UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
BEFORE THE PETITION REVIEW BOARD

In the matter of	
Pacific Gas and Electric Company	Docket Nos. 50-275, 50-323
Diablo Canyon Nuclear Power Plant	Seismic Shutdown Petition
Units 1 and 2	June 7, 2024

SUPPLEMENTAL DECLARATION OF PETER BIRD, Ph.D

Under penalty of perjury, I, Peter Bird, declare as follows:

I. INTRODUCTION

1. My name is Peter Bird. I am Professor of Geophysics and Geology, Emeritus at the University of California at Los Angeles (UCLA). On March 4, 2024, I submitted to the U.S. Nuclear Regulatory Commission (NRC) a declaration in support of a petition by San Luis Obispo Mothers for Peace, Friends of the Earth and Environmental Working Group (Petitioners) for shutdown of the Diablo Canyon nuclear power plant (DCPP) due to the unacceptable risk of a seismic core damage accident. In this Supplemental Declaration, the shutdown petition will be referred to as “Petition” and my supporting declaration will be referred to as “Bird March 4, 2024 Declaration.”

2. I reaffirm that the facts stated in my March 4, 2024 Declaration are true and correct to the best of my knowledge and that the opinions expressed therein are based on my best professional judgment.

3. On March 28, 2024, Petitioners received an email from Perry Buckberg of the NRC, stating that the NRC Staff had determined that immediate closure of DCPP was not necessary and that the concerns raised by the Petition had been referred to a Petition Review Board (PRB). On May 15, 2024, in another email from Perry Buckberg to the Petitioners, the PRB reported its “initial assessment” that the concerns presented in the Petition and the Bird March 4, 2024 Declaration did not satisfy NRC guidance for taking action on the Petition because the issues we raised had previously been the subject of a facility-specific or generic NRC staff review and that we had not provided significant new information that the staff did not consider in a prior review. This Supplemental Declaration will refer to the NRC’s response to our concerns as the “Initial Assessment.”

4. The purpose of this Supplemental Declaration is to respond to the assertions made by the PRB in the Initial Assessment, including each of the four technical grounds for refusing to consider the Petition.

II. DISCUSSION[1]

5. At the outset, the PRB is incorrect in stating that the issues we raised in the Petition and the Bird March 4, 2024 Declaration have "previously been the subject" of a review by the NRC. We have reviewed the NRC's technical evaluations of Pacific Gas & Electric Co.'s (PG&E's) seismic studies and find no evidence that the NRC considered or even understood our concerns and the data on which they are based. The PRB's Initial Assessment continues to demonstrate the same fundamental failure to grasp our concerns or to consider the basic geological concepts and data underlying them. Instead, the PRB accuses the Petitioners of disregarding established geologic data. In making this accusation, however, the PRB fails to recognize that all of PG&E's seismic analyses are based on an artificially-limited geologic dataset, starting with PG&E's deficient Fault Geometry Models (FGMs). Starting in 2015, these deficient FGMs led to a biased Seismic Source Characterization (SSC), which led to a biased Seismic Probabilistic Risk Assessment (SPRA). These studies grossly underestimated the frequency of seismic core damage and caused both PG&E and the NRC to falsely conclude that the seismic risk to DCPP is acceptable. The purpose of the Bird March 4, 2024 Declaration was to demonstrate the fallacy of PG&E's assumptions and their significance with respect to accident risk at DCPP.

6. On page 1, the Initial Assessment provides a summary of four specific technical concerns raised in the Petition and the Bird March 24, 2024 Declaration. Our first concern is accurately described as follows:

> Thrust faulting is neglected by Pacific Gas & Electric Company's (PG&E's) 2012 Seismic Source Characterization (SSC) model, because the model assumes that a majority of large earthquakes affecting Diablo Canyon are strike-slip and disregards the significant contribution of thrust faulting earthquake sources under the Diablo Canyon site and the adjacent Irish Hills. In addition, PG&E did not use a hanging-wall term for the modeling of potential ground motions from the Los Osos and San Luis Bay thrust faults.

