ATTACHMENT 4

June 18, 2012 Petition to Intervene and Supporting Declarations

BEFORE THE UNITED STATES
NUCLEAR REGULATORY COMMISSION

In the Matter of	)	
	)	
SOUTHERN CALIFORNIA EDISON COMPANY	)	Docket Nos. 50-361, 50-362
	)	
(San Onofre Nuclear Generating Station)	)	June 18, 2012

PETITION TO INTERVENE AND REQUEST FOR HEARING BY FRIENDS OF THE EARTH

I. INTRODUCTION

On January 31, 2012, San Onofre Nuclear Generating Station ("San Onofre") in San Clemente, California suffered a steam generator tube rupture in Unit 3 that resulted in the release of radioactive material into the environment. Prior to the leak in Unit 3, SCE discovered excessive wear in Unit 2, which was offline for a refueling outage. Subsequently, advanced deterioration of many tubes was discovered in the replacement steam generators (SG), which had been in operation for eleven months in Unit 3 and less than two years in Unit 2.

As detailed in the attached May 31, 2012 Declaration of Mr. Arnold Gundersen ("Gundersen Expert Decl."), a nuclear engineer and former licensed reactor operator, the failure of tubes in the steam generator has the potential to cause extremely serious releases of radioactivity into the environment, which in turn could cause grave injury to public health and the environment.[1] Significantly, more than 8.3 million people live within 50 miles of the San Onofre Nuclear Power Station. The safety of members of the Petitioner, Friends of the Earth (FOE), and the viability of the environment and economy of Southern California, may depend on

[1] Fairewinds Associates is a nuclear safety firm retained as a consultant to Petitioner. Mr. Gunderson is the Chief Engineer at Fairewinds Associates.

whether the NRC understands and corrects the root causes of the steam generator failures that have happened at San Onofre.

Pursuant to 10 C.F.R. § 2.309, Petitioner hereby petitions to intervene and requests a hearing in the NRC proceeding to amend the operating license for Southern California Edison's (SCE, or Licensee) San Onofre plant. The outcome of the current proceeding could jeopardize the Petitioner's interests, which are detailed below in Section II. Petitioner sets forth its contentions in Section IV.

Petitioner asserts that under 10 C.F.R. § 50.59 the San Onofre replacement steam generators may not be operated without an amendment to the San Onofre operating license.[2] It asks that the Commission either recognize that the current Confirmatory Action Letter (CAL) process is in fact a license amendment proceeding under 10 C.F.R. § 2.309 and 42 U.S.C. § 2239, or convene such a license amendment proceeding under these authorities or under the Commission's inherent supervisory authority over the nuclear industry.[3] Petitioner further requests that it be given status as a party in such proceeding, and that, pursuant to 10 C.F.R. § 2.309, the Commission provide an adjudicatory public hearing with respect to the causes and potential remedies for the failure of the replacement steam generators at San Onofre.

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[2] SCE's amendments to the licenses for Unit 2 and Unit 3, proposed on June 27, 2008 and approved on June 25, 2009, are insufficient to address all of the changes Edison made in the replacement steam generators. The license amendment application clearly states: "The proposed changes reflect revised [steam generator] inspection and repair criteria and revised peak containment post-accident pressure resulting from installation of the replacement [steam generators]." The application does not include any request to amend the licenses with regard to major design changes such as removal of the stay cylinder, replacement of the egg crate tube support with a broached plate tube support, or the thickening of the tube sheet. Thus, the previous license amendment was incomplete and additional amendments are required before the replacement steam generators can be allowed to restart. Letter from Southern California Edison Company to the Nuclear Regulatory Commission re "Amendment Application Numbers 252 and 283," 2 (June 27, 2008); Letter from James Hall, Nuclear Regulatory Commission to Ross T. Ridenoure, Southern California Edison Company re "San Onofre Nuclear Generating Station, Units 2 and 3- Issuance of Amendments Re: Technical Specification Changes in Support of Steam Generator Replacement (TAC Nos. MD9160 and MD9161)" (June 25, 2009).

[3] *See Statement of Policy on Conduct of Adjudicatory Proceedings*, 48 N.R.C. 18, 20, 1998 WL 518232 (N.R.C.); *Public Service Co. of New Hampshire* (Seabrook Station, Units 1 and 2), CLI–90–3, 31 NRC 219, 229 (1990).

As will be shown below, operating San Onofre after SCE replaced the steam generators six years ago without a license amendment and § 2.309 proceeding was improper under NRC regulations. The failure of the replacement steam generators has only made that impropriety more obvious. Though SCE apparently convinced itself that it did not have to seek a license amendment for the replacement steam generators,[4] the major changes in the steam generators proposed by SCE created risks not considered in the Updated Final Safety Analysis Report (UFSAR). Under 10 C.F.R. § 50.59, these changes triggered the Commission's obligation to convene a formal license amendment proceeding.[5]

Only two years after the installation of the replacement steam generators it has become apparent that the changes in the steam generators have resulted in risks not considered in the UFSAR. The excessive degradation of the SG tubes in both units and the tube rupture in Unit 3 demonstrate graphically the new safety issues created, but never analyzed, by the licensee or the NRC. Thus, San Onofre Units 2 and 3 may not properly be restarted until the Commission approves a license amendment under the process provided in 10 C.F.R. § 2.309.

It is immaterial that NRC staff has not called its current action a "license amendment proceeding," since that is the function served by the NRC's current activity and what is required by NRC's own regulations. *See, e.g.*, *Brodsky v. U.S. Nuclear Regulatory Com'n,* 578 F.3d 175 (2009), quoting *Columbia Broad. Sys., Inc. v. United States*, 316 U.S. 407, 416 (1942) ("The particular label placed upon [an order] by [an agency] is not necessarily conclusive, for it is the

[4] *See* Boguslaw Olek & Tomoyuki Inoue, "Improving Like-for-Like RSGs," *Nuclear Engineering International* 36, 37 (Jan. 2012) ("the major premise of the steam generator replacement project was that it would be implemented under the 10 C.F.R. 50.59 rule, that is, without prior approval"). In the end, SCE sought and received minor licensing amendments that encompass neither the full suite of changes nor the most significant structural alterations made to the design of the replacement steam generators.

[5] To date, the NRC has sought to treat the failure of the steam generators as an enforcement matter, but this approach lacks credibility and legal authority, given that the poorly performing and potentially hazardous steam generator replacements are currently outside the approved licensing basis for the plant.

substance of what the [agency] has purported to do and has done which is decisive"). Where changes of the magnitude of those at San Onofre are made, the NRC's own regulation requires the licensee to apply for a license amendment, which requires the NRC to evaluate its effect on the safety of the plant and hold a public hearing if requested so that the public may evaluate the safety risks associated with the proposed changes. While the federal courts often defer to an agency's procedural determinations, they will not permit an agency to ignore its own regulations. *Auer v. Robbins*, 519 U.S. 452, 461 (1997) (finding that an agency's application of its own regulations is "controlling unless plainly erroneous or inconsistent with the regulation[s]").

To support Petitioner's contention, the Declaration from Mr. Arnold Gundersen, MSNE, a nuclear engineer with Fairewinds Associates, is attached.[6] A former nuclear industry Senior Vice President, Mr. Gundersen earned his Bachelor's and Master's Degrees in nuclear engineering and was a licensed reactor operator during a twenty-year career in the nuclear industry. During his nuclear industry career, Mr. Gundersen reviewed projects at seventy nuclear plants and was frequently called upon to testify to the NRC and Congressional and State officials on nuclear power operations. He was also an expert witness in the cases involving Three Mile Island, Western Atlas, Peach Bottom, and Florida Power and Light.

In addition to the Declaration Mr. Gundersen has provided, he has authored three expert reports providing an analysis of the reasons for the tube degradation and rupture at San Onofre and offering an assessment of possible technical solutions.[7] Mr. Gunderson's third report from May 11th, 2012, entitled "San Onofre's Steam Generator Failures Could Have Been Prevented,"

[6] Fairewinds Associates is a nuclear safety firm retained as a consultant to Petitioner. Mr. Gunderson is the Chief Engineer at Fairewinds Associates.

[7] Arnie Gunderson, Fairewinds Associates, Inc., STEAM GENERATOR FAILURES AT SAN ONOFRE (Mar. 2012); SAN ONOFRE CASCADING GENERATOR FAILURES CREATED BY EDISON (Apr. 10, 2012); *and* WHY SAN ONOFRE STEAM GENERATORS ARE NOT "LIKE-FOR-LIKE" (May 4, 2012).

contains extensive analysis of the steam generator design changes likely responsible for the vibration causing the tube degradation and failures, as well as the options for continued operation of the reactors.

