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UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION  
  
BEFORE THE COMMISSION

OFFICE OF SECRETARY  
RULEMAKINGS AND  
ADJUDICATIONS STAFF

In the Matter of )  
Pa'ina Hawaii, LLC )  
 )  
Material License Application )  
\_\_\_\_\_ )

Docket No. 30-36974-ML

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INTERVENOR CONCERNED CITIZENS OF HONOLULU'S  
OPENING BRIEF RE: QUESTIONS CERTIFIED BY  
THE LICENSING BOARD ON AUGUST 31, 2007

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November 7, 2007

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## TABLE OF CONTENTS

	<u>Page</u>
I. INTRODUCTION .....	1
II. BACKGROUND .....	2
A. Aviation Accidents And Natural Disasters Involving Pa'ina's Proposed Irradiator Pose Significant Threats To Public Health And Safety .....	2
B. Procedural History .....	5
III. 10 C.F.R. § 30.33(a)(2) REQUIRES A SAFETY ANALYSIS OF THE RISKS THAT ARE ENDEMIC TO PA'INA'S PROPOSED IRRADIATOR SITE .....	6
IV. TO PROTECT PUBLIC HEALTH AND SAFETY ADEQUATELY, THE COMMISSION SHOULD ESTABLISH $10^{-6}$ PER YEAR AS THE PROBABILITY THRESHOLD TRIGGERING SITE-RELATED SAFETY ANALYSIS .....	11
V. CONCLUSION.....	13

## TABLE OF AUTHORITIES

	<u>Page</u>
<b>FEDERAL CASES</b>	
<u>Colautti v. Franklin</u> , 439 U.S. 379 (1979).....	7
<u>Jarecki v. G.D. Searle &amp; Co.</u> , 367 U.S. 303 (1961).....	7
<u>Kungys v. United States</u> , 485 U.S. 759 (1988).....	7
<u>United States v. Bucher</u> , 375 F.3d 929 (9th Cir. 2004) .....	7
<b>ADMINISTRATIVE DECISIONS</b>	
<u>Duke Power Co. (Catawba Nuclear Station, Units 1 and 2)</u> , CLI-83-19, 17 NRC 1041 (1983).....	6
<u>Entergy Nuclear Vermont Yankee, L.L.C., and Entergy Nuclear Operations, Inc.</u> , (Vermont Yankee Nuclear Power Station), LBP-04-31, 60 NRC 686 (2004) .....	9
<u>Pa`ina Hawaii, LLC (Material License Application)</u> , LBP-06-12, 63 NRC 403 (2006).....	8, 9
<u>Private Fuel Storage, LLC (Independent Spent Fuel Storage Installation)</u> , CLI-01-22, 54 NRC 255 (2001).....	1, 2, 11, 12
<b>CODE OF FEDERAL REGULATIONS</b>	
10 C.F.R. § 2.306.....	5
10 C.F.R. § 30.33(a)(2).....	passim
10 C.F.R. § 36.13(a).....	6, 7, 9
<b>FEDERAL REGISTER</b>	
58 Fed. Reg. 7,715 (Feb. 9, 1993) .....	10, 11
60 Fed. Reg. 20,883 (Apr. 28, 1995) .....	12

**UNITED STATES CODE**

42 U.S.C. § 2013(d) ..... 11

UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

BEFORE THE COMMISSION

In the Matter of )  
Pa'ina Hawaii, LLC ) Docket No. 30-36974-ML  
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Material License Application )  
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INTERVENOR CONCERNED CITIZENS OF HONOLULU'S OPENING BRIEF  
RE: QUESTIONS CERTIFIED BY THE LICENSING BOARD ON AUGUST 31, 2007