7. In response, the PRB states:

> *The licensee's seismic models (ML15071A045) developed in response to NRC's 10 CFR 50.54(f) request include the potential for thrust faulting, as both the Los Osos and San Luis Bay thrust faults were evaluated in great detail and considered by PG&E to be primary fault sources in the models used for the hazard calculations. For both thrust faults, the ground motion model developed by PG&E includes a hanging wall term to incorporate the potential for higher ground motions. The NRC staff assessment (ML16341C057) of PG&E's 2015 seismic*

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[1] Note to the reader: In the discussion below, quotations of the PRB's summaries of my principal concerns are underlined. Quotations from the PRB's assessment of my concerns are italicized.

hazard reevaluation includes confirmatory calculations of the hazard from both the Los Osos and San Luis Bay thrust faults and concludes that the licensee adequately characterizes the seismic hazard for Diablo Canyon, including the potential for thrust faulting near the site.

8. But the PRB's response perpetuates two fundamental errors by PG&E that yield a gross underestimate of the seismic hazard at DCPP, *i.e.,* by almost two orders of magnitude. First, the PRB accepts assumptions by PG&E of thrust fault dips that range from the unlikely to the impossible. Our contention regarding the Los Osos thrust fault is that it should be modeled with a dip of ~25° like most other thrust faults in the lab or in the field, worldwide. But PG&E (2015; 2015L; 2024) assigned alternative dips of 30° or 50° or 80°, assigning a combined weight of 70% to the dips of 50° to 80° in their logic-tree. But dips of 50° or 80° are mechanically impossible; such faults would not slip under the present horizontal compressive stress regime. Due to the irrationally step dips assumed by PG&E, PG&E also assumes that the FGM variant fault planes within the seismogenic (upper-crustal) portion of the Los Osos thrust fault does not pass below DCPP. The combined distance from DCPP and the excessive dip angle artificially and severely reduced the hanging-wall effect at DCPP in PG&E's hazard models.

9. Second, we estimate that the total slip rate in all thrust-faulting under the Irish Hills is about 2.8 mm/year. As discussed in the Bird March 24, 2024 Declaration, this estimate was confirmed by three different analytical methods. We also consider that the topographic symmetry of the Irish Hills implies a slip-rate for the Los Osos thrust fault of about half of this, or ~1.4 mm/year. However, PG&E modeled this fault as having a slip-rate of 0.2 or 0.4 mm/year, which is too low by a factor of 7 to a factor of 3.5, respectively.

10. The net result of these two errors was that PG&E underestimated the hazard at DCPP from the Los Osos thrust fault by factors of about 12 to 24, or more than one order of magnitude.

11. PG&E also incorrectly minimized the significance of the San Luis Bay fault. PG&E assigned unphysical dips of 45~75°, which would be implausible or impossible, respectively. Furthermore, PG&E assigned 90%-confidence slip-rates of 0.24~0.46 mm/year to this fault. As discussed in (Bird, 2023) a slip-rate of 0.76~1.04 mm/year is justified as follows:

> According to the geologic map of Fig. 13-16 [of PG&E's SSC] and associated cross-section C-C' (Fig. 13-17), the apparent throw (vertical offset) of stratigraphic unit Tmo Obispo Formation is 1.6~2.2 km across the Shoreline fault trace. . . . None of this can be explained by strike-slip on the Shoreline fault, because its slip-rate is very low and because regional strikes of bedding are roughly parallel to it. Instead, the simplest explanation is thrust-faulting, either on the Shoreline fault (if it is not actually vertical), or on another northeast-dipping

> fault plane, such as a NW extension of the San Luis Bay thrust fault, that shares the surface trace of the Shoreline fault. Assuming a typical thrust-fault dip of 25°, the amount of slip required to create this throw is (1.6~2.2 km) / sin(25°) = 3.8~5.2 km. Then, assuming this occurred since ~5 Ma . . . the mean rate of slip on the inferred thrust fault has been 0.76~1.04 mm/a.

Finally, in many of PG&E's FGM model variants, this fault terminates to the South of DCPP, so that DCPP is not within its hanging-wall. This assumption is inconsistent with the geology (specifically, the present form of the once-horizontal Obispo Formation beds) showing that thrusting continues northwestward along the coast in the Inferred Coastline thrust fault.

