UNITED STATES OF AMERICA
BEFORE THE NUCLEAR REGULATORY COMMISSION

In the Matter of	)	
Proposed Rule: Renewing Nuclear Power Plant Operating Licenses -- Environmental Review	)	Docket No. 2018-0296

COMMENTS BY SAN LUIS OBISPO MOTHERS FOR PEACE ON PROPOSED RULE AND DRAFT GENERIC ENVIROMENTAL IMPACT STATEMENT FOR RENEWING NUCLEAR POWER PLANT LICENSES

INTRODUCTION

San Luis Obispo Mothers for Peace ("SLOMFP") hereby comments on the U.S. Nuclear Regulatory Commission's ("NRC's" or "Commission's") Proposed Rule, Renewing Nuclear Power Plant Operating Licenses, 88 Fed. Reg. 13,329 (Mar. 3, 2023). These comments also address the draft environmental impact statement ("EIS") that underlies the Proposed Rule, Draft Generic Environmental Impact Statement for License Renewal of Nuclear Plants (NUREG-1437, Rev. 2, Feb. 2023) ("Draft GEIS"). These comments are supported by the attached Declaration of Dr. Peter Bird, Professor of Geophysics and Geology, Emeritus, at the University of California at Los Angeles (UCLA).

SLOMFP is a non-profit membership organization concerned with the dangers posed by Diablo Canyon and other nuclear reactors, nuclear weapons, and radioactive waste. SLOMFP also works to promote peace, environmental and social justice, and renewable energy. Since 1973, SLOMFP has participated in NRC licensing cases for Diablo Canyon, including a license renewal proceeding initiated in 2010 that was later terminated at the request of the licensee, Pacific Gas and Electric Co. ("PG&E").

PG&E has stated that it intends to submit a new license renewal application in late 2023. SLOMFP intends to participate in the NRC proceeding for consideration of the application. Therefore, we seek to preserve a meaningful opportunity to participate under the National Environmental Policy Act ("NEPA") and the Atomic Energy Act. No meaningful opportunity to participate in that proceeding can be provided if the NRC relies on an inadequate GEIS to exclude significant environmental issues from the license renewal proceeding.

COMMENTS

The Draft GEIS is inadequate to satisfy NEPA because the NRC has failed to justify treating the environmental impacts of re-licensing nuclear reactors as a generic issue. Nor has the NRC justified its generic finding of no significant impact. In support of its position, SLOMFP hereby adopts and incorporates the comments of Beyond Nuclear, Inc. and the Sierra Club, Inc. that have also been filed today in this rulemaking docket. SLOMFP also adopts and incorporates by reference the comments of Natural Resources Defense Council.

In addition, SLOMFP proffers additional evidence demonstrating that generic treatment is unjustified for any conclusions regarding accident risks at the Diablo Canyon nuclear plant. As demonstrated in Dr. Bird's attached declaration, the Draft GEIS fails to satisfy NEPA because its conclusion that the environmental impacts of externally initiated accidents are small is unsupported. In particular, the NRC fails to support the assertion that "new information" from external event probabilistic risk assessments (PRAs) is "not significant" for purposes of revising an earlier conclusion that the environmental impacts of reactor accidents initiated by external events are small. The NRC relies on PG&E models of seismic sources, ground motion equations, and site amplification that are not "up-to-date" as claimed by NRC, but outdated and inadequate.

PG&E's failure to utilize these modern methods has led to incomplete and biased results, both in terms of underestimated tectonic strain rates and overestimated minimum distances of active faults from DCPP. As a result, PG&E underestimates the seismicity of the region surrounding DCPP by a factor of approximately two. And it also fails to recognize the significant potential for thrust faults dipping under the reactors. These factors could significantly increase both earthquake rates and strength of shaking above the NRC's estimates.