I. INTRODUCTION

Pursuant to the Commission's order in CLI-07-26, intervenor Concerned Citizens of Honolulu hereby files its opening brief regarding whether, in the circumstances presented, 10 C.F.R. § 30.33(a)(2) requires a safety analysis of the risks endemic to the site applicant Pa'ina Hawaii, LLC proposes for its irradiator. As discussed in greater detail herein, a thorough analysis of the risks associated with placing up to one million curies of Cobalt-60 at a location vulnerable to aviation accidents, tsunamis, hurricanes and earthquakes is vital to determine whether Pa'ina's proposed irradiator would be "adequate to protect health and minimize danger to life or property," as 10 C.F.R. § 30.33(a)(2) mandates. See Part III, infra. Such an analysis must include identifying and evaluating the likelihood of accidents, both natural and manmade, that could affect the facility and comparing that likelihood to an established threshold probability to determine which accidents qualify as "credible event[s]" which the [irradiator] must be designed to withstand without releasing dangerous levels of radiation." Private Fuel Storage, LLC (Independent Spent Fuel Storage Installation) ("PFS"), CLI-01-22, 54 NRC 255, 257 (2001). For the reasons set forth below, Concerned Citizens submits that the appropriate

probability threshold beyond which site-related safety analysis is required is  $10^{-6}$  (one in a million) per year, the same threshold the Commission has established for other non-reactor facilities. Id., 54 NRC at 263-65; see Part IV, infra.

## II. BACKGROUND

### A. Aviation Accidents And Natural Disasters Involving Pa'ina's Proposed Irradiator Pose Significant Threats To Public Health And Safety.

Pa'ina seeks a license from the Nuclear Regulatory Commission ("NRC") to possess up to a million curies of Cobalt 60 for use in an underwater irradiator for the production and research irradiation of food, cosmetic, and pharmaceutical products. See Final Topical Report on the Effects of Potential Natural Phenomena and Aviation Accidents at the Pa'ina Hawaii, LLC Irradiator Facility at 1-1 (ML071280833) ("Final Topical Report"); 4/30/07 Licensing Board Order (Posing Questions for the Parties) at 6. The Co-60 sources would be stored in an irradiator pool with a liner consisting of 6 inches of concrete, with ¼-inch of steel on the inside and outside. See Final Environmental Assessment Related to the Proposed Pa'ina Hawaii, LLC Underwater Irradiator in Honolulu, Hawaii at 2 (ML071150121) ("Final EA").

Pa'ina proposes to locate its irradiator immediately adjacent to active runways at Honolulu International Airport, "one of the busiest airports in the United States," which are used by both civilian and military aviation for more than 300,000 departures and landings annually. Final Topical Report at 2-1; see also id. at 2-3 to 2-4; M. Resnikoff, "The Probability of Aircraft Impact into the Proposed Pa'ina Hawaii Irradiator" at 3-5 (Feb. 7, 2007) ("Resnikoff Report").<sup>1</sup> Due to the proximity of the proposed irradiator site to busy runways, the NRC Staff's consultants concluded the facility would have a one-in-5,000 chance of being hit by an airplane during each

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<sup>1</sup> The Resnikoff Report is attached as Exhibit 1 to Concerned Citizens' Contentions Re: Draft Environmental Assessment and Draft Topical Report (filed Feb. 9, 2007) (ML070510116).

year of its operation (one-in-500 odds during the ten-year period of the requested material license). Final Topical Report at 2-18. Concerned Citizens' expert found that even this high probability underestimates the risk, calculating that the annual likelihood of an aviation accident involving the irradiator would actually be 1-in-2,786 or 1-in-1,757 (nearly one-in-175 over the license's ten year period), depending on the methodology used. See Resnikoff Report at 18; Declaration of Marvin Resnikoff, Ph.D. Re: Draft Environmental Assessment and Draft Topical Report at ¶¶ 10-14 (Feb. 9, 2007) ("Resnikoff Declaration I").<sup>2</sup>

Pa'ina's proposed site is also extremely vulnerable to natural disasters. The site lies within the official State of Hawai'i Civil Defense tsunami evacuation zone and, due to its location adjacent to Ke'ehi Lagoon, is at significant risk of flooding associated with hurricane storm surges. Declaration of George Pararas-Carayannis, Ph.D. Re: Draft Environmental Assessment and Draft Topical Report at ¶¶ 14-16, 23 (Feb. 9, 2007) ("Pararas-Carayannis Declaration I"); Pararas-Carayannis, "Assessment of Natural Disaster Risks for the Proposed Site Of Pa'ina Hawai'i, LLC's Cobalt-60 Irradiator Facility," at 2-18 (Feb. 2007) ("Pararas-Carayannis Report").<sup>3</sup> Moreover, Pa'ina proposes to build its irradiator on unconsolidated, alluvial sediments, posing a substantial risk of liquefaction from an earthquake. Pararas-Carayannis Declaration I at ¶¶ 32-34; Pararas-Carayannis Report at 1-2, 18-20; Declaration of George Pararas-Carayannis, Ph.D. Re: Concerned Citizens' Contentions Re: Final Safety Evaluation Report at ¶¶ 6-13 (Sept. 12, 2007) ("Pararas-Carayannis Declaration II"); Supplemental Declaration of George Pararas-Carayannis, Ph.D. Re: Concerned Citizens'