12. Most importantly, we contend that there is an unrecognized Inferred Coastline Thrust fault just offshore from DCPP, with a similar slip-rate of 0.76~1.04 mm/year. Again, assuming a standard dip of ~25°, this fault would pass under DCPP at shallow depths, implying maximal hanging-wall effect (*i.e.,* increasing the intensity of shaking by a large factor relative to sites on the footwall).

13. The simplest demonstration that PG&E grossly underestimated the seismic hazard from thrust-faulting is this: In their SSC, the Los Osos and San Luis Bay faults have major seismic hazards (specifically, Peak Ground Accelerations (PGAs) over 1 g and spectral accelerations over 2 g which would cause SCD), adding up to less than the hazard from the strike-slip Hosgri fault, and consequently less than half of the total hazard. Yet, the Bird March 4, 2024 Declaration estimates that the joint hazard from the Inferred Coastline and Los Osos thrusts (alone) is ~47× greater than the total hazard (specifically, SCDF) estimated by PG&E. Together, these facts show that PG&E underestimated the hazard from thrust-faulting by a factor of at least 100, or two orders of magnitude.

14. The PRB accurately describes our second concern as follows:

> <u>The magnitude 7.5 (moment magnitude) January 2024 earthquake centered in the Noto Peninsula (Japan), with an average slip of 2 meters on the fault, is analogous to future potential thrust mechanism earthquakes beneath Diablo Canyon. Based on the slip rate of the Irish Hills adjacent to Diablo Canyon and the slip of the Noto earthquake, large thrust fault earthquakes will occur, on average, every 715 years near the Diablo Canyon site.</u>

15. In response, the PRB states:

> *The petition did not provide sufficient factual information to conclude that the 2024 Noto Peninsula earthquake can be used as an analogous thrust earthquake beneath Diablo Canyon with an associated slip of 2 meters for a magnitude 7.5 earthquake. However, PG&E, based on the estimated length (70 kilometers [km]) and width (13 km) of the Los Osos fault and using the magnitude-area relation of Hanks and Bakun (2014), estimated a maximum moment magnitude of 7.0 for the*

Los Osos fault. Similarly, PG&E modeled a maximum moment magnitude of 6.3 for the San Luis Bay fault based on its estimated length (15 km) and width (11 km). In addition to considering earthquakes on these two faults individually, PG&E also modeled several larger earthquake ruptures occurring on these two faults linked together with adjacent faults such as the Shoreline and Hosgri faults. The NRC staff assessment of PG&E's 2015 seismic hazard reevaluation concludes that the maximum magnitudes for the Los Osos and San Luis Bay faults are appropriate due to their estimated lengths and widths and that PG&E's hazard reevaluation adequately considered the potential for larger linked earthquake ruptures occurring on multiple adjacent faults.

16. This response suggests that the proper way to consider the 2024.01.01 Noto Peninsula earthquake (as an analogous source of shaking in the Irish Hills) is to reduce the earthquake to a magnitude and a fault location, and then plug these numbers into one or more Ground Motion Prediction Equations (GMPEs). This method might be acceptable for a minor source of hazard, but the analog Noto Peninsula earthquake is now seen as the major threat to DCPP. Therefore, in order to provide a reasonably accurate assessment of seismic risk to DCPP, actual seismograms from the Noto Peninsula must be used in a completely new SSC for DCPP.

17. In such a future new SSHAC Level-3 SSC for DCPP, the Technical Integration (TI) team might decide that the plausible length of a thrust rupture (combining the Inferred Offshore and San Luis Bay thrust) near DCPP is less than the length of the recent Noto Peninsula rupture. If so, they can handle this detail by truncating the Noto Peninsula seismograms at the point where seismic S waves from the "excess" (non-comparable) parts of the rupture surface began to arrive, and use these truncated Noto Peninsula seismograms to compute PGA and spectral-acceleration estimates appropriate for DCPP and the Irish Hills. However, as a seismologist, I expect that such a correction will have only a small effect, because the most intense shaking at a hanging-wall site is determined by the amount of fault slip underneath it, and by how fast this slip occurs. The total length of the rupture mostly affects the duration of shaking, but not its peak intensity.