As Dr. Bird concludes, the Draft EIS is inadequate to evaluate seismic risks at Diablo because its conclusions perpetuate rather than correct the significant errors and gaps in PG&E's analysis. Therefore, the relatively low accident rates assumed in the Draft GEIS do not provide an adequate basis for evaluating the significance of earthquake-related environmental impacts at Diablo Canyon.

CONCLUSION

For the foregoing reasons, the NRC should withdraw the Proposed Rule and the Draft GEIS and proceed with site-specific environmental impact statements for reactor license renewal.

Respectfully submitted,

__/signed electronically by/___
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May 2, 2023

UNITED STATES OF AMERICA
BEFORE THE NUCLEAR REGULATORY COMMISSION

In the Matter of	)	
	)	
Proposed Rule: Renewing Nuclear Power Plant Operating Licenses -- Environmental Review	)	Docket No. 2018-0296

DECLARATION OF DR. PETER BIRD

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

INTRODUCTION AND STATEMENT OF QUALIFICATIONS

1. My name is Peter Bird. I am a Professor of Geophysics and Geology, Emeritus, at the University of California at Los Angeles (UCLA). I am qualified by training and experience as an expert in the fields of tectonophysics and seismicity. A copy of my curriculum vitae is attached.

2. I have a Ph.D. in Earth and Planetary Sciences from the Massachusetts Institute of Technology (1976) and a B.S. in Geological Sciences from Harvard College (1972). For over 46 years, I have been a Professor of Geophysics and Geology at UCLA. I have written 82 academic papers, mostly about tectonics and seismicity, including the tectonics and seismicity of California. I have also been a member or officer of several professional organizations relating to my expertise, including the Geological Society of America, the American Geophysical Union and the Southern California Earthquake Center. The former two organizations have recognized my work with fellowships and awards.

3. I have broad expertise in the fields of geology and geophysics, with a focus on plate motion and plate deformation. Over the past 44 years, I have authored or contributed to a number of academic papers on computer modeling methods and applications, including studies of the ongoing (neotectonic) deformation in California.

4. In 2012, I participated in a Senior Seismic Hazards Analysis Committee (SSHAC) workshop sponsored by PG&E and Lettis Consultants International consultants regarding seismic hazard at the Diablo Canon power plant site. I presented results on both strike-slip and compressional deformation rates affecting the site, which were derived from my latest computer models of neotectonics (prepared for the Southern California Earthquake Center's project Unified California Earthquake Rupture Forecast version 3, and also for the US Geological Survey's 2013 Update to the National Seismic Hazard Model).

PURPOSE OF DECLARATION AND SUMMARY OF PROFESSIONAL OPINION

5. I have been retained by San Luis Obispo Mothers for Peace (SLOMFP) to evaluate the seismic risk analysis in the NRC's Draft Generic Environmental Impact Statement for License Renewal of Nuclear Plants (NUREG-1437, Rev. 2, Feb. 2023) (Draft GEIS). My review of the Draft GEIS has also involved the review of other relevant documents, including Pacific Gas & Electric Co.'s (PG&E's) Geologic Map of the Irish Hills and Adjacent Area (*Pacific Gas & Electric,* 2014), submitted to NRC in 2014 as part of PG&E's Central Coastal California Seismic Imaging Project (CCCSIP) (NRC Accession No. ML14260A028); PG&E's Technical Summary for the CCCSIP (NRC Accession No. ML14260A028); PG&E's 2015 post-Fukushima Probabilistic Seismic Hazard Analysis (PSHA), Parts 1 & 2[1]; PG&E's 2018 Seismic Probabilistic Risk Assessment (SPRA)[2]; the NRC Staff's 2019 review letter for the SPRA[3]; and the NRC's 2020 letter closing out the post-Fukushima seismic review for Diablo Canyon.[4]

6. To summarize my opinion of the Draft GEIS, I believe its conclusion that environmental impacts of externally initiated accidents are small is unsupported. The PG&E-sponsored analysis relied on by the NRC for its conclusion significantly underestimates the earthquake rate and proximity of potential earthquakes that could affect the Diablo Canyon nuclear reactors, because it is based on incomplete information, and did not consider all relevant methods for estimating hazard available at the time.