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<sup>2</sup> Resnikoff Declaration I is attached to Concerned Citizens' Contentions Re: Draft Environmental Assessment and Draft Topical Report (ML070510116).

<sup>3</sup> Pararas-Carayannis Declaration I and the Pararas-Carayannis Report are both attached to Concerned Citizens' Contentions Re: Draft Environmental Assessment and Draft Topical Report (ML070510116), with the Pararas-Carayannis Report attached as Exhibit 9.

Contentions Re: Final Safety Evaluation Report (Oct. 5, 2007) (“Pararas-Carayannis Declaration III”).<sup>4</sup>

Damage to the irradiator pool from an aviation accident or natural disaster would threaten radiation exposures far in excess of regulatory limits. A crack in the pool lining – from flying aircraft or building debris, increased buoyancy resulting from tsunami or hurricane storm surge inundation, or liquefaction and strong ground motions during an earthquake – would allow vital shielding water to drain out, with even the Staff acknowledging that radiation doses of 8,465 millirems/hour – nearly double the annual occupational dose limit and over 80 times the public limit – would result from a loss of irradiator shielding water to the level of the surrounding water table. “Microshield Summary Sheet for Loss of 8 Feet of Water Shielding” (ML072630315); Final EA at 8; Final Topical Report at 1-2; Pararas-Carayannis Declaration I at ¶ 19; Pararas-Carayannis Declaration II at ¶ 3; Declaration of Mete A. Sozen, Ph.D Re: Draft Environmental Assessment and Draft Topical Report at ¶ 7 (Feb. 8, 2007) (“Sozen Declaration”);<sup>5</sup> see also Declaration of Marvin Resnikoff, Ph.D. Re: Final Environmental Assessment at ¶ 13 (Aug. 24, 2007) (“Resnikoff Declaration II”) (drop in shielding water to depth of water table would result in dose greater than 14 rem/hour).<sup>6</sup> In cases in which more shielding water were removed from the irradiator, such as from the force of an explosion following an aviation accident or through

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<sup>4</sup> Pararas-Carayannis Declaration II is attached to Concerned Citizens’ Contentions Re: Final Safety Evaluation Report (ML072610141). Pararas-Carayannis Declaration III is attached to Concerned Citizens’ Reply In Support Of Its Contentions Re: Final Safety Evaluation Report (filed Oct. 8, 2007). As Pararas-Carayannis Declaration III does not appear to be currently available on ADAMS, for the Commission’s convenience, a copy of this document is attached hereto.

<sup>5</sup> The Sozen Declaration is attached to Concerned Citizens’ Contentions Re: Draft Environmental Assessment and Draft Topical Report (ML070510116).

<sup>6</sup> Resnikoff Declaration II is attached to Concerned Citizens’ Amended Environmental Contentions #3 Through #5 (filed Sept. 4, 2007) (ML072530634).

evaporation in a fuel fire, radiation doses would be far higher. Removal of all water would result in a dose over 107,000 rems/hour, with emergency responders receiving an LD50 dose in less than a minute. Resnikoff Declaration II at ¶ 14. More widespread harm could result in the event of radioactive releases due to contaminated pool water escaping the facility or dispersal of pulverized Cobalt 60. See Pararas-Carayannis Declaration I at ¶ 19; Resnikoff Declaration I at ¶ 18; Resnikoff Declaration II at ¶ 9; Sozen Declaration at ¶ 7.<sup>7</sup>

B. Procedural History.

Concerned Citizens incorporates by reference the chronology set forth in the Licensing Board's memorandum certifying questions to the Commission, which describes the relevant procedural history through the end of August 2007. See 8/31/07 Board Memorandum (Certifying Question to the Commission) at 3-6.