18. We also have reason to expect that great thrust-faulting earthquakes under the Irish Hills will be more intense than in the Noto Peninsula, not less. The slip under DCPP would probably occur more rapidly, because the seismic stress-drop there would be higher than under the Noto Peninsula. Rate-and-state friction theory, as developed by Prof. James Dieterich of UC Riverside over many scholarly publications, implies that the stress-drop of an earthquake varies as the logarithm of the time since the previous earthquake on the same fault patch. Given that crustal shortening is about 5× slower under the Irish Hills (~2 mm/year vs. ~10 mm/year), the recurrence time for Irish Hills thrust earthquakes should be ~5× greater (~733 years vs. ~146 years), and the expected stress-drop will therefore be higher. Peak Ground Acceleration (PGA) at sites close to the fault is proportional to stress-drop.

19. The PRB **inaccurately** describes our third concern as follows: "<u>Uplift rates for the Irish Hills should be several times higher than the rates used by PG&E in its SSC model in 2012.</u>"

20. The neotectonic uplift rate of the Irish Hills has been determined by PG&E (or possibly by its contracted consultants) to be approximately 0.2 mm/year, based on topography and ages of uplifted marine terraces compared to a global sea-level history. This is basic geologic data, and we are willing to stipulate that this uplift rate is approximately correct.

21. The PRB confuses the two distinct concepts of uplift rate and crustal thickening. As discussed in (Bird, 2023):

> The neotectonic uplift rate of the whole Irish Hills region is uniform at 0.2 mm/a. . . . Because the Franciscan Complex basement is weak, and because there is no large isostatic gravity anomaly over the Irish Hills [Simpson et al., 1986], this uplift process should be modeled with Airy isostasy. The implied rate of crustal thickening is then about 6 times larger, or about 1.2 mm/a. If this crustal thickening is occurring on a single thrust fault of dip 25°, then its rate of slip should be (1.2 mm/a) / sin(25°) = 2.8 mm/a. Or, if the crustal thickening is driven by two oppositely-vergent and overlapping thrust faults . . . then each should have a slip-rate of ~1.4 mm/a. Obviously, more complex models with more thrust faults can be devised, but the implication for total strain and seismicity due to thrust-faulting will remain unchanged.

Since the first measurements of gravity (two centuries ago) it has been recognized that highlands have about the same mass-per-unit-area as lowlands, because highlands have crustal "roots" that mirror the surface topography but with amplitude ~5× greater, and because crust is less dense than mantle. Thus, the creation of the Irish Hills required crustal thickening much greater than the visible topography. Under Airy isostasy, therefore, the rate of crustal thickening under the Irish Hills must be about 6× larger than the uplift rate, or about 1.2 mm/year. PG&E's FGMs do not acknowledge or comply with this basis principle of geophysics, and so they are in conflict with gravity data.

22. The distinction between uplift rate and crustal thickening is important, because there is an elementary trigonometric relation between the rate of crustal thickening and the rate of thrust-faulting: (crustal thickening rate) = (thrust fault slip-rate) × sin (fault dip angle). This led us to the conclusion (and still does) that PG&E grossly underestimated the slip-rates and areas of active thrust faults under the Irish Hills.

23. Thus, our second concern should be summarized as: <u>Thrust fault slip-rates in the Irish Hills should be much higher than the rates used by PG&E in its SSC model in 2015, because they should be based on crustal thickening rates rather than uplift rates."</u>

24. In response to our third concern, the PRB states:

The petition's postulated magnitude recurrence rate of $1.4x10^{-3}$/yr for large thrust fault earthquakes near Diablo Canyon, is based on the slip (2 m) from a single earthquake in Japan (2024 Noto earthquake) and an uplift rate for the Irish Hills (2.88 millimeters per year [mm/yr]) that is several times higher rather than the rates inferred from geologic field observations in the region surrounding Diablo Canyon. Based on geologic studies in the region, PG&E assumed an uplift rate for the Irish Hills that ranges from about 0.15 to 0.35 mm/yr and apportioned this rate to several scenario thrust earthquakes in the region. The PRB concludes that a long-term slip rate of 2.88 mm/yr for the Irish Hills is inconsistent with the slip rates inferred from geologic studies in the region. The NRC staff assessment of PG&E's 2015 seismic hazard reevaluation concludes that PG&E adequately characterized the potential for thrust fault earthquakes in the vicinity of the Diablo Canyon site.