II. STANDING

FOE is a national non-profit environmental organization headquartered and incorporated in the District of Columbia with an office in San Francisco, California. Declaration of Marcelin Keever at ¶ 2, May 30, 2012 ("Keever Decl."). FOE has a nationwide membership of over 9,100 (including 1,900 members in California) and over 140,000 activists. *Id*. at ¶ 4. Among its missions, FOE seeks to ensure the public has an opportunity to influence the outcome of government and corporate decisions that affect the lives of many people. *Id*. at ¶ 7. Since its inception in 1969, FOE has sought to improve the environmental, health, and safety conditions at civil nuclear facilities licensed by the NRC and its predecessor agencies. *Id*. at ¶ 3. To that end, FOE utilizes its institutional resources, including legislative advocacy, litigation, and public outreach and education, to minimize the risks that nuclear facilities pose to its members and to the general public. *Id.*

Under the Atomic Energy Act (AEA), the Commission must grant a hearing on a license amendment application upon "the request of any person whose interest may be affected by the proceeding, and shall admit any such person as a party to such proceeding." 42 U.S.C. § 2239(a)(1)(A). To support the request, a petitioner must provide the Commission with information regarding "(1) the nature of the petitioner's right under the governing statutes to be made a party; (2) the nature of the petitioner's property, financial, or other interest in the proceeding; and (3) the possible effect of any decision or order on the petitioner's interest." *Entergy Nuclear Vermont Yankee, L.L.C., and Entergy Nuclear Operations, Inc. (Vermont*

Yankee Nuclear Power Station), 60 N.R.C. 548, 552 (2004) (citing 10 C.F.R. § 2.309(d)(1)). "The NRC generally uses judicial concepts of standing in interpreting this regulation." *Entergy Nuclear Vermont Yankee,* 60 N.R.C. at 552. Thus, a petitioner may intervene if it can specify facts showing "that (1) it has suffered or will suffer a distinct and palpable harm constituting injury-in-fact within the zone of interests arguably protected by the governing statutes, (2) the injury is fairly traceable to the action being challenged, and (3) the injury will likely be redressed by a favorable determination." *Id.* at 552–53. In determining whether a petitioner has met the requirements for establishing standing, the Commission "construe[s] the petition in favor of the petitioner." *Id.* at 553.

Member organizations such as FOE may intervene on behalf of their members if they can "demonstrate that the licensing action will affect at least one of [their] members, . . . identify that member by name and address, and . . . show that [they are] authorized by that member to request a hearing on his or her behalf." *Id.* Lyn Harris Hicks, a member of FOE, resides at 3908 Calle Ariana, San Clemente, California, 92672. Declaration of Lyn Harris Hicks at ¶ 1, May 29, 2012 ("Hicks Decl."). Ms. Hicks's declaration describes her personal health, safety, economic, aesthetic, and environmental interests in the proper operation of the San Onofre Nuclear Generating Station and the risk of harms that SCE's defective steam generators, without further analysis and repair, poses to those interests. She also describes her interest in open government and corporate decision making, which is also at stake in this proceeding. The Declaration of Mr. Gundersen affirms the engineering basis for Ms. Hicks's concerns. *See* Gundersen Expert Decl. Ms. Hicks supports this Petition, and has authorized FOE to intervene in this proceeding and request a hearing on her behalf. Hicks Decl. at ¶ 11, 12.

For over thirty years, Ms. Hicks has lived within about three miles from the San Onofre Nuclear Generating Station. *Id*. at ¶ 1, 3. Thus, Ms. Hicks and her family are at risk of serious health effects caused by exposure to radioactivity if the defective steam generators are not properly repaired before the Commission allows them to be restarted. *Id*. at ¶ 8.

In addition to risking the health effects of radiation exposure, Ms. Hicks would suffer substantial devaluation of her property and loss of the enjoyment of the beautiful coastal environment, where her family has lived for decades, in the event of an accident caused by restarting the reactors without thorough analysis of the root cause of the existing problems in the steam generators. *Id*. at ¶ 10. She and her family have spent many years enjoying the beautiful beaches of San Clemente. *Id*. at ¶ 5. Both her property value and the aesthetic value of the surrounding area will decline if the steam generators are not operated safely. *Id*. at ¶ 10.

Petitioner's expert, Mr. Gundersen, discusses in his Declaration the scenarios under which Ms. Hicks could suffer the effects of radiation leaks. Mr. Gundersen details the potential for San Onofre to release radioactivity into the atmosphere as a result of the design flaws in the replacement steam generators. Gundersen Expert Decl. at ¶¶ 15-18.

As Ms. Hicks has explained, she will suffer a concrete and particularized risk of injuries from the operation of San Onofre Units 2 and 3 with defective steam generators.[8] Petitioner's experts confirm the engineering behind Ms. Hicks's assertions as to these risks, which will occur if the reactors are restarted with defective steam generators without sufficient understanding of the cause of the defects and adequate repair. The fact that the NRC staff have ordered the two units shut down during investigation confirms the risks Ms. Hicks is exposed to if the root

[8] So long as a Petitioner falls within the zone of interests protected by the statute, and alleges harm that is "concrete and particularized," rather than "conjectural" or "hypothetical," the "requisite injury may either be actual *or threatened*." *Crow Butte Res., Inc. (License Amendment for the North Trend Expansion)*, 67 N.R.C. 241, 271 (2008) (emphasis added).

cause(s) degrading the steam generator are not fully understood and appropriate action taken.. Ms. Hicks also suffers concrete and particularized injury to her interests in transparent government and corporate decision making when the NRC allows SCE to avoid the license amendment process required in the NRC's own regulations, and, as consequence, neither SCE nor the NRC is required to provide the public with a root cause analysis of what has happened at San Onofre and explain how, and whether, it can be repaired.

The Commission is capable of granting the Petitioner redress by requiring SCE to undergo the license amendment process of 10 C.F.R. § 2.309, including convening a public adjudicatory hearing in which Petitioner has the opportunity to participate as a party. Such a hearing will assure that the Commission obtains the benefit of the testimony of Petitioner's witnesses regarding the root cause of the untimely deterioration of the San Onofre steam generators. It will also assure the public that the San Onofre reactors will not be restarted until the health and safety of the millions of people who live near the San Onofre plant will be protected.

Ms. Hicks's concerns plainly fall within the zone of interests protected by the AEA and its implementing regulations. *Sequoyah Fuels Corp. and General Atomics (Gore, Oklahoma Site)*, 39 N.R.C. 54, 75 (1994) (membership organization granted standing by showing that "the health and safety interests of its members are within the AEA-protected zone of interests"); *Babcock and Wilcox (Apollo, Pennsylvania Fuel Fabrication Facility)*, 37 N.R.C. 72, 80 (1993) (holding that specified "health, safety, and environmental concerns . . . clearly come within the zone of interests safeguarded by the AEA and NEPA").

Ms. Hicks therefore has standing to intervene in her own right: she has met the requirements for injury-in-fact, causation, and redressability, and her concerns fall within the

zone of interests protected by the AEA and implementing regulations. She will be affected by the failure of SCE's replacement steam generators, has provided her name and address, and has authorized FOE, of which she is a member, to intervene in this proceeding on her behalf. Thus, Petitioner FOE has standing to pursue this action. *Entergy Nuclear Vermont Yankee,* 60 N.R.C. at 553.

III. TIMELINESS

The balance of the criteria under 10 C.F.R. § 2.309(c)(1) weigh heavily in favor of considering the petition. Each criterion is examined below.

Good cause. Petitioner has shown good cause to become a party to the current San Onofre license amendment proceeding. Petitioner FOE represents a substantial number of members who live within fifty miles of the San Onofre plant, and who have an interest in the outcome of the proceeding because whether the licensee is required to fully correct the safety risks created by SCE's replacement steam generators could profoundly affect their health, safety, environmental quality, and economic well-being.

As described above, Petitioner FOE has retained the services of consultant Fairewinds Associates with expertise in nuclear engineering and operation of nuclear power plants. Mr. Gunderson can provide important expert assistance to the NRC in understanding and correcting the steam generator problems at San Onofre.

Nature of Petitioner's rights under the Atomic Energy Act to be made a party to the proceeding. Under the Atomic Energy Act (AEA), the Commission must grant a hearing in a proceeding upon "the request of any person whose interest may be affected by the proceeding, and shall admit any such person as a party to such proceeding." 42 U.S.C. § 2239(a)(1)(A). As described in section II, above, and in the attached declaration, Petitioner's members have

economic, aesthetic, health, safety, and environmental interests, and interests in open and transparent government and corporate decision making, that they wish to safeguard. Operation of SCE's defective steam generators, without undergoing the proper license amendment process, poses a grave threat to those interests.

Nature and extent of Petitioner's property, financial or other interest in the proceeding. Petitioner's interests in the proceeding are fully described in the attached declaration and in section II, above.

Possible effect of any order that may be entered in the proceeding on the Petitioner's interests. Any order issued by the NRC in this proceeding will have potentially fundamental effects on the interests of Petitioner and its members, such as Lyn Hicks, living in Southern California. As detailed in Report 3 of Petitioner's expert, Fairewinds Associates, a catastrophic failure of the San Onofre steam generators that resulted in cascading tube failure could cause substantial releases of radioactivity into the air of southern California. Petitioner's interests, described in Section II, in the health and physical safety of its members, such as Ms. Hicks, and the economic well-being, and environmental quality of the area surrounding San Onofre are all potentially threatened by the current situation at the plant, where a radioactive release has already occurred. Whether the order(s) resulting from this proceeding are adequate to assure that the San Onofre reactor is safe to operate thus could directly and profoundly affect the interests of Petitioner and its members.

Likewise, an order requiring that SCE amend its license to account for the potential effects on public health and safety and the environment related to the replacement steam generators, and requiring an adjudicatory hearing on the health, safety and environmental issues

associated with the replacement steam generators, will affect the Petitioner's interests in open and accountable government and corporate decision making.

Availability of other means whereby the Petitioner's interest will be protected. The CAL issued by the NRC is not sufficient to protect Petitioner's interest. Foremost, the CAL merely restates SCE's description of the steam generator problems and the commitments SCE made as of March 23, 2012 to rectify the issues at Units 2 and 3. The CAL, issued only four days later, shows no independent analysis by the NRC, nor does it require anything further than what the licensee had itself volunteered. Thus, the CAL simply reiterates the licensee's plan for managing the technical issues at the reactors and facilitating an expeditious restart; it does not demonstrate that the NRC, as the regulator, has intervened on behalf of the public to require any particular action by the licensee to ensure that both reactor units will operate safely prior to restart.