7. In particular, in my professional opinion, PG&E underestimates the seismicity of the region surrounding DCPP by a factor of approximately two. And it also fails to recognize the significant potential for thrust faults dipping under the reactors. These factors could

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[1] PG&E Letter DCL-15-035 re: Response to NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding the Seismic Aspects of Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident: Seismic Hazard and Screening Report (Mar. 11, 2015) (NRC Accession No. ML15071A045).

[2] PG&E Letter DCL-18-027 re: Seismic Probabilistic Risk Assessment for the Diablo Canyon Power Plant, Units 1 and 2 – Response to NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding the Seismic Aspects of Recommendation 2.1: Seismic of the (sic) Near-Term Task force Review of Insights from the Fukushima Dai-Ichi Accident (Apr. 24, 2018) (NRC Accession No. ML18120A201).

[3] Letter from Louise Lund, NRC to James M. Welsch, PG&E, re: Diablo Canyon Power Plant, Unit Nos. 1 and 2 – Staff Review of Seismic Probabilistic Risk Assessment Associated with Reevaluated Seismic Hazard Implementation of the Near-Term Task Force Recommendation 2.1: Seismic (EPID No. L-2018-JLD-0006) (Jan. 22, 2019) (NRC Accession No. ML18254A040).

[4] Letter from Robert A. Bernardo, NRC, to James M. Welsch, PG&E, re: Diablo Canyon Power Plant, Unit Nos. 1 and 2 – Documentation of the Completion of Required Actions Taken in Response to the Lessons Learned From the Fukushima Dai-Ichi Accident (May 8, 2020) (NRC Accession No. ML20093B934).

significantly increase both earthquake rates and strength of shaking above the NRC's estimates.

STATEMENT OF PROFESSIONAL OPINION

8. At page E-34 of the Draft GEIS, the NRC reports that "new information" from external event probabilistic risk assessments (PRAs) is "not significant" for purposes of revising an earlier conclusion that the environmental impacts of reactor accidents initiated by external events are small. As discussed below, this conclusion may not reasonably be applied to the Diablo Canyon reactors, because the supporting analyses are out of date and incomplete.

9. One of the foundational documents for the NRC's conclusion that seismic impacts are insignificant is the seismic hazard reevaluation performed by PG&E in response to post-Fukushima orders by the NRC. This seismic hazard reevaluation can be found in the PSHA referenced above in par. 5 and note 1. The PSHA provides estimates for fault traces, fault dips, and fault slip-rates that affect the risk of an earthquake at Diablo Canyon, plus application of ground-motion prediction equations to forecast the intensities of acceleration (and spectral accelerations) as a function of recurrence time. Then in the SPRA, these estimates of shaking are combined with estimates of plant fragility to estimate recurrence times between plant failures due to earthquakes.

10. At page E-29 of the Draft GEIS, the NRC states:

> "In the first phase of this screening approach, a seismic hazard reevaluation was performed for each nuclear power plant site, which included development of new plant-specific seismic hazard curves using *up-to-date models* representing seismic sources, ground motion equations, and site amplification."

11. I emphasized the phrase "up-to-date" in quoting the Draft GEIS because that assertion is not only incorrect now, but it was incorrect in 2015, when PG&E performed the PSHA. The only sense in which the PSHA is "up-to-date" is the fact that it updated the parameter values for specific fault sources that had been considered in previous PSHAs. It did not take account of, or make use of, then-published and available scientific developments in measurement and computation of the parameters for those and other fault sources, including:

    a. measurement of crustal motion by permanent and campaign Global Positioning System (GPS) receivers (*e.g.*, *Shen et al.*, 2003; *Kreemer et al.*, 2003, 2014; *Kreemer*, 2016) or

    b. computation of long-term crustal strain rates and fault slip rates by computer modeling (including kinematic finite-element models) of crustal motion measurement data, in combination with geologic and stress data (*e.g.*, *Bird*, 2009; *Field et al.*, 2013, 2014; *Parsons et al.*, 2013).