25. This objection is based on a mis-statement of our model, as detailed above in ¶¶ 19-23. Our figure of 2.8 mm/year for the Irish Hills describes the total of the slip-rates of all thrust faults of 25° dip under the Irish Hills (assuming that each of these thrust faults underlies <u>all</u> of the Irish Hills). It is not an estimate of uplift rate, for which we accept the results of PG&E studies (0.15 to 0.35 mm/year). Furthermore, if PG&E did, in fact, "partition" this uplift rate into slip-rates of their model thrust faults, they made a fatal error by ignoring the Airy-isostasy factor of ~6× for the ratio of crustal thickening rate to uplift rate.

26. The PRB accurately describes our fourth concern as follows: "<u>Seismic core damage frequency (SCDF), estimated by PG&E in 2018 to be $3x10^{-5}$, should be $1.4x10^{-3}$ per year (about once every 715 years) based on this higher recurrence rate for thrust earthquakes.</u>"

27. In response to our fourth concern, the PRB states:

The calculation of SCDF involves consideration of the seismic hazard curve and equipment fragility. Seismic hazard curves are developed based on the characterization of all potential seismic sources in the region, including their estimated fault slip rates. The PRB finds that it is inappropriate to estimate a new SCDF using modeled slip rates that are several times higher than those inferred from geologic field observations in the region surrounding Diablo Canyon. The NRC's assessment (ML18254A040) of PG&E's 2018 seismic probabilistic risk assessment concludes that PG&E adequately characterized the risk to the Diablo Canyon site.

28. Obtaining a definitive value for SCDF from all sources requires lengthy calculations; however, with our model we obtained a useful <u>lower limit</u> on SCDF by considering only the thrust faults under the Irish Hills that can produce earthquakes comparable to the 2024 Noto Peninsula earthquake. We merely noted that the PGA of 1.0~2.3 g recorded on the Noto Peninsula would be associated with 5-Hz spectral accelerations

of 2.0~4.6 g at hanging-wall sites, which would cause core damage at DCPP (according to the SPRA filed by PG&E in 2015). Therefore, the recurrence interval for SCD is almost the same as the recurrence interval for great thrust earthquakes. There is no question that these important calculations should be redone by competent and disinterested professionals to get the full value of SCDF – which I believe may be slightly higher than the already-high lower limit we have estimated.

29. We are particularly concerned by the PRB's assertion that: *"[I]t is inappropriate to estimate a new SCDF using modeled slip rates that are several times higher than those inferred from geologic field observations in the region surrounding Diablo Canyon."* In brief, we accept the validity of existing "geologic field observations." But, we find 3 fatal errors in the assumptions that PG&E used to "infer" their deficient FGMs and the resulting biased SSC. Each point will be expanded on in the following paragraphs 30 through 34.

30. The primary "geologic field observations" available to constrain the activity of thrust faults are the relative vertical offset rates (throw rates) across fault traces obtained from relative vertical offsets of quasi-horizontal features. In the case of the San Luis Bay thrust fault, these offset features are marine terraces carved in Late Quaternary time, and their ages can be obtained in multiple ways (*e.g.*, relative sea-level still-stands, amino acid racemitization in fossil shells, cosmogenic nuclide dating of exposed rocks). In the case of the Los Osos thrust fault, these offset features are river terraces which were correlated with coastal marine terraces also deposited in Late Quaternary time (*e.g.*, by Lettis and Hall, 1994). We accept these data as valid constraints.