The current situation at San Onofre may be seen as result of a too close and closed relationship between the NRC staff and the licensee. While the Petitioner does not know the full details of that relationship on the steam generator matter, it is apparent already that the licensee went to considerable trouble in an attempt to avoid any public review of its decision to install significantly different steam generators built by a company that was unfamiliar with the particular needs of a steam generator in the San Onofre type of reactor, and that the NRC staff willingly acceded. As detailed in Mr. Gundersen's Declaration, under NRC regulation 10 C.F.R. § 50.59 it is clear that a formal license amendment was required. Gundersen Expert Decl. at ¶¶ 24-32. Yet the NRC mutely accepted the licensee's incorrect conclusion that no license amendment was called for.

The requirements of the license amendment process recognize that for the NRC to do its job it must keep the public informed. Even the best technical oversight is insufficient if the

public does not have the opportunity to participate to ensure its interests are being protected. While it makes no sense to require a public proceeding on every change a licensee makes to a nuclear power plant, a nearly $671 million entire replacement of one of the major structures that determines whether the public health and safety will be protected is not a minor change. The NRC's CAL fails to provide the public involvement that NRC regulations, *e.g.*, 10 C.F.R. § 2.309, require. By passively accepting the licensee's self-evident misreading of 10 C.F.R. § 50.59 to avoid any public process, the NRC failed to do its job. Now, with the potentially dangerous results of that failure apparent, the Commission needs to reassure the public by providing an adjudicatory public hearing. Speaking for the public, Petitioner's interests are not satisfied by the continuation of the private conversation between the licensee and the Commission that has produced the failure of the San Onofre steam generators; nor are Petitioner's interests satisfied by the promised public meetings, which do not offer the kind of procedure guaranteed by 42 U.S.C. § 2239 and 10 C.F.R. § 2.309.

The CAL, a mere restatement of the licensee's conclusion about what actions are necessary, does not afford meaningful opportunity for independent technical evaluation of the adequacy of the fixes proposed to be adopted and for public participation in the form of an opportunity for an adjudicatory hearing. As one might suppose from a document that is devoid of any directive originated from the expert government agency entrusted with ensuring the safe commercial operation of nuclear power plants, the CAL also does not adequately assure the public of the safety of the replacement steam generators, in particular because it does not require a root cause analysis of the excessive tube vibration and resulting untimely wear.

Lastly, the Augmented Inspection Team (AIT) ordered by the CAL to "assess the circumstances surrounding the tube leak and unexpected wear of tubes in the Unit 3 steam

generators"[9] is insufficient to protect the Petitioner's interests. First, the AIT investigation does not reflect the reality that severe tube wear was discovered in both Unit 2 and Unit 3. Petitioner's interest lies in assuring the adequate safety of *both* units, not just Unit 3. Second, the AIT charter does not include an assessment of whether SCE illegally skirted the license amendment process by incorrectly asserting that no amendment is necessary for the major design changes it made to the replacement steam generators under the criteria of 10 C.F.R. § 50.59.[10]

Third, while the AIT has promised public meetings to review the AIT's report, such meetings are not an adequate substitute for the kind of adjudicatory public hearing available under 10 C.F.R. § 2.309. Petitioner requests a hearing on the root cause of the rapid tube wear in *both* Unit 2 *and* Unit 3, with the ability to participate in review of the safety issues using adjudicatory procedures. The kind of public meetings the Commission promises will not provide Petitioner with the hearing contemplated by 10 C.F.R. § 2.309 (*see, e.g.*, 10 C.F.R. § 2.310 (detailing the required procedures for hearings granted under § 2.309)). For these reasons, there are no other means outside the requested proceeding by which Petitioner's interests can be protected.[11]

Extent to which Petitioner's interests will be represented by existing parties. Petitioner's interests will not be represented by either the licensee or the NRC staff. The continuing failure of both SCE and the NRC staff to recognize the need for a public adjudicatory hearing on a matter of such concern demonstrates that neither can represent the interests of the Petitioner.

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[9] *Memorandum to Gregory Werner, Chief, Plant Support Branch 2, Division of Reactor Safety from Elmo Collins, Regional Administrator, Region IV,* "Augmented Inspection Team Charter to Evaluate the Steam Generator Tube Integrity Issues at San Onofre Nuclear Generating Station Unit 3, Revision 1," at 1 (May 16, 2012).

[10] *Id.*

[11] Petitioner's request is properly before the Commission under 10 C.F.R. §2.309 rather than 10 C.F.R. §2.206 for two reasons. First, Petitioner is requesting the opportunity to participate in a license amendment proceeding. Section 2.206 does not provide for such a request. It instead offers the public a means by which to request enforcement action by NRC. Second, there is no authority under §2.206 for the staff to entertain requests for public participation in a proceeding. Section 2.309, on the other hand specifically provides that authority.

SCE's economic interest lies in restarting San Onofre Units 2 and 3 as soon as possible. For the reasons stated in this petition, specifically in Contention 1, that approach is at odds with Petitioner's interest in adequately addressing safety risks presented by the root cause of the defects in the replacement steam generators. Given the prima facie case that it may have erred both technically and legally in allowing installation of substantially modified steam generator replacements at San Onofre, the NRC staff involved in that decision may have a vested interest in defending the adequacy of its prior review, and this interest would detract from taking a clear-eyed objective view of the implications of this troubled steam generator replacement for public health and safety.

The NRC has given no indication to date that it plans to afford the public this adjudicatory hearing opportunity. Thus, Petitioner's interests are not represented by existing parties to the proceeding.

Extent to which the Petitioner's participation will broaden the issues or delay the proceeding. Of its own accord, the NRC has already ordered Units 2 and 3 to remain shut down until the internal technical evaluations formalized in the CAL are completed. Petitioner simply asks that the NRC follow its established public procedures for considering a license amendment application with respect to the replacement of all four steam generators in San Onofre Units 2 and 3 with ones that contain a significantly different design than the original generators. Although Petitioner brings new information and perspective, it wishes to focus on the safe operation of the replacement steam generators.

Extent to which the Petitioner's participation may reasonably be expected to assist in developing a sound record. If granted, a hearing on Petitioner's contentions would provide an opportunity to assure the public that the NRC has conducted an adequate assessment of the

safety of the replacement steam generators at San Onofre, including input and review by independent experts. FOE has retained Mr. Gundersen to assist in developing the record regarding the problems with the steam generator replacements, and to date Mr. Gundersen has produced three technical reports, referenced above, providing analysis on the causes and potential remedies for the steam generator failures. His wealth of experience in nuclear engineering and the nuclear industry will assist the Commission in deliberating and deciding the correct response to the situation at San Onofre.

IV. ADDITIONAL COMMISSION AUTHORITY

In addition to its authority to convene a license amendment proceeding under 10 C.F.R. § 2.309, the Commission can convene such a proceeding, including an adjudicatory public hearing, under its inherent supervisory authority.[12] In the interest of assuring adequate protection of the health and safety of the public, the Commission must consider what amendment(s) to the license is/are required by the cumulative changes made to the replacement generators, both in their original design and manufacture and in response to the recently revealed tube wall erosion, rupture, and vibration problems.

[12] *See supra*, n. 3.

V. CONTENTION

CONTENTION 1

PETITIONER CONTENDS THAT SAN ONOFRE CANNOT BE ALLOWED TO RESTART WIHOUT A LICENSE AMENDMENT AND ATTENDANT ADJUDICATORY PUBLIC HEARING AS REQUIRED BY 10 C.F.R. § 2.309, IN WHICH PETITIONER AND OTHER MEMBERS OF THE PUBLIC MAY PARTICIPATE

BASES FOR CONTENTION:

1. The San Onofre Nuclear Operating Station consists of two twin units, Unit 2 and Unit 3, each of which originally had two recirculating steam generators fabricated by Combustion Engineering (the "CE generators"), beginning operation in 1983 and 1984, respectively. In 2009, SCE replaced Unit 2's CE generators with new steam generators designed and fabricated by Mitsubishi Heavy Industries (MHI). Unit 3's replacement steam generators were ordered under the same contract and to the same specifications, and were replaced in 2010.

2. SCE extensively modified the original CE generator without seeking a license amendment pursuant to 10 C.F.R. § 50.90 in clear violation of 10 C.F.R. § 50.59.

3. There is evidence that a deliberate design objective shared by SCE and MHI was to avoid NRC review by claiming the new MHI steam generators were replacements that met the section 50.59 safety criteria enabling licensees to make modifications without having to seek a license amendment. According to engineers at SCE and MHI, "the major premise of the steam generator replacement project was that it would be implemented under the 10 C.F.R. § 50.59 rule, that is, without prior approval" by the NRC.[13]

[13] Boguslaw Olek & Tomoyuki Inoue, "Improving Like-for-Like RSGs," *Nuclear Engineering International* 36, 37 (Jan. 2012).

4. To this end, the SCE's Facility Change Report for San Onofre Units 2 and 3 for the period from December 19, 2008 through February 10, 2011 asserts: "Replacement of the steam generators is a replacement in kind in terms of overall fit, form, and function with no, or minimal, permanent modifications to the plant Safety Systems or Components (SSC)." Facility Change Report at 4.

