curve is extremely steep, showing an increase of a factor of 10 for each 15-20 mph in wind gust speed, possibly consistent with the leading edge of an extreme value distribution.

PG&E chooses instead to use a logistic function, which is generally used to characterize systems having exponential growth rates such as pandemics, which is why it refers to a "growth" parameter,[11] rather than a statistical model used for reliability analysis. It chose this function because it reaches a maximum value, as a CDF must. The PG&E distribution system consists of a massive and diverse ensemble of components with different properties, and one would not expect a simple model of any type to fit exactly, and so phenomenological curve-fitting is acceptable. However, this curve fitting must observe physical constraints, and PG&E makes a serious additional error of setting a maximum outage fraction of 60% from "scrutinizing the tail of the wind-outage distribution".[12] This assumption yields physically absurd results. From PG&E's fitted model, the curve in red in Figure 1, one would expect an outage probability of 60% for 60 mph winds. One would also expect an outage probability of 60% for 80 mph winds. In fact, one would expect and outage probability of only 60% for 243 mph winds, which would be remarkable if it were true. Physical properties and logic dictate that the maximum outage fraction will be 100% for extreme winds. The fact that PG&E observes a saturation at 60% in its analysis indicates there is a severe systematic flaw somewhere in that analysis, and the source is not obvious from PG&E's cursory description. This is disturbing, because the

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[8] 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.

[9] See, for example, "Fatigue and Reliability Analysis with Time-Varying Stress Using the Cumulative Damage Model"; Reliability Hot Wire; 200; October 2017. https://www.weibull.com/hotwire/issue200/hottopics200.htm (Downloaded 8/8/2020)

[10] 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

[11] PG&E Fire Risks; p. 25.

[12] Id/ pp. 24-25.

OPW is a critical component of PG&E's de-energization threshold determination and affects whether or not millions of people will be subjected to power shutoff, or conversely, to utility-ignited wildfire.

Recommendation:

- WSD needs to conduct an urgent technical review of PG&E's Outage Producing Winds model.

1.3. SCE

1.3.2. SCE Hardening and PSPS Planning Should Incorporate Extreme Fire Weather

SCE's description of its risk modeling for its hardening programs and for its de-energization planning show inconsistencies that are due to inadequate modeling of extreme fire weather. SCE states that: "Since PSPS is significantly influenced by expected and observed weather conditions at a particular time, circuit segments at high risk of PSPS do not necessarily coincide with circuit segments that have high risk score based on probability and consequence of ignition estimated based on ***average conditions*** at that location. Therefore, current initiatives for reducing ignition risks do not necessarily target areas that experienced PSPS." (emphasis added). It is critical to note that catastrophic wildfires very rarely start under average conditions, but instead are ignited under extreme wind and FPI conditions. If SCE hardening prioritization is based only upon average conditions it may not be correct. Areas most likely to be the source of catastrophic fire ignitions should also be expected to be the most subject to PSPS, and one would expect these to have highest priority for hardening.

Recommendation:

- SCE's risk scores should properly incorporate probability and consequences of ignitions during extreme weather conditions, and this should be used to set priorities.

2. VEGETATION MANAGEMENT – SDG&E-13, SCE-12, PGE-26

SDG&E, SCE, and PG&E state that they have been meeting to agree on methodologies to measure the effect of post-trim distances on the probability of outages and ignitions. This is a positive step, and should over time provide useful data. The IOUs' decision to measure outage rates year round, and not just during fire season,[13] should be supported as this will greatly improve the

[13] PG&E RCP; p. 50.

statistical accuracy of the results – both through increasing the size of the statistical sample and also because fire season data may be biased by PSPS events, which will create “blind spots” in outage and ignition records. SDG&E[14] and SCE[15] state that “fall-in” data will be excluded from the data set, as this is more applicable to the “danger tree” program.

Recommendation:

- The IOUs should also separately collect and coordinate “fall-in”/“blow-in” data that relates to trees outside of the typical clearance distances, as these are also fire ignition causes.
- “Fall-in”/ “Blow-in” data should be used to validate SCE’s “tree risk calculator”.[16]

3. PG&E’S LACK OF GRANULAR DETAIL – PGE-1

PG&E has provided updated data tables in its submission as Attachment 1. PG&E’s new submissions provide little additional granularity and should be deemed insufficient by WSD. PG&E’s new “Effectiveness of initiative at reducing ignition risk” column is insufficient in that it only provides a qualitative description of the initiative’s value and does not provide a quantitative estimate. Also, the only additional program granularity appears to be PG&E’s covered conductor program, and comparison to PG&E’s hardening program shows that these two programs have identical risk scores and RSEs, leading to the conclusion that PG&E considers these identical programs.

Recommendations:

- WSD should request quantitative estimates of “effectiveness of initiative at reducing ignition risk” or require that PG&E provide a reason why such an estimate cannot be provided.
- PG&E should break its covered conductor and hardening programs into separate initiatives.

4. PG&E’S HIGH INCIDENCE OF CONDUCTOR FAILURE – PGE-3

PG&E was required by the WSD to present a root cause analysis for its abnormally high rate of conductor failure. In its response, PG&E has included a study performed by the National

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[14] SDG&E RCP; p. 5.
[15] SCE RCP; p. 5.
[16] SCE RCP; p. 18.