31. The first false assumption made by PG&E in their analysis was that <u>only</u> offsets of Late Quaternary features are relevant to hazard. In fact, a detailed statistical analysis of geologic constraints on fault offset rates in the western United States by Bird (2007) found that the probability of "inapplicability" of a dated offset feature (defined in that paper, and graphed in its Figures 7 and 8) is equally low for all offset features up to 3 Ma (late Pliocene) in age, and almost as low for features of 5-6 Ma (Miocene/Pliocene boundary, or the time at which the Irish Hills began to form). Furthermore, that study concluded that a single offset feature is very rarely enough to make the fault offset rate "well-constrained;" instead, 4 offset features are needed to achieve a 50%-chance that the rate is "well-constrained," and 7 offset features are needed to guarantee it. Thus, PG&E was negligent and unprofessional in failing to consider additional geologic constraints from older offset features, such as the once-planar Obispo Formation beds. Our own analysis (*e.g.*, Figure 1 of Bird's March 24, 2024 Declaration to NRC, repeated as Figure 1 here) shows that including this feature will increase the throw-rate for the San Luis Bay-Inferred Coastline thrust system of faults. PG&E should have created one or more structure models showing how this formation (and overlying sedimentary rocks) came to be bent into the present Pismo syncline and other folds in the center of the Irish Hills. It is strikingly negligent that they never considered or attempted this.

32. The second false assumption made by PG&E is that the dip angles of thrust faults can be assigned whimsically based on very weak evidence or alleged analogies to other tectonic belts. In fact, the Mohr-Coulomb theory for frictional faulting (which is now a century old and included in every structural geology textbook) proves that these dip angles must be less than 45°, and that the specific angle depends on the coefficient of friction of the rocks. Since the vast majority crustal rocks have coefficients of friction around 0.85 (Byerlee, 1978), the appropriate and most common dip angle for thrust faults is 25°. The critical importance of correct dip is shown by 2 simple formulas: *(i)* (fault slip-rate) = (throw-rate) / sin(dip); *(ii)* Assuming a brittle-ductile transition depth of B, the (down-dip seismogenic length of a thrust fault) = B / sin(dip). Because "seismic potency rate" (per unit length of thrust fault trace) is the product of these two factors, it is extremely sensitive to dip. For example, a seismic potency rate that is correctly computed as 5.6 (using relative units) using a dip of 25° becomes a seismic potency of only 1.7 using an impossible dip of 50°, or only 1.03 using a ridiculous dip of 80°. Furthermore, characteristic earthquake frequency is proportional to seismic moment rate, and seismic moment rate is proportional to seismic potency rate. Thus, PG&E's assertion of impossibly steep dips for the 2 known thrust faults caused them to underestimate the seismic hazard from these 2 faults by factors of 3.3 to 5.4, quite apart from the throw-rate issues mentioned in PP. 31 and the fault-extension-under-DCPP issue mentioned in PP. 8 above.

33. The third false assumption made by PG&E is that only these 2 mapped thrust faults (Los Osos and San Luis Bay) can produce earthquakes. But the crustal "basement" under the folded sedimentary rocks of the Irish Hills is Franciscan Complex, which contains numerous Jurassic-Cretaceous thrust faults available for reactivation. Slip on those thrust faults would not reach the surface (allowing for mapping) because this slip encounters and folds the layered sedimentary rocks of the Pismo syncline. Thus, there are an unknown number of "blind" thrust faults active, such as those that produce devastating earthquakes under the Zagros Mountains of Iran, or in Nepal. Therefore, Bird's March 24, 2024 Declaration necessarily introduced two global measures of the total activity of all thrust faults under the Irish Hills: (i) the rate of crustal thickening inferred from the uplift rate of the Irish Hills and their (negative) isostatic gravity anomaly; and (ii) the rate of horizontal convergence along SSW-NNE axes measured by Global Positioning System (GPS) permanent stations. These essential kinds of geophysical evidence showed that the total rate of thrust fault slip under the Irish Hills is 2.2~2.8 mm/year, with the higher value preferred.

34. Because of these 3 false assumptions, the Fault Geometry Models (FGMs) produced by PG&E (2015, 2015L, 2024) are grossly inadequate and systematically deficient.