5. The Facility Change Report also asserts: "The results of the RSG [Replacement Steam Generators] tube wall thinning analysis are conservative or essentially the same as results from the USFAR described tube wall thinning analysis for the OSGs [Original Steam Generators]. […] It was concluded that this change may be made without prior NRC approval." Facility Change Report at 4.

6. Contrary to SCE's claim that the new steam generators were in-kind replacements, the MHI generators differ significantly from the previous CE model. The key fabrication change in the new generators was the decision to add almost 400 tubes to each steam generator, increasing the total number of tubes by more than 4%. This significant increase in the number of tubes resulted in a series of subsequent design changes necessary to physically accommodate the additional tubes, including: removing the stay cylinder, which functioned as a support pillar to the tubesheet into which the U-tubes are inserted; thickening the tubesheet to compensate structurally for the removal of the stay cylinder; reducing the volume of water in the steam generator; changing the flow pattern; and reducing the inspection access area below the tubesheet. Gundersen Expert Decl. at ¶¶ 20, 23.1-23.2.

7. These design modifications altered the structural loads on the tubesheet, a critical safety consideration as the tubesheet serves as the key barrier keeping radiation inside the containment. Adding tubes also required increasing the nuclear reactor core flow, on which the

original design basis safety calculations for cooling the reactor are based. This flow increase necessitated yet more modifications to control the flow distribution to the tubes, including subsequent changes to the tube supports in an attempt to avoid increased vibration in the tubes. Gundersen Expert Decl. at ¶¶ 23.3-23.5. Notably, increased vibration resulting from the cascading design changes is now hypothesized to be the cause of the rapid tube degradation.

8. Replacement of the original steam generators with a substantially modified steam generator design created risks not considered in the safety analysis that require public review.

9. In SCE's Safety Evaluation assessing whether the proposed changes in the replacement steam generator's design would affect the safety analysis on which San Onofre's license is based, SCE took the position that the design changes would not affect the reactors' reliability or safety. This evaluation was wrong at the time of the generators' replacement because the new design repeatedly triggered the requirement for a license amendment under 10 C.F.R. § 50.59, as Mr. Gundersen's Declaration demonstrates. Gundersen Expert Decl. at ¶¶ 24-32. The failures of the steam generators at the reactors in 2012 showed why review of the design and amendment of the license is necessary.

10. The NRC failed to follow its own regulations, in particular 10 C.F.R. § 50.59, which require a formal licensing proceeding be convened and a license amendment granted before changes can be made to the facility that affect the final safety analysis. The NRC failed to follow its own regulations by allowing SCE to replace the steam generators without the requisite proceeding to amend the license. Accordingly, before San Onofre may be cleared to restart, the NRC must undertake a license amendment proceeding, including the adjudicatory public hearing required under 10 C.F.R. § 2.309.

SUPPORTING EVIDENCE

A. UNDER NRC REGULATION 10 C.F.R. § 50.59, THE NRC CONTINUES TO BE OBLIGED TO REQUIRE A LICENSE AMENDMENT BEFORE SAN ONOFRE UNITS 2 AND 3 MAY BE RESTARTED

11. Under 10 C.F.R. § 50.59, a licensee is required to obtain a license amendment if the proposed modification meets any one of eight criteria affecting the existing safety analysis as enumerated in subpart (c)(2) of section 50.59. The criteria, in part, require an amendment when the proposed changes would:

> a. Create a possibility for an accident of a different type than any previously evaluated in the final safety analysis report [(FSAR)] (as updated);
>
> b. Create a possibility for a malfunction of an SSC [system, structure, or component] important to safety with a different result than any previously evaluated in the final safety analysis report (as updated);
>
> c. Result in a departure from a method of evaluation described in the FSAR (as updated) used in establishing the design bases or in the safety analyses.

12. The design of the replacement steam generators at San Onofre met the criteria that trigger a license amendment thirty-nine separate times. Gundersen Expert Decl. at ¶ 32. Thus, the replacement of the steam generators at San Onofre triggered an obligation that the NRC determine, through a license amendment proceeding, whether the new design was safe.

13. As an example, SCE's removal of the stay cylinder alone meets at least three of the criteria in section 50.59. Each criterion independently triggers the requirement to seek a license amendment. As has now become apparent, the removal of the stay cylinder alone

increased the possibility of a structural malfunction or a different type of accident than previously analyzed as a result of the changes in structural loading. While every one of the regulation's eight triggering criteria has since been subsequently manifested through the failures at San Onofre in 2012, even at the time of replacement the changes SCE proposed required it to seek a license amendment under section 50.59. Gundersen Expert Decl. at ¶ 32.

14. Despite their own regulations, the NRC staff failed to require SCE to propose a formal license amendment. Had a license amendment proceeding been convened, it is likely that the NRC staff would have understood the important safety-related changes SCE planned, and the untimely tube degradation and radioactivity leak might have been avoided.

B. FAILURES IN TUBE INTEGRITY AND REACTOR PERFORMANCE AT SAN ONOFRE IN 2012 DEMONSTRATE THE NEED FOR A PUBLIC REVIEW OF THE SAFETY OF SAN ONOFRE, INCLUDING A ROOT CAUSE ANALYSIS OF THE TUBE FAILURES AND REVIEW OF NECESSARY DESIGN CHANGES IN THE SAN ONOFRE STEAM GENERATORS

15. SCE's assertion that the design modifications would have no impact on safety and reliability have also proven to be wrong in practice, as evidenced by the current inoperability of both reactors and the uncontrolled radioactive leak from Unit 3 into the environment. SCE's claim that the new MHI steam generators are replacements "in-kind" has thus been demonstrated empirically to be incorrect. Gundersen Expert Decl. at ¶ 32.

16. As explained further in Mr. Gundersen's Declaration, had the NRC conducted a review of the SG replacement design, it would have identified inadequacies in MHI's and SCE's analysis and design that could have prevented the present situation. Specifically, the NRC would have identified the inadequacy of the MHI computer codes applied to validate the tube design and vibration pattern prior to fabrication. MHI has had very little experience with the type of CE

reactor design at San Onofre, in particular the tight tube pitch and unique egg crate tube supports in the original SGs that kept the tubes from vibrating and colliding, and which MHI changed to broached plate tube supports in the replacement steam generator design. The computer code MHI used for design validation simply was not capable of analyzing the reactor design at San Onofre; rather, the code was qualified only for Westinghouse generators, which are not similar to CE generators. Review by the NRC would have identified this and other deficiencies, and is now necessary to rectify the public safety problem the generators present in their current state. *Id.* at ¶ 39-41.

17. A root cause analysis is necessary to determine the cause of the tubal degradation and failure, and to identify what design changes are needed to assure safe operation of the replacement steam generators. To this end, a public hearing process would enable experts such as Mr. Gundersen to contribute their knowledge of the current steam generator problem to the NRC's diagnostic work. Mr. Gundersen explains in his Declaration how the flow resistance of the broached plate designed by MHI is much higher than the original CE egg crate design because of the reduced spacing of the tubes in the broached plate. *Id.* at ¶ 33, 34. This key design difference between the old and new steam generators that both MHI and SCE missed has resulted in almost no water reaching the top of the steam generator, creating regions where the U-tubes are almost dry. Without liquid in the mixture, there is no damping against vibration, resulting in a severe fluid-elastic instability. A fundamental problem in the steam generator causing the vibration and, consequently, the tube wear is that there is too much steam and too little water at the top of the steam generators in the U-bend region. *Id.* at ¶ 35-38.

18. SCE has begun plugging damaged tubes in an attempt to return the reactor units to service quickly. This solution is inadequate, as Mr. Gundersen's analysis of the problem

demonstrates: plugging tubes will not address the root cause of the vibration and therefore additional large numbers of tubes will continue to degrade rapidly or rupture, leaving the public perpetually at risk. *Id.* at ¶ 43. Further, even if the tubes are not leaking or have not ruptured, they are at risk of bursting in a main steam line accident scenario. If a steam line break accident were to occur, the depressurization of the steam generator caused by the steam line break, coupled with the lack of water at the top of the steam generators, would cause cascading tube failures resulting in a massive radiation leak. *Id.* at ¶ 44. Plugging tubes as a solution fails to address the design deficiency causing the vibration and thus will never be sufficient to ensure the safety of the reactors. Input from experts like Mr. Gundersen will assist the Commission in determining an appropriate solution to the tube wear following a root cause analysis.

19. The magnitude of the risks to public health and safety from the excessive and rapid tube degradation at San Onofre is too great for too many people to be dealt with without public participation. The current shutdown and potentially very large financial penalty for replacing or repairing the steam generators is the result of a closed process including only the licensee and the NRC staff. An open hearing will allow the Commission to obtain the valuable insights of experts outside SCE and NRC staff. It will also help to assure the public that their health and safety are not being compromised behind closed doors.

20. The real-world evidence now available proving that the replacement steam generators meet the section 50.59 criteria triggering the licensing amendment process provides further reason for the Commission to require a formal adjudicative hearing at this time and allow parties such as Petitioner full rights of participation as contemplated in 10 C.F.R. § 2.309.

21. This Contention is supported by the Expert Declaration attached hereto. Specific paragraphs of the Declaration that support each basis are identified following each basis, and the Declaration as a whole is also generally supportive of the Contention.