12. The PSHA also ignored recent initiatives in seismic hazard estimation which do not assume that a complete inventory of active faults is available, but instead compute the expected seismicity across the map area from crustal strain rates and fault slip rates (if and where available) using a calibration of global shallow seismicity categorized by plate-tectonics (*Bird & Kagan*, 2004; *Bird & Liu*, 2007; *Bird et al.*, 2010; *Bird et al.*, 2015). Two motivations for the development of such models were that:

(a) a number of recent large earthquakes in the California region (Landers 1972 m7.3, Hector Mine 1999 m7.1, El Mayor-Cucupah 2010 m7.2, Ridgecrest 2019 m6.5 + m5.4 + m7.1) had occurred in places where no seismogenic fault, or only short and disconnected faults, had been recognized; and

(b) the discovery that the global distribution of shallow earthquakes was such that they spread in bands of half-width 257 km around plate boundary faults of the Continental Transform Fault (CTF) type (*Bird & Kagan*, 2004).

13. PG&E's failure to utilize these modern methods led to incomplete and biased results, both in terms of underestimated tectonic strain rates and overestimated minimum distances of active faults from DCPP. The distance between the plant and the active earthquake rupture is important because it is one factor affecting the peak acceleration (and spectral acceleration) at the plant; this is recognized in the ground-motion prediction equations that are routinely used in the PSHA process.

14. The Irish Hills and the San Luis Range are a dextral-transpressional orogen that has formed since ~3.5 million years or mega annus (Ma) (*Page et al.*, 1998), or possibly since 7.8~6 Ma (*Atwater & Stock*, 1998; *Bird & Ingersoll*, 2022) when the motion of the Pacific plate changed its direction to become more compressional relative to North America. This means that the region can be expected to be cut by a number of both strike-slip and thrust (compressional) faults.

15. Evidence of this ongoing compression includes:

a. The Pismo syncline is the primary structural feature in the Irish Hills (*Pacific Gas & Electric*, 2014). Here beds have been rotated ~45° since ~5 Ma, which is the depositional age of the youngest strata in the core of the fold (*ibid*). This folding implies crustal strains of ~0.8, and mean strain-rates of ~0.8/5 Ma = 5×10^{-15} per second (/s). This is ~10× faster than rates of "off-fault" or "off-modeled-fault" (or "continuum") deformation that are typical in the long-term neotectonics of the western US (5×10^{-16} /s, *Bird*, 2009). This high rate of strain implies a high rate of faulting and of earthquakes, even if the specific fault traces and fault planes have not yet been identified.

b. The 2003 San Simeon m6.6 and 1983 Coalinga magnitude (m) 6.2 earthquakes had thrust mechanisms (Global Centroid Moment Tensor Catalog, *Ekström et al.*, 2012). This is evidence of highly compressive horizontal stresses in the Coast Ranges region, suggesting a likelihood of thrust-faulting in other locations as well.

c. SSW-NNE directions of most-compressive stress shown by data in the World Stress Map (*Mueller et al.*, 1997; *Heidbach et al.*, 2008, 2016), and by interpolation of stress directions using the method of *Bird & Li* (1996), are almost perpendicular to the traces of the regional fault grain (Shoreline, San Luis Bay, and Los Osos faults). This strongly suggests that these faults are currently either purely, or dominantly thrust faults.

d. Models of neotectonic deformation, informed and guided by GPS velocity data, include such long-term compression. Specifically, *Shen & Bird* (2022) computed a suite of kinematic finite-element (F-E) models of neotectonics across the western US based on geodetic, geologic, & stress data with program NeoKinema. Their preferred model, which is being incorporated into the 2023 update of the USGS National Seismic Hazard Model, shows convergence of crustal blocks on both sides of the Irish Hills/San Luis Range at velocities of ~1 mm/a, for a total of ~2 mm/a of local convergence.