Electric Energy Testing, Research and Applications Center (NEETRAC), which it had submitted as part of its 2020 GRC filing in 2018.[17]

4.1. The NEETRAC Report Does Not Consider Wind-Driven Aging

NEETRAC performs an analysis of PG&E conductor failure as a function of time using a Weibull statistical analysis. NEETRAC's analysis clearly shows the increasing fraction of conductor failure with time (Figure 3), and show an aging failure mode for segments older than 20 years.[18] NEETRAC concludes that without an accelerated replacement schedule, PG&E's conductor failure rate will continuously increase with time.[19]

One issue not considered in the NEETRAC report is wind as a driver of accelerated aging. While NEETRAC considered geographic area in its analysis, these were only broad region classifications and did not consider areas with extreme winds. In fact, the word "wind" is not mentioned in the NEETRAC report. "Cumulative damage" models in reliability and mechanical engineering, such as Miner's Rule, account for the fact that damage leading to failure accumulates as a function of stress over time.[20,21] Overall stress will be higher in high-wind areas, and one would expect that these areas will exhibit accelerated aging of conductors. Furthermore, one would expect from first principles that conductor failure is most likely during extreme wind events.

Recommendation:

- WSD should require PG&E to give priority to high wind areas in the HFTD to target its conductor replacement program.

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[17] Attachment PGE-3-Atch1-1; Georgia Tech/National Electric Energy Testing, Research, and Applications Center (NEETRAC); PG&E Distribution Wire Longevity Study; NEETRAC Project Number: 17-158; Final Report; March 2018 (NEETRAC Report)
[18] Id.; p. 14.
[19] Id.; p. 27.
[20] See, for example: "Miner's Rule and Cumulative Damage Models"; Reliability HotWire; Issue 116; October 2010. https://www.weibull.com/hotwire/issue116/hottopics116.htm (Downloaded August 9, 2020)
[21] Mitchell, 2009.

4.2. PG&E's Conductor Wire Down Rates Underestimate Weather Effects

At WSD's direction, PG&E analyzed its conductor wire down data with respect to age, type, condition and weather. It provides its results for data between 2014 and 2019 in its Figure 10,[22] shown below:

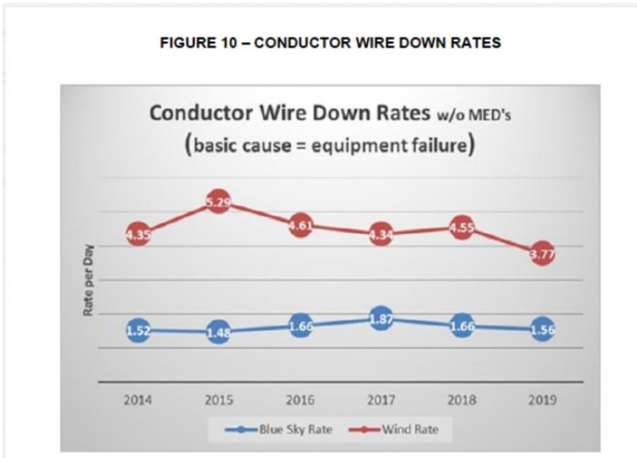

Figure 2 - PG&E Conductor wire down rates due to equipment failure.

PG&E's ratio of conductor wire down rates on windy days between 2014 and 2019 is 2.76, averaging over the results for each year. However, this result significantly underestimates the actual conductor down rate. An important caveat is that PG&E excludes data from "major event days", with the justification that there is no time for a root cause analysis on those days. However, from the extremely steep outage dependencies shown in Mitchell 2013 and in PG&E's OPW model, one would expect that they are discarding a major portion of their wire down data.

PG&E also notes that it currently has difficulty correlating conductor wire down events with its OPW model.[23] As noted previously, there appear to be serious issues with PG&E's OPW model, and these should be urgently investigated.

Recommendation:

- In addition to the analysis PG&E has provided, it should additionally present "unfiltered" wire down data that includes the Major Event Days as well. It should break major event days into their own category in addition to the weather condition bins it has already chosen.

[22] PG&E RCP; p. 24.
[23] Id.; p. 25.

5. CAUSES OF NEAR MISSES, SCE-2

In its original WMP submission, SCE classified 74% of its root causes as "Other".[24] WSD directs SCE to conduct additional analysis on its "Other" cause category. In response, SCE has issued new tables as part of its RCP with additional subcategories for "Other".[25]

Of particular concern are fault types that are more likely to occur during extreme weather conditions. The reclassified "Other" event categories that are more likely to occur during severe weather conditions would be OTHER and No Cause Found. As indicated by the data, events in these categories can cause ignitions. It is reasonable to postulate that these events are due either to transitory object contact or transitory equipment faults. To compare, object contact is responsible for 19 ignitions per year in HFTD Their 2 and 3 while equipment failure is responsible for 9.8 ignitions per year. The unclassified faults add 3.4 ignitions per year to either of these categories, which would potentially be a 10% increase due to this reclassified category.

Additionally, we note that wire-to-wire contact has its own classification. As properly designed and built equipment should not be subject to wire slap, this should more properly be classified as a sub-category of equipment/facility failure.

Recommendation:

- WSD should request that SCE reclassify wire-to-wire contact as a subcategory of equipment failure.

Respectfully submitted this 10th day of August, 2020,

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[24] SCE RCP; p. 1-1.
[25] SCE-02 Revised 2020 WMP Tables 11&18