VI. CONCLUSION

For the foregoing reasons, Petitioner has demonstrated that it has standing and that its contention should be admitted. Under 10 C.F.R. § 50.59, the cumulative changes in the licensing basis of San Onofre, carried out to accommodate substantially modified steam generators, necessitate a formal license amendment proceeding. The Commission should either clarify that the CAL process is a license amendment proceeding convened under 10 C.F.R. § 2.309 requiring an adjudicatory hearing, or in the alternative, pursuant to § 50.59 and its inherent supervisory authority[14] find that such a proceeding is in the public interest to fulfill the NRC's mandate to ensure adequate protection of the public health and safety. The Petitioner should be permitted to intervene in this proceeding and is entitled under 10 C.F.R. §2.309 to a hearing on its contention.

Respectfully submitted,

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/s/ Jessica Olson

/s/ Kristin Hines

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[14] *See supra* note 3.

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Counsel for Friends of the Earth

Date: June 18, 2012

Docket No. 50-361 and 50-362
FRIENDS OF THE EARTH
EXHIBIT ONE

UNITED STATES OF AMERICA BEFORE THE NUCLEAR REGULATORY COMMISSION

In the matter of

	)	May 31, 2012
Southern California Edison Company	)	Docket No. 50-361 and 50-362
	)	
San Onofre Nuclear Generating Station	)	

DECLARATION OF ARNOLD GUNDERSEN SUPPORTING THE PETITION TO INTERVENE BY FRIENDS OF THE EARTH REGARDING THE ONGOING FAILURE OF THE STEAM GENERATORS AT THE SAN ONOFRE NUCLEAR GENERATING STATION

I, Arnold Gundersen, declare under penalty of perjury under the laws of the United States of America that the following is true and correct, and executed this 31st day of May 2012:

1. My name is Arnold Gundersen. I am sui juris. I am over the age of 18-years-old.

2. As Chief Engineer for Fairewinds Associates, I have been retained by Friends of the Earth to provide expert services in connection with the above captioned matter regarding the ongoing failure and deterioration of the steam generators at San Onofre Nuclear Generating Station.

3. I earned my Bachelor Degree in Nuclear Engineering from Rensselaer Polytechnic Institute (RPI) cum laude. I earned my Master Degree in Nuclear Engineering from RPI via an Atomic Energy Commission Fellowship. Cooling tower operation and cooling tower plume theory were my area of study for my Master Degree in Nuclear Engineering.

4. I began my career as a reactor operator and instructor in 1971 and progressed to the position of Senior Vice President for a nuclear licensee prior to becoming a nuclear engineering consultant and expert witness. My Curriculum Vitae is attached as Exhibit 2.

5. I have testified before the Nuclear Regulatory Commission (NRC) Atomic Safety and Licensing Board (ASLB) and Advisory Committee on Reactor Safeguards (ACRS), the State of Vermont Public Service Board, the State of Vermont Environmental Court, the Florida Public Service Commission, the State of New York Department of Environmental Conservation, and in Federal Court.

6. I am an author of the first edition of the Department of Energy (DOE) Decommissioning Handbook, and the book entitled *Fukushima Daiichi: The Truth And The Way Forward*, Shueisha Publishing, 2012-2-17, Japan.

7. I have more than 40-years of professional nuclear experience *including and not limited to*: Cooling Tower Operation, Cooling Tower Plumes, Consumptive Water Loss, Nuclear Plant Operation, Nuclear Management, Nuclear Safety Assessments, Reliability Engineering, In-service Inspection, Criticality Analysis, Licensing, Engineering Management, Thermohydraulics, Radioactive Waste Processes, Decommissioning, Waste Disposal, Structural Engineering Assessments, Nuclear Fuel Rack Design and Manufacturing, Nuclear Equipment Design and Manufacturing, Prudency Defense, Employee Awareness Programs, Public Relations, Contract Administration, Technical Patents, Archival Storage and Document Control, Source Term Reconstruction, Dose Assessment, Whistleblower Protection, and NRC Regulations and Enforcement.

8. I have personal knowledge of the facts contained in this Declaration; and I am qualified to testify in support of this Petition. I have previously testified to the Advisory Committee on Reactor Safeguards and the NRC's 2.206 Petition Review Board.

OVERVIEW AND SCOPE OF THE PROCEEDING

9. My declaration is intended to support Friends of the Earth's Petition Concerning the Steam Generators at San Onofre Nuclear Generating Station.

SAN ONOFRE NUCLEAR REACTOR BACKGROUND

10. Originally designed and built by Combustion Engineering (CE), San Onofre's nuclear steam generators are a very unique design that is radically different from all other Pressurized Water Reactor (PWR) designs. Southern California Edison (Edison) decided to replace each San Onofre steam generator due to tube deterioration and degradation that slowly evolved during each Unit's 25-years of operation.

11. Documents reviewed show that the four replacement steam generator specifications are identical to each other and they were purchased together under a single contract with Mitsubishi Heavy Industries (MHI). However, rather than simply rebuild the steam generators to their original design specifications, Edison decided to extensively modify the original San Onofre steam generator design. Furthermore, none of the design modifications were necessary for operation of either San Onofre Unit 2 or 3.

ISSUES OF REACTORS

12. It now appears that after new Steam Generators were installed at San Onofre Unit 2 and Unit 3, the new tubes began to seriously degrade very quickly. Technicians first detected the unanticipated problems of significant wear in the tubes during the Unit 2 refueling outage in January 2012.

13. The wear-rate for these steam generator tubes is extraordinary because tube thickness has been reduced by as much as 30 percent in less than two years. While Unit 2 was shutdown for refueling, San Onofre Unit 3 was operating at full power when it experienced a complete perforation of one steam generator tube that allowed highly radioactive water from inside the reactor to mix with the non-radioactive water that turns the turbine.

14. As a consequence, an uncontrolled release of radiation into the environment ensued, and San Onofre Unit 3 was also forced to shut down due to steam generator failure.

RISKS POSED

15. The San Onofre reactors have significant problems because their newly installed steam generators have extensive degradation and are unable to perform their design function of containing the radioactive water in the facility. Steam generator tube degradation, like that which San Onofre is experiencing, causes a significant nuclear safety risk by substantially increasing the likelihood of an accident that releases radioactivity into the environment.

16. Unfortunately, a leak or disintegration of one or more tubes would cause the radioactive water to escape the containment. Because there is a 1,000-pound-per-square-inch (psi) pressure difference between the high-pressure radioactive side of the tubes and the lower pressure steam that then leaves the containment, a leak will inevitably release radioactivity to the environment.

17. Gross failure of one or more of the steam generator tubes could create a nuclear design basis accident and cause the nuclear reactor core to lose a portion of its cooling water. However, the unique concern of degraded steam generator tubes is that uncontrolled radiation releases from a tube break do not remain inside the containment building and instead leak out of the facility and into public areas via atmospheric dump valves and steam generator blowdown.

18. If a steam line break accident were to occur, the depressurization of the steam generator caused by the steam line break coupled with the lack of water at the top of the steam generators would cause cascading tube failures, involving hundreds of tubes. The cascading tube failures would pop like popcorn and cause excessive offsite radiation exposures.

CASCADING DESIGN CHANGES AS BASIC CAUSE

19. A cascading series of deliberate design changes likely caused the tube failures and tube degradation.

20. The key fabrication change supplanted to the San Onofre steam generators by the Edison/MHI team increased the total number of tubes in each steam generator by almost 400

tubes to more than 104 percent of each generator's original design. Each Original Steam Generator contained 9350 tubes while the Replacement Steam Generators each contain 9727 tubes.

21. Fairewinds believes it was this management decision to increase the number of tubes that lead in turn to a series of cascading design changes that created the serious problems San Onofre is experiencing in 2012.

22. The original San Onofre steam generator contained a tubesheet, which is a metal disc approximately 13-feet in diameter and slightly less than two feet thick, located near the bottom of the steam generator. Due to the already extremely large size of the CE steam generators, this tubesheet is one of the largest tubesheets ever fabricated after which 18,700 holes (9,350 in-hot/9,350 out-cold) were then drilled. This metallic disk serves as an anchor into which both sides of the U-tubes are inserted. Not only is the tubesheet extraordinarily heavy, but also there can be a pressure difference of approximately 2,000 pounds per square inch (psi) between the radioactive water on one side and non-radioactive water on the other.

23. In order to support the enormous tubesheet metallic disk, the original steam generator design at San Onofre contained a 'stay cylinder' in the center of the tubesheet that is a support pillar designed to relieve the weight in the middle of the tubesheet.

    23.1. When Edison decided to cram in additional steam generator tubes, the fabrication technique created by Edison/MHI for the San Onofre steam generators necessitated the removal of the 'stay cylinder' so that more tube holes could be drilled through the tubesheet. The Edison/MHI decision to add additional tubes and replace this key support pillar was part of the cascading fabrication changes that caused additional stresses and steam generator failure.

    23.2. Removing the stay cylinder required additional cascading fabrication changes. Because the tubesheet was no longer supported in the center by the stay cylinder, Edison/MHI required the fabrication of a thicker tubesheet so that it could bear the additional stress without a stay cylinder. This change in the tubesheet thickness meant

yet another design change by reducing the volume of water in the steam generator and changing the flow pattern and also reducing the inspection access area beneath the tubesheet that is required to fit personnel and equipment for tube inspection.

23.3. Changing the structural loads on the tubesheet have not only affected the reliability of the steam generators but also should have raised a serious safety concern because the tubesheet is the key barrier keeping radiation inside the containment. Should the tubesheet fail, radiation within the reactor would bypass the containment and pass directly into the environment. Due to the installation of the 'stay cylinder' in the original San Onofre steam generator configuration, a tubesheet failure and subsequent radiation release is considered to be beyond the calculations for a design basis accident at San Onofre. Yet Edison chose to challenge this critical safety barrier and licensing parameter by removing the "stay cylinder" in order to install more, unnecessary tubes.