On September 4, 2007, Concerned Citizens timely filed amended Environmental Contentions 3 through 5 in response to the Staff's service on August 13, 2007 of the Final EA and associated Finding of No Significant Impact. See Concerned Citizens' Amended Environmental Contentions #3 Through #5 (filed Sept. 4, 2007) (ML072530634); see also 6/21/07 Board Order at 2 (deadline to file contentions regarding the Final EA "within 21 days of service of the Final EA").<sup>8</sup> The filing of Concerned Citizens' reply on October 1, 2007 completed briefing on these amended environmental contentions. See Concerned Citizens' Reply In Support Of Its Amended Environmental Contentions #3 Through #5 (filed Oct. 1, 2007) (ML072780350). The Licensing Board has not yet ruled on their admissibility.

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<sup>7</sup> Notably, while Pa'ina's proposed irradiator would create substantial threats to public health and safety, potential benefits would be insignificant. Final EA at 8-9.

<sup>8</sup> Since the last day of the filing period fell on Labor Day, the deadline was extended until Tuesday, September 4, 2007. See 10 C.F.R. § 2.306.

On September 14, 2007, Concerned Citizens timely filed Safety Contentions 15 and 16 in response to the Staff's service on August 21, 2007 of the Final Safety Evaluation Report ("SER") (ML072260186). See Concerned Citizens' Contentions Re: Final SER (filed Sept. 14, 2007) (ML072610141); see also 5/1/06 Board Order at 2 (late-filed contentions relating to SER due within thirty days). Safety Contention 15 challenges the omission from the SER of any evaluation of safety risks from aviation crashes, tsunamis and hurricanes, and Safety Contention 16 challenges the adequacy of the SER's analysis of safety risks from earthquakes. Briefing regarding these contentions was completed on October 15, 2007, and a Board ruling on their admissibility is pending.

III. 10 C.F.R. § 30.33(a)(2) REQUIRES A SAFETY ANALYSIS OF THE RISKS THAT ARE ENDEMIC TO PA'INA'S PROPOSED IRRADIATOR SITE

The Commission's regulations governing irradiators expressly require material license applicants like Pa'ina to demonstrate their "proposed equipment and facilities are adequate to protect health and minimize danger to life or property." 10 C.F.R. § 30.33(a)(2); see also Duke Power Co. (Catawba Nuclear Station, Units 1 and 2), CLI-83-19, 17 NRC 1041, 1048 (1983) ("It is well established that the Applicant carries the burden of proof on safety issues"). To lay to rest any question about the applicability to Pa'ina's proposed irradiator of this fundamental prerequisite, the specific licensing requirements for irradiators make clear that an application for use of licensed material in an irradiator will be approved only if "the applicant meets the requirements contained in [10 C.F.R. § 36.13]," which include "satisfy[ing] the general requirements specified in § 30.33 of this chapter." 10 C.F.R. § 36.13(a). In turn, the general requirements in section 30.33 include 10 C.F.R. § 30.33(a)(2).

Pa'ina cannot satisfy 10 C.F.R. § 30.33(a)(2) merely by demonstrating compliance with the design and performance standards set forth in Part 36. If that were so, there would be no point in the Commission also promulgating sections 30.33(a)(2) and 36.13(a). The Commission should reject this reading of the irradiator regulations, which runs afoul of the interpretive canon requiring regulations “to be read so that none of [their] terms are rendered redundant.” United States v. Bucher, 375 F.3d 929, 933 (9<sup>th</sup> Cir. 2004).<sup>9</sup>

Applying the rule to this case makes clear section 30.33(a)(2) imposes an obligation on irradiator license applicants distinct from, not synonymous with, the requirements set forth in Part 36. Pa'ina must “satisfy the general requirements specified in § 30.33 of this chapter,” which include section 30.33(a)(2), in addition to satisfying “the requirements contained in [Part 36].” 10 C.F.R. § 36.13(a); see also 8/31/07 Board Memorandum at 15 (“10 C.F.R. § 36.13 requires that the applicant satisfy the general mandate of 10 C.F.R. § 30.33(a)(2), as well as the specific requirements in Part 36”). While compliance with Part 36’s design and performance requirements is necessary to secure an irradiator license, it is not sufficient. Pa'ina must, in addition, demonstrate its proposed irradiator is “adequate to protect health and minimize danger to life or property.” 10 C.F.R. § 30.33(a)(2).