35. In addition, the FGMs in the SSC studies by PG&E (2015, 2015L, 2024) are contradicted by 3 critical facts:

a) The sedimentary beds of the Miocene Obispo Formation (which were originally flat) have been offset vertically by 1.6~2.2 km at the southwest coastline of the Irish Hills, near DCPP. This is documented in the geologic map of Figure 13-16 and the geologic section of Figure 13-17 of PG&E (2015), the latter of which Dr.

Bird modified to create Figure 1 (attached to this Supplementary Declaration). Neither the Shoreline nor the San Luis Bay faults in the FGMs from PG&E can explain this.

b) About 7 permanent Global Positioning System (GPS) stations around the Irish Hills have been recording crustal velocities continuously for a decade or more, achieving horizontal precisions of ~0.2 mm/year. These data show crustal shortening at a rate of ~2 mm/year in the SW-NE direction across the Irish Hills. Specifically, this convergence rate is from the deformation model that Shen & Bird (2022) computed for use in the 2023 Update of the USGS National Seismic Hazard Model. PG&E (2015, 2015L, 2024) never computed a horizontal shortening rate for the Irish Hills from their FGMs. Instead, PG&E ignored this critical constraint.

c) Gravity data shows that there has been major crustal thickening under the Irish Hills since they began to form ~5 Ma. In fact, the local isostatic gravity anomaly near DCPP is about -37 mGal (Chapter 6 of PG&E, 2024 Updated SSC). This shows that local crustal thickening has been <u>more</u> than enough to balance the weight of the Irish Hills. However, the FGMs of PG&E predict very minor crustal thickening, and a large positive isostatic gravity anomaly from the unbalanced weight of the Irish Hills topography.

36. Thus, in all likelihood, the 2015 and 2024 FGMs would be ruled "not technically defensible" as proposed sets of seismic sources if a new SSHAC Level-3 SSC study were performed.

37. In contrast, we have corrected the FGM to be consistent with these 3 facts by: (1) setting the dips of the Los Osos and San Luis Bay thrusts to 25° and increasing their slip-rates to ~1.4 mm/year; and (2) adding the Inferred Coastline thrust to explain the fault throw, gravity, and topography in the area around DCPP. After these corrections, seismic hazard at DCPP is dominated by these 3 thrusts (and/or additional "blind" and unmapped thrust faults in the basement), and the strike-slip faults (*e.g.*, Hosgri and Shoreline) emphasized by PG&E make only minor contributions. Our new estimate of the lower limit on SCDF (considering the 2024.01.01 Noto Peninsula earthquake as a comparable thrust event) is high enough to justify our petition for immediate shut-down.

38. In conclusion, repetition of arguments and assertions found in PG&E filings (2015, 2015L, 2024) is not an adequate basis for failing to seriously consider our new estimates of very high seismic hazard at DCPP, which are based on the same geologic data, plus additional offsets of older features, and also incorporate gravity, GPS, and stress-regime data, as well as more defensible assumptions and logic. The PRB should engage our well-supported concerns and re-evaluate the Petitioners demand for the immediate shutdown of DCPP. Before continued operation of DCPP can be allowed, the NRC should require a new and independent SSC that evaluates currently available data without skewing it towards a desired outcome.

Under penalty of perjury, I declare that the foregoing statements of fact are true and correct to the best of my knowledge and that the statements of opinion expressed above are based on my best professional judgment.