23.4. Fabricating more tubes increased nuclear reactor core flow, which was unacceptable because it changed the original design basis safety calculations for cooling the reactor. For that reason Edison welded a flow-restricting ring into the steam generator nozzle in order to reduce the flow of cooling water back into the reactor to the original design parameters, which also changes the flow distribution to the tubes. Thus significant operational changes were also made to the radioactive side of the steam generator as a result of Edison's addition of more steam generator tubes.

23.5. All of these changes necessitated even more fabrication changes within the steam generator. For example, more tubes meant that the tube supports had to be modified in an attempt to avoid the increased vibration caused by the flow changes induced by the Edison/MHI fabrication changes. The feedwater distribution ring inside the steam generator was also dramatically modified in order to avoid a serious flow induced water hammer.

SIGNIFICANCE OF DESIGN MODIFICATIONS ON SAFETY

24. The requirements for the process by which nuclear power plant operators and licensees may make changes to their facilities and procedures as delineated in the safety analysis report and without prior NRC approval are limited by specific regulations detailed in The Nuclear Regulatory Commission's *10 CFR Part 50, Domestic Licensing of Production and Utilization Facilities, Section 50.59, Changes, Tests and Experiments*.

25. The implementing procedures for the 10 CFR 50.59 regulations have eight criteria that are important for nuclear power plant safety. (These eight criteria are provided in Table 1, footnote A below.)

26. These implementing procedures created for 10 CFR. 50.59 require that the license be amended unless none of these eight criteria are triggered by any change made by Edison at San Onofre. If a single criterion is met, then the regulation requires that the licensee pursue a license amendment process.

27. By claiming that the steam generator replacements were a *like-for-like* design and fabrication, Edison avoided the more rigorous license amendment process. From the evidence reviewed, it appears that the NRC accepted Edison's statement and documents without further independent analysis. In the analysis detailed below, Fairewinds identified 39 separate safety issues that failed to meet the NRC 50.59 criteria. Any one of these 39 separate safety issues should have triggered the license amendment review process by which the NRC would have been notified of the proposed significant design and fabrication changes.

28. As the NRC guidelines state:

> "(c)(1) A licensee may make changes in the facility as described in the final safety analysis report (as updated), make changes in the procedures as described in the final safety analysis report (as 1.187-A-1updated), and conduct tests or experiments not described in the final safety analysis report (as updated) without obtaining a license amendment pursuant to § 50.90 only if: (i)A change to the technical specifications

incorporated in the license is not required, and **(ii) The change, test, or experiment does not meet any of the criteria in paragraph (c)(2) of this section."**[1] [Emphasis Added]

29. In its previous reports, Fairewinds identified at least eight modifications to the original steam generators at San Onofre.

30. Table 1 below was designed to compare the eight major design modifications that Fairewinds identified in its analysis with the eight criteria the NRC applies to the license review process in order to determine whether or not a new license amendment process is required.

31. The major design changes are located at the top of the table, and the NRC Criteria are listed in the left hand column of table. The term SSC stands for Systems, Structures and Components. A green *No* means that the *like-for-like* criteria were indeed met and that no license amendment was required. A red *Yes* means that Edison should have applied for a license amendment.

32. Table 1 shows that 7 out of 8 of the major design changes to the original steam generators meet a total of 39 of the NRC's 50.59 criteria requiring amendment to the license.

[1] See, 1.187-A-1, ttp://pbadupws.nrc.gov/docs/ML0037/ML003759710.pdf

Table 1
Steam Generator Design Changes Identified By Fairewinds Compared With The NRC's Like-For-Like Criteria

50:59 Criteria (A)	(B) Remove stay cylinder	Change tube sheet	Tube alloy change	Add tubes	Change tube support	Add flow restrictor	Additional water volume	Feed water distribution ring
i – Accident Frequency Increase	Yes (1)	Yes (1)	No	Yes (3,4)	Yes (3,4,8)	No	No	No
ii – Increase in SSC Malfunction occurrence	Yes (1)	Yes (1)	No	Yes (3,4)	Yes (3,4,8)	No	No	No
iii - Accident consequent increase	Yes (1)	Yes (1)	No	Yes (3,4)	Yes (3,4,8)	Yes (2)	Yes (2,5,6)	No
iv - Increase in SSC consequence of malfunction	Yes (1)	Yes (1)	No	Yes (3,4)	Yes (3,4,8)	Yes (2)	Yes (2,5,6)	No
v - Create unanalysed accident	Yes (1)	Yes (1)	No	No	No	Yes (2)	Yes (2,5,6)	Yes (3,7,8)
vi – Create new malfunction	Yes (1)	Yes (1)	No	No	Yes (3,8)	Yes (2)	No	Yes (3,7,8)
vii – Alter fission product barrier	Yes (1)	Yes (1)	No	Yes (3)	No	No	No	No
viii – Change design basis evaluation method	Yes (2)	Yes (2)	No	Yes (2)	Yes (2,8)	Yes (2)	Yes (2,5,6)	No

Table Footnotes

A - The criteria listed in the left column in the table above refers to the criteria as laid out in the NRC Guidelines[2] which states as follows:

"(2) A licensee shall obtain a license amendment pursuant to § 50.90 prior to implementing a proposed change, test, or experiment if the change, test, or experiment would:

(i) Result in more than a minimal increase in the frequency of occurrence of an accident previously evaluated in the final safety analysis report (as updated);

(ii) Result in more than a minimal increase in the likelihood of occurrence of a malfunction of a structure, system, or component (SSC) important to safety previously evaluated in the final safety analysis report (as updated);

(iii) Result in more than a minimal increase in the consequences of an accident previously evaluated in the final safety analysis report (as updated);

(iv) Result in more than a minimal increase in the consequences of a malfunction of an SSC important to safety previously evaluated in the final safety analysis report (as updated);

[2] See, 1.187-A-1, ibid, ttp://pbadupws.nrc.gov/docs/ML0037/ML003759710.pdf

(v) Create a possibility for an accident of a different type than any previously evaluated in the final safety analysis report (as updated);
(vi) Create a possibility for a malfunction of an SSC important to safety with a different result than any previously evaluated in the final safety analysis report (as updated);
(vii) Result in a design basis limit for a fission product barrier as described in the FSAR (as updated) being exceeded or altered; or
(viii) Result in a departure from a method of evaluation described in the FSAR (as updated) used in establishing the design bases or in the safety analyses."

B – The horizontal axis contains a list of design changes made by Edison and whether they meet or have not met the criteria as set out in 10 CFR 50.59.

1 – The Steam Generator Replacement Project modified the tube sheets and stay cylinder that are a containment barrier – The NRC was not informed nor did it specifically approve these changes to the containment barrier as they were apparently not addressed under Edison's analysis for the 10 CFR 50.59 process;
2 – The Mitsubishi thermo hydraulic code is inadequate to assess flow inside the Steam Generators that dramatically affect the ability to cool the nuclear reactor core in the event of an accident;
3 – The Steam Generator Replacement Project increases the consequences of a steam line break accident;
4 – The Steam Generator Replacement Project has already proven to increase the frequency of tube failure;
5 – The Steam Generator Replacement Project changed the volume of primary coolant because more tubes were added, which changes the Final Safety Analysis Report;
6 – The Steam Generator Replacement Project changed the flow rate of primary coolant, which changes the Final Safety Analysis Report;
7 – The Steam Generator Replacement Project changed the potential for water hammer. Given that the Mitsubishi thermo hydraulic code is inadequate, the potential for water hammer is increased;
8 – The Steam Generator Replacement Project created steam binding at top of steam generator. The steam generator is designed to remove heat in the event of an accident and its role has been compromised.

The Actual Steam Generator Problem Causing Vibration

33. As water moves vertically up in a steam generator, the water content reduces as more steam is created. When the volume of steam is much greater than water then the flow resistance of the water/steam mixture passing through the tube supports accounts for one third of the total resistance at the top of the steam generator. Therefore to avoid vibration at the top of the tubes, Mitsubishi needed to specifically analyze the type of tube support to use in this unique application.

34. The flow resistance of the Mitsubishi broached plate is *much higher* than that of the original Combustion Engineering egg crate design because the tubes are so tightly packed in the original CE San Onofre steam generators. By reviewing the documents thus far produced, it appears that due to Mitsubishi's fabrication experience with broached plates, both Edison and Mitsubishi missed this key difference in the design and fabrication of the new San Onofre steam generators.

35. Not only is Mitsubishi unfamiliar with the tightly packed CE design, but also Edison's engineers created so many untested variables to the new fabrication that this new design had a significantly increased risk of failure. As a result of the very tight pitch to diameter ratios used in the original CE steam generators, Mitsubishi fabricated a broached plate design that allows almost no water to reach the top of the steam generator.

36. The maximum quality of the water/steam mixture at the top of the steam generator in the U-Bend region should be approximately 40 to 50 percent, i.e. half water and half steam. With the Mitsubishi design the top of the U-tubes are almost dry in some regions.[3] Without liquid in the mixture, there is no damping against vibration, and therefore a severe fluid-elastic instability developed.

37. In response to the Edison/Mitsubishi steam generator changes, the top of the new steam generator is starved for water therefore making tube vibration inevitable. Furthermore, the problem appears to be exacerbated by Mitsubishi's three-dimensional thermal-hydraulic analysis determining how the steam and water mix at the top of the tubes that has been benchmarked against the Westinghouse but not the Combustion Engineering design.