16. The 2015 PSHA for DCPP is seriously deficient because it considers only the strike-slip component of ongoing deformation, and ignores this thrusting/compressional component.

17. Given the evidence cited above (par. 12) for active horizontal compression, thrust faults and resulting thrust-faulting earthquakes must be expected. The lack of consideration of thrust faulting in the 2015 PSHA is unacceptable given that:

    a. the basement of the Irish Hills is Franciscan Complex, which is an accretionary melange with incorporated thrust nappes (*Wakabayashi*, 1999) that formed in a dextral-transpressional subduction environment in Jurassic-Neogene times (*Cloos*, 1982). This thick pile of materials originally scraped off the tops of subducting oceanic plates is full of low-angle thrust faults which are available for reactivation; and

    b. bedding-plane slip is the dominant mode of compression in layered sedimentary rocks such as the Paleogene and Neogene units that overlie the Franciscan Complex in the Irish Hills (*Pacific Gas & Electric*, 2014) but bedding-plane slip produces no visible or mappable offsets of rock lithologies; and

    c. the 2015 m7.8 Nepal earthquake showed that low-angle thrust faults can produce devastating shaking without leaving any mappable surface rupture.

18. PG&E's systematic omission from the PSHA of earthquakes resulting from horizontal compression is material and serious because:

    a. Kinematic F-E models of regional neotectonics (*Shen & Bird*, 2022) prepared for use in the US Geological Survey's National Seismic Hazard Model, and seismicity models based on their kinematics plus global calibrations (*Bird & Kagan*, 2004; *Bird et al.*, 2009; *Bird & Kreemer*, 2015), suggest that seismicity due to distributed compression may be roughly equal (and additive) to that caused by strike-slip on named, mapped faults. Specifically, in my publications I have advocated a seismicity model known as Seismic Hazard Inferred From Tectonics (SHIFT), with two basic principles:

i. the long-term seismic moment rate of any tectonic fault, or any large volume of permanently deforming lithosphere, is approximately that computed using the coupled seismogenic thickness (*i.e.*, dimensionless seismic coupling coefficient × seismogenic thickness) of the most comparable class of plate boundary; and

ii. the long-term rate of earthquakes generated along any tectonic fault, or within any large volume of permanently deforming lithosphere, is approximately that computed from its SHIFT moment rate (of method i above) using the frequency–magnitude distribution of the most comparable class of plate boundary.

19. This method, encoded in my program Long_Term_Seismicity_v12, provides maps and statistics on model seismicity above any desired minimum earthquake magnitude. For the preferred model of *Shen & Bird* (2022), we compute that "off-fault" seismicity should be 44% of total m7+ seismicity in the western US, compared to 56% "on-fault" seismicity. That is, a regional PSHA prepared for the western US by traditional methods that rely on a list of named active faults would miss about half of the actual earthquake rate.

20. Following the method described above, DCPP must be reevaluated for its vulnerability to thrust faults. Locally, DCPP lies on a transition from a domain to the SW where seismicity is dominated by the strike-slip component on modeled faults, to a domain on the NE (Irish Hills and San Luis Range) where seismicity is dominated by compression in the continuum. This means that cryptic bedding-plane and Franciscan thrust faults, and/or a NE-dipping strand of the Shoreline fault, could exist directly under DCPP at shallow depths.

21. The simplest structural explanation for the folding that produced the Pismo syncline in the Irish Hills is that both flanking faults (Shoreline fault on the SW; Los Osos fault on the NE) are active thrust faults which have relatively uplifted their respective flanks of the Irish Hills. In this connection, we note the assertion in the 2015 PSHA that the Shoreline fault has a vertical dip (and therefore is strike-slip), but also note the point raised by Prof. Jackson (*Jackson,* 2015):

> "PG&E's seismic hazards analysis fails to account for reasonably foreseeable earthquakes located nearer to the DCPP than PG&E has assumed. For instance, the seismic stations used to locate earthquakes on the Shoreline Fault are all onshore, east of the fault, so that the fault's east-west location is highly uncertain."