Executed in Accord with 10 C.F.R. § 2.304(d) by
Peter Bird

Date: June 7, 2024

Figure 1

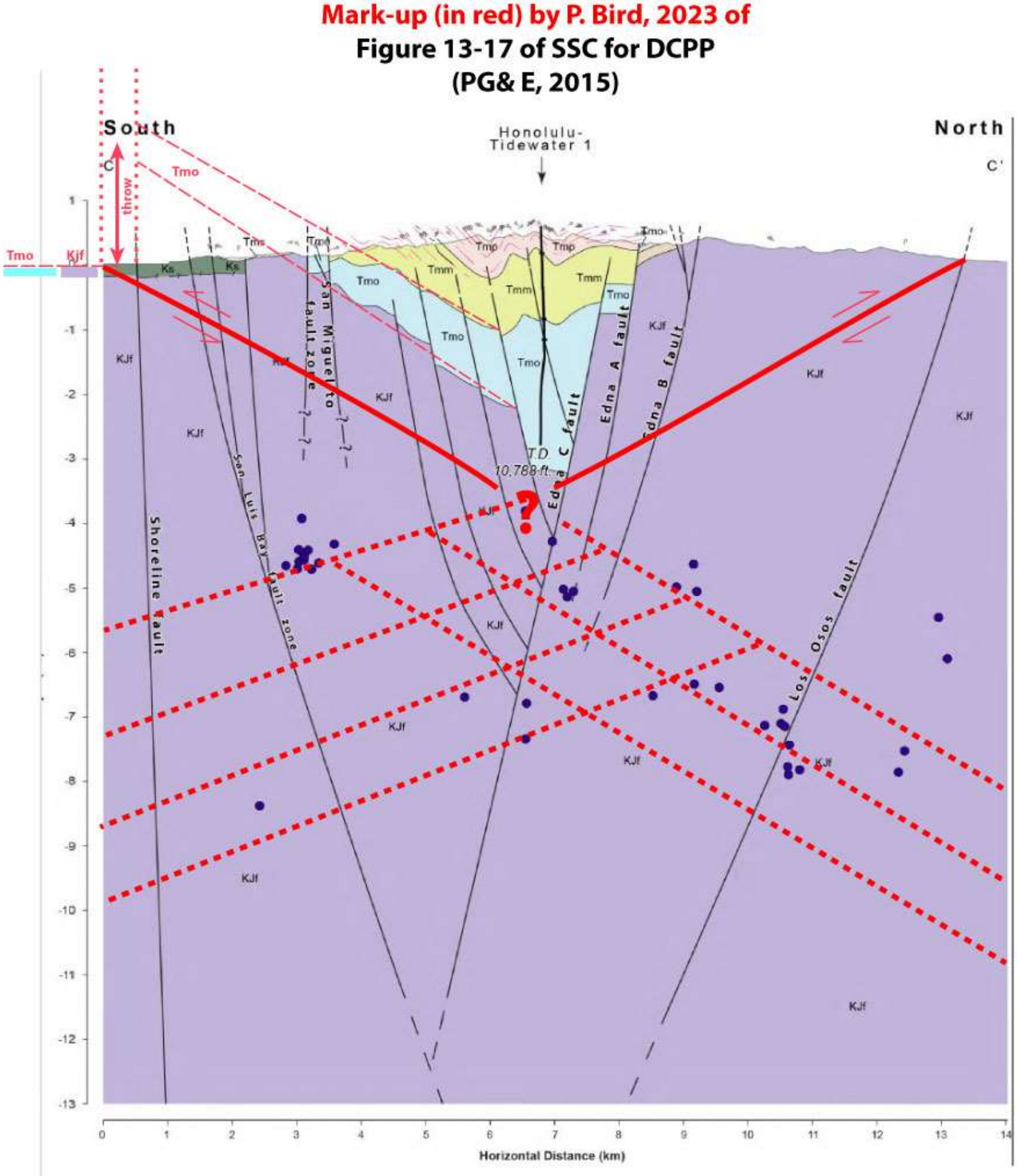

Figure 1. Revised geologic section through the Irish Hills near DCPP. The base for this figure is Figure 13-17 of the Seismic Source Characterization for DCPP (PG&E, 2015). Note that the fault dips suggested by black lines in their figure were not based on data, but were constrained by PG&E's (2015) *a priori* assumption that only strike-slip tectonics is active in the area. In red, I have suggested more plausible 25° dips for the Los Osos thrust (at right/North) and the Inferred Coastline thrust (at left/South). The upper-left portion of this figure is also edited to show the throw (vertical offset) of map unit Tmo across the Inferred Coastline thrust.

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CURRICULUM VITAE of Peter Bird was included the Bird March 24, 2024 Declaration, and is not repeated here.