38. The real problem in the replacement steam generators at San Onofre is that too much steam and too little water is causing the tubes to vibrate violently in the U-bend region. The tubes are quickly wearing themselves thin enough to completely fail pressure tests. Even if the new tubes are actively not leaking or have not ruptured, the tubes in the Mitsubishi fabrication are at risk of bursting in a main steam line accident scenario and spewing radiation into the air.

RAMIFICATIONS OF AN INADEQUATE NRC REVIEW

39. Edison's strategic goal was to avoid the process of license amendment according to the January 2012 article in *Nuclear Engineering International NEI Magazine.*[4] Had Edison

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[3] With the Mitsubishi design the top of the U-tubes are almost dry in some regions. Fairewinds research and four independent industry experts, who wish to remain anonymous, substantiate this statement.

[4] Improving Like-For-Like Replacement Steam Generators by Boguslaw Olech of Southern California Edison and

notified the NRC that the new steam generators at San Onofre were not a *like-for-like* replacement, a more thorough review through the license amendment process would have been required. Given that scenario, it is likely that the requisite and thorough NRC review would have identified the design and fabrication inadequacies that appear to have caused the San Onofre steam generator tube failures.

40. More specifically, Fairewinds believes that the NRC would have identified the inadequacy of the Mitsubishi Heavy Industry computer code applied to validate the tube design and vibration pattern prior to fabrication. Mitsubishi's computer code was simply not capable of analyzing Combustion Engineering (CE) designs like San Onofre and was only qualified for Westinghouse designs that are not similar to the original CE steam generator design. In NRC licensing jargon, the Mitsubishi design codes were not benchmarked for the CE Design.

41. While Mitsubishi Heavy Industry has been supplying steam generators for many years in Japan, it did so under a specific license from Westinghouse for Westinghouse nuclear reactors. Although Mitsubishi made several incremental changes to the Westinghouse design, such as switching to alloy 690 tubing and the use of stainless steel broached plate tube supports, Mitsubishi has had very little experience with the tight tube pitch and the egg crate design used in the original CE design for San Onofre.

REPAIR

42. San Onofre engineers should have precise maps detailing the degraded and leaking tubes as well as the exact location of the leak(s) on each tube. Such data is just one piece of critical information required in conducting a thorough root cause analysis of the problem and determining an accurate solution. Edison claims that the proximate cause of these U-tube failures at San Onofre is high vibration, and it has embarked upon a process of plugging some of these damaged tubes in hopes of quickly restarting one or both units. Fairewinds

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Tomouki Inoue of Mitsubishi Heavy Industries, Nuclear Engineering International, January 2012, page 39. This article was based on a paper published at ICAPP 2011, 2-5 May 2011, Nice, France, paper 11330. Boguslaw Olech, P.E., Southern California Edison Company, 14300 Mesa Rd., San Clemente, CA 92674, USA, Email: bob.olech@sce.com. Tomoyuki Inoue, Mitsubishi Heavy Industries Ltd. (MHt), 1-1 Wadasaki-cho 1-Chome, HyogoKu, Kobe, Japan 652 8585, Email: tomoyukiJnoue@mhi.co.jp.

believes that this damage is occurring on the outside of the tubes where they collide with each other, while access to the tubes for repair and/or plugging can only be conducted from inside the tubes. Space limitations due to the tight fit of the 9,700 tubes (19,400 holes in the tube sheet) in each steam generator have made it impossible to access the outside of the U-tubes for inspection where the wear is actually occurring.

43. Presently, the Edison approach is to plug tubes in the most heavily damaged zone of each steam generator. Plugging the tubes only eliminates the radioactive water inside the tubes, but it does not eliminate the vibration, so the plugged tubes will continue to vibrate and damage adjacent tubes.

44. If a steam line break accident were to occur, the depressurization of the steam generator caused by the steam line break coupled with the lack of water at the top of the steam generators would cause cascading tube failures, involving hundreds of tubes. The cascading tube failures would pop like popcorn and the cascading failures would cause excessive offsite radiation exposures.

45. Fairewinds investigation has found that plugging the tubes is not a sure solution, because it fails to deal with the root causes of a failed design and it relies upon the incorrectly applied Mitsubishi 3-Dimensional steam analysis to determine which tubes should be plugged. Realistically, the 3-D steam analysis is not accurate enough to apply to such important safety-related determinations. To make such mathematical risk 3-D analysis, a very large margin of error must be applied, and that has not been done. For example, if the 3-D steam analysis determines that plugging 100 tubes is a solution, then plugging ten times that number might be the appropriate solution due to the mathematical errors in the 3-D analysis being applied by Edison and Mitsubishi.

46. Fairewinds concludes that plugging the tubes will never solve the underlying problem because vibration is the result not the root cause of the steam generator problems at San Onofre. The actual problem is a variety of design changes that have caused too much steam and too little water at the top of the steam generators. Plugging tubes cannot repair these design changes that are causing the tubes to collide with each other.

OPTIONS FOR CONTINUED OPERATION

47. Complete Replacement - The ongoing plugging of the tubes will not eliminate the vibrational failure mechanism causing tube failures. Over time, the damaged tubes that are plugged will in turn damage more tubes. Therefore, Fairewinds believes that the only sure solution to this significant safety issue is to once again cut open the reactor containment and install new steam generators that replicate the original CE design.

48. Repair In Place - While technically this would be an extremely challenging repair process, it may be possible to cut the steam generators apart while still inside the containment. Such a process would take approximately 18 months to make repairs and then weld the steam generators back together again without cutting the containment open. Cutting the top off the steam generators would allow construction personnel access so that additional supports could be inserted into the U-tube region. Smaller replacement packages would fit through the existing equipment hatch and the containment would not be compromised another time. The cost for these repairs would be less than completely redesigning and manufacturing new steam generators and replacement power costs would be less.

49. Power Reduction - Reducing power does not provide a remedy for the underlying structural problems that are creating the vibration that has damaged and will continue to damage tubes deep inside the San Onofre steam generator. Edison has suggested that plugging tubes and operating at indeterminate reduced power levels for the remainder of the life of the plant may be a solution to the San Onofre tube vibration problem.

50. Unfortunately this course of action would leave San Onofre operating with a significant safety risk if the NRC were to allow the reactors to restart.

51. Operating at reduced power will not prevent previously damaged tube supports and plugged tubes from vibrating and damaging surrounding tubes and tube supports, and it will worsen the existing damage.

52. More importantly, Fairewinds concern is that operating the San Onofre reactors at a lower power and flow rate might actually create a resonant frequency within the steam generators at

which some of the tubes will vibrate as bad or worse than they did originally. Because the plugged tubes are now filled with air their weight has changed, and therefore the plugged tubes will vibrate with a different amplitude and frequency. The inaccuracies in the Edison and Mitsubishi computer code do not allow Edison and Mitsubishi to conduct a resonant frequency analysis proving that such a problem will not occur.

53. Historical evidence from other operating nuclear reactors that have attempted to mitigate vibrational damage by using power reductions rather than solving the resonant frequency issues have in fact compromised other nuclear safety related components by operating at reduced power.

53.1. In 2002 the Exelon Quad Cities Nuclear Power Plant in Illinois operated its Unit 2 reactor at reduced power in order to eliminate vibrationally induced damage causing high moisture carryover in its steam dryer. While the power reduction temporarily reduced moisture carryover, the problem reoccurred and a shutdown was ordered causing an extended unplanned outage. Vibrationally induced severe cracking was discovered in the steam dryer and repaired. Following an analysis and subsequent repairs, Exelon claimed to have rectified the Quad Cities Unit 2 problems only to be forced in 2003 to once again attempt operation at a reduced power level when vibrationally induced steam dryer moisture carryover became excessive. Following this second attempt to operate the reactor at a reduced power level, pieces of the dryer as large as a man broke off and damaged nuclear power safety related components, and a second unplanned extended outage ensued. Once again, vibration was determined to be the cause of the gross failure and another unplanned and forced outage. Finally, following years of analysis and two damaged steam dryers, Quad Cities made major piping modifications that are alleged to have eliminated harmonic frequencies, prevented further component damage, and allowed Unit 2 to eventually return to full power production.[5]

53.2. A second example of a failed attempt to reduce power to solve vibrationally induced resonance frequency problems occurred at the Susquehanna nuclear plant in

[5] http://pbadupws.nrc.gov/docs/ML0609/ML060960338.pdf

Pennsylvania. During the mid 1990s, a vibrationally induced failure in the jet pump sensing lines occurred at Susquehanna. This failure was attributed to the vane passing frequency from the recirculation pumps causing harmonic vibration of the lines. Like Quad Cities, Susquehanna attempted to implement a power reduction in order to minimize the harmonic vibrations. Unfortunately, the resonant vibration issues continued to damage systems after the power was reduced thereby forcing an unplanned outage and extensive modifications and repairs.

CONCLUSION

54. In conclusion, the NRC has stated that nuclear power plants like San Onofre cannot risk compromising critical safety systems and possible radiological contamination in an effort to return to operation before a thorough root cause analysis, modifications, and subsequent repairs are adequately reviewed by the NRC and implemented. Historical evidence has proven that power reductions do not solve underlying and serious degradation problems, resonance frequency issues. Rather, power reductions can significantly increase the risk of unplanned, forced outages during times of peak demand and can cause significant risk to public health in the event of a single tube rupture or a series of ruptures if the main steam line were to break.