In my professional opinion, Dr. Jackson raised an important consideration which remains valid. Furthermore, the Shoreline fault could have partitioned slip, on two active planes.

CONCLUSION

22. The 2015 PSHA for DCPP was incomplete with regard to potential seismic sources, and its estimates of expected shaking (as a function of recurrence time) therefore are biased low to a potentially significant degree. This was due to the systematic omission or underestimation of horizontally-compressional (thrust-faulting) deformation in the region. All subsequent analyses relying on the PSHA simply perpetuate the errors and omissions in the PSHA, and therefore are correspondingly inadequate to assess earthquake risk. Therefore, the relatively low accident rates obtained from that SPRA and assumed in the Draft GEIS do not provide an adequate basis for evaluating the significance of earthquake-related environmental impacts at DCPP.

23. As discussed above in par. 7, in my professional opinion, PG&E underestimates the seismicity of the region surrounding DCPP by a factor of approximately two. And it also fails to recognize the significant potential for thrust faults dipping under the reactors. These factors could significantly increase both earthquake rates and strength of shaking above the NRC's estimates.

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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 opinions expressed herein are based on my best professional judgment.

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

April 28, 2023

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CURRICULUM VITAE OF PETER BIRD

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EDUCATION

Massachusetts Institute of Technology: Ph.D. in Earth and Planetary Sciences, 1976
Harvard College: B.A. in Geological Sciences, 1972

EMPLOYMENT

University of California, Los Angeles:
- Professor Emeritus, 2011-
- Professor of Geophysics and Geology, 1985-2011
- Vice-chairman, Dept. of Earth and Space Sciences, 1994-2002
- Associate Professor of Geophysics and Geology, 1981-85
- Assistant Professor of Geophysics and Geology, 1976-81

HONORS

Woollard Award, Geological Society of America, 2013
Fellow, American Geophysical Union, 1990
Fellow, Geological Society of America, 1989

RESEARCH AREAS (CHRONOLOGICAL FROM 1973)

Lateral refraction and attenuation of surface waves	1973-1977
Marine paleomagnetism and seafloor spreading	1974-1975
Thermal modeling with finite differences	1975-1977
Dynamic modeling with finite elements	1975-
Tectonophysics of continental collisions	1975-
Formation of marginal basins	1976-1977
Stress and temperature in subduction zones	1976-2009
Continental delamination	1977-1982
Neotectonic models of California	1978-
Hydration state and friction of montmorillonite clays	1979-1984
Mechanism of Laramide orogeny	1982-
Mechanism of Basin/Range taphrogeny	1986-
Solution transfer experiments on quartz	1986-1993
Lateral extrusion of lower crust	1987-1991
Regional neotectonic models: Africa, Alaska, Asia, Europe, ...	1989-
Global dynamic lithosphere models with plates & driving forces	1992-
Inverse or kinematic tectonic models from geologic & paleomag data	1994-
Global long-term seismicity forecasts from geodesy & plate tectonics	2000-
Long-term seismicity forecasts for Europe, especially Italy	2009-

CONSULTING EXPERIENCE ON SEISMIC HAZARD (FROM 2009 TO PRESENT)

GeoPentech, Lettis Consultants International, FM Global, Temblor, San Luis Obispo Mothers for Peace

UNPAID AFFILIATIONS

Southern California Earthquake Center (2000-present; Board member 2004-2012)
Collaboratory for the Study of Earthquake Predictability (model contributor, 2015)

PUBLICATIONS (CHRONOLOGICAL FROM 1975; OMITTING MOST ABSTRACTS)

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