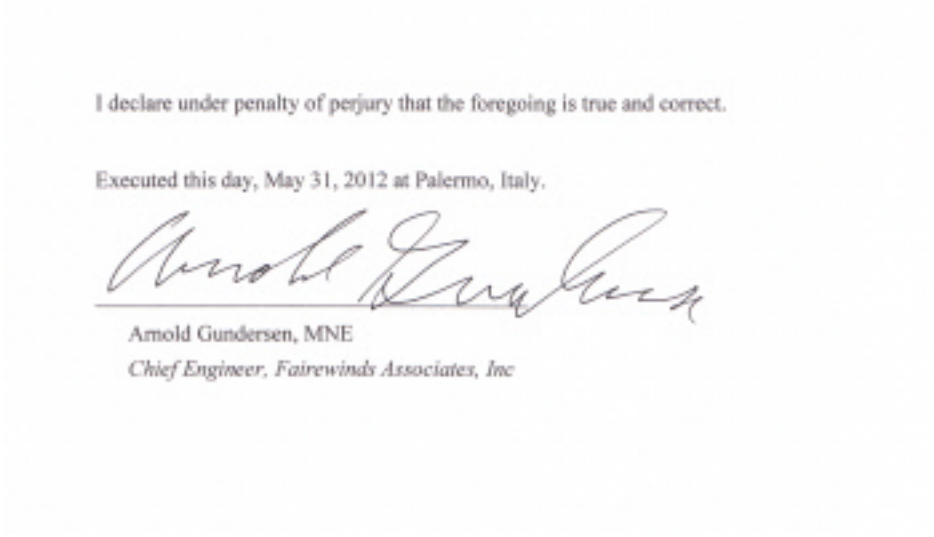
55. Finally, if a steam-line accident were to occur, vibrationally induced tube damage at San Onofre could cause an inordinate amount of radioactivity to be released outside of the containment system compromising public health and safety in one of the most heavily populated areas in the entire United States.

-End-

I declare that under penalty of perjury that the foregoing is true and correct to the best of my knowledge. The facts presented in this declaration are true and correct to the best of my knowledge, and the opinions expressed are based on my best professional judgment. Executed in Accord with 10 CFR 2.304 (d) and 2.326 (b),

(Electronically signed)

Arnold Gundersen, MENE, RO
Fairewinds Associates, Inc
Burlington, Vermont 05408
Tel: (802) 865 9955
Email: arnie@sailchamplain.net
Date: May 31, 2012



DECLARATION OF LYN HARRIS HICKS

I, LYN HARRIS HICKS, declare as follows:

1. I am a resident of San Clemente, California. I own a house at 3908 Calle Ariana, San Clemente, California, 92672 and I have lived here since 1969 with my husband KC Hicks, and our two daughters Meri Berniece and Lyn Ellen. Prior to living on Ariana at this address, we lived there for eleven years at 253 Avenida Montalvo, San Clemente about 3.5 miles from the San Onofre nuclear plant. I am now a widow of one year.
2. I have been a member of Friends of the Earth intermittently for approximately 40 years and I am currently a member of Friends of the Earth. I became a member of Friends of the Earth due to my appreciation for their work, including their campaign focused on the San Onofre nuclear plant in San Clemente, California.
3. My home is about 2.5 miles from San Onofre nuclear power plant. I am a retired teacher and was a journalist and was the editor of the Daily Sun Post, San Clemente.
4. My two daughters attended school at Concordia Elementary approximately three miles from the San Onofre nuclear plant.
5. One of my grandchildren, fifteen year old Kellen, son of our daughter Ellen and her husband Ken Rhoda, was born and raised within two to three miles of San Onofre nuclear plant. We have spent many decades on our beautiful beaches throughout the summer plus many weekends throughout the years in our bit of heaven.
6. I have been concerned about the environmental and potential impacts from nuclear generated electricity for half a century.
7. After the nuclear accident at Fukushima, Japan in March 2011, I became even more troubled about the impacts from nuclear power. My interest in the issue is heightened due the proximity of my home to San Onofre nuclear power plant which lies 2.5 miles to the south.
8. Given how close I live to San Onofre one of my main concerns is that my health and welfare is at risk from the operation of this plant. I am also worried for the health and safety of my children and grandchild since they live within a few miles of the nuclear plant at San Onofre.

9. My concerns about nuclear power increased further after San Onofre's January 31, 2012, steam generator tube rupture in Unit 3 that released radioactive material into the environment. My interests will be harmed if San Onofre is allowed to restart without the problems at the plant being resolved.
10. The quality of my life in San Clemente and my peace of mind have increased dramatically since the shut down of the nuclear reactors at San Onofre in January 2012. The lack of reliability at San Onofre impacts me and my community in Southern California. An accident at San Onofre as a result of restarting the plant would negatively affect my property value and the property values in my community. An accident at San Onofre would also negatively affect the environment of the community in which I live and enjoy.
11. I request that the Nuclear Regulatory Commission hold a public hearing regarding the safety of the steam generators at San Onofre.
12. I strongly support the petition to intervene, request for a hearing and request for a stay filed by Friends of the Earth with the Nuclear Regulatory Commission regarding San Onofre and I believe that San Onofre should not be restarted until it can be guaranteed that there will be no repeat of the severe damage to the San Onofre steam generators.

I declare, under penalty of perjury, that the foregoing information is true, accurate, and correct. Executed on May 29th, 2012, in San Clemente, California.

Lyn Harris Hicks

SUPPLEMENTAL DECLARATION OF LYN HARRIS HICKS

I, LYN HARRIS HICKS, declare as follows:

1. I submit this addition to my Declaration ("Supplemental Declaration") to supplement my previous Declaration from May 29th, 2012.

2. I authorize, and had previously intended to authorize with my Declaration of May 19th, 2012, FOE to request a hearing on my behalf, and to represent my interest in such a proceeding, as well as any litigation pertaining to this issue.

I declare, under penalty of perjury, that the foregoing information is true, accurate, and correct. Executed on **July 18, 2012**, in San Clemente, California.

Lyn Harris Hicks

Lyn Hicks

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of	)	Docket No. 50-361
	)	50-362
SOUTHERN CALIFORNIA	)	
EDISON COMPANY	)	May 30, 2012
	)	
(San Onofre Nuclear Generating Station)	)	

DECLARATION OF MARCELIN E. KEEVER

I, Marcelin E. Keever, hereby declare as follows:

1. The facts set forth in this declaration are based on my personal knowledge.

2. I am the Oceans and Vessels Project Director and Legal Director for Friends of the Earth, Inc. I have served as the Oceans and Vessels Project Director since being hired at Friends of the Earth in June 2008 and as the Legal Director since September 2010. Friends of the Earth is a tax exempt, nonprofit environmental advocacy organization founded in 1969. Friends of the Earth is headquartered and incorporated in the District of Columbia and has an office in San Francisco, California. I am also a member of Friends of the Earth.

3. I am familiar with the organization's mission, which is to defend the environment and create a more healthy and just world, in particular by engaging in efforts to improve the environmental, health, and safety conditions at civil nuclear facilities licensed by the Nuclear Regulatory Commission and its predecessor agencies and fighting proposals to design and build new reactors that use federal funds to underwrite such initiatives. To that end, Friends of the Earth utilizes its institutional resources, including legislative advocacy, litigation, and public outreach and education, to minimize the risks that nuclear facilities pose to its members and to the general public.

4. Friends of the Earth is a part of Friends of the Earth International, a federation of grassroots groups working in 76 countries on today's most urgent environmental and social issues. Friends of the Earth International is the world's largest grassroots environmental federation. In the United States, Friends of the Earth has more than 9,100 members in all 50 states (including 1,900 members in California), and over 140,000 activists.

5. Friends of the Earth relies on science and uses the law to create and advocate for innovative strategies to conserve natural resources and protect public health and the environment. Friends of the Earth actively engages in a number of efforts before the Nuclear Regulatory Commission (NRC) to improve operating nuclear facilities and in litigation to support these efforts. The instant petition, request for a hearing and request for a stay in the NRC proceeding regarding Southern California Edison's (SCE) San Onofre Nuclear Generating Station (San Onofre) in San Clemente, California, is a central and integral part of our advocacy to address the environmental, health and safety impacts from the San Onofre nuclear facility.

6. Friends of the Earth's work on nuclear facilities and issues frequently appears in its publications, in its quarterly newsmagazine, and on the internet at its website at www.foe.org, its Facebook page and its Twitter feed. As Legal Director, I am familiar with Friends of the Earth's efforts to educate and inform our members and activists, including outreach to members on nuclear issues. Friends of the Earth's members rely on the organization to advocate before the NRC regarding nuclear facilities. They also rely on the organization to represent their interests by participating in rulemaking and other regulatory processes.

7. A major objective for Friends of the Earth is that the public have an opportunity to influence the outcome of government and corporate decisions that affect the lives of many people. Thus the organization regularly advocates for transparency and openness in government and corporate decision making. In particular, Friends of the Earth has sought for many years to

increase public involvement in the decisions of the Nuclear Regulatory Commission and the nuclear industry.

8. Friends of the Earth members include persons owning property and recreating in the area surrounding San Onofre Nuclear Generating Station who risk exposure to radiation from those facilities affecting their health and safety, adverse impacts to the ecosystem of Southern California, and diminished property values, from possible radiation leaks.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge, information, and belief.

Executed at San Francisco, on May 30, 2012.

Marcelin E. Keever