The Staff’s and Pa'ina’s claim that Pa'ina can satisfy its burden to demonstrate its proposed irradiator’s safety without addressing the man-made and natural threats that are endemic to its preferred site defies common sense. Pa'ina proposes to “place a source of up to a million curies of radioactivity on the grounds of the Honolulu Airport, a location at the ocean’s

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<sup>9</sup> This canon is not limited to criminal matters, as Pa'ina has claimed. Rather, the Supreme Court has emphasized it is a “cardinal rule of statutory interpretation,” with universal application. Kungys v. United States, 485 U.S. 759, 778 (1988) (applying rule in citizenship revocation case); see, e.g., Colautti v. Franklin, 439 U.S. 379, 392 (1979) (interpreting abortion control legislation); Jarecki v. G.D. Searle & Co., 367 U.S. 303, 307-08 (1961) (interpreting tax code).

edge that is subject to unique risks of aircraft crashes and destructive wave damage from tsunamis and hurricanes.” 4/30/07 Licensing Board Order at 6. As discussed above, because of Pa‘ina’s decision to locate its irradiator next to active runways at “one of the busiest airports in the United States,” even the Staff concedes there is a one-in-500 chance the facility would be hit by an airplane during the 10-year license term, while Concerned Citizens’ expert calculated the risk of an aviation accident as two to three times higher. Final Topical Report at 2-1. Pa‘ina’s choice to place its irradiator adjacent to Ke‘ehi Lagoon, within the tsunami evacuation zone, and on unconsolidated fill material susceptible to liquefaction presents additional threats from natural disasters that have struck in the past and may strike again while Pa‘ina’s irradiator would be up and running. It is only logical that, to carry its burden of demonstrating its irradiator’s safety, Pa‘ina must evaluate the likelihood that aviation accidents and natural disasters would occur and the potential for such events to result in radioactive exposures above the limits established in Part 20 to protect life and property. Without such analysis, the NRC cannot possibly determine whether Pa‘ina’s “proposed equipment and facilities are adequate to protect health and minimize danger to life or property,” a key condition to license issuance. 10 C.F.R. § 30.33(a)(2).

That the Part 36 regulations do not specify siting requirements for irradiators does not relieve Pa‘ina of its obligation to establish its proposed irradiator’s safety from natural and human-induced disasters. As the Licensing Board correctly held in admitting Safety Contention 7, “the lack of a regulatory prohibition against siting an irradiator at an airport does not affirmatively establish that any airport location satisfies the general requirement of 10 C.F.R. § 30.33(a)(2) that an irradiator facility be ‘adequate to protect health and minimize danger to life or property.’” Pa‘ina Hawaii, LLC (Material License Application), LBP-06-12, 63 NRC 403, 419 (2006). Likewise, Pa‘ina bears the burden of establishing the proposed irradiator’s safety in the

event of a tsunami, hurricane, or earthquake, even if there is no “regulatory provision specifically requiring an analysis of the probabilities and consequences of [natural disasters].” Id.

The discussion of aviation accidents and natural disasters in the Statement of Considerations accompanying the Part 36 regulations does not, as the Staff and Pa’ina have argued, relieve Pa’ina of its burden to demonstrate its proposed irradiator would be safe from such threats. 10 C.F.R. § 36.13(a) expressly requires Pa’ina to comply with 10 C.F.R. § 30.33(a)(2), which is equally clear in placing the burden on the applicant to demonstrate its proposed facility would be safe from all threats. Since the plain language of the applicable regulations is unambiguous, it would be improper to resort to the regulatory history to justify a contrary interpretation. Entergy Nuclear Vermont Yankee, L.L.C., and Entergy Nuclear Operations, Inc., (Vermont Yankee Nuclear Power Station), LBP-04-31, 60 NRC 686, 705 (2004) (“When ‘the meaning of the regulation is clear and obvious, the regulatory language is conclusive’ and a Board is ‘not free to go outside the express terms of an unambiguous regulation to extrinsic aids such as regulatory history’”) (quoting Cleveland Elec. Illuminating Co. (Perry Nuclear Power Plant, Unit 1), LBP-95-17, 42 NRC 137, 145 (1995)).

Even if it were proper to consider the regulatory history, nothing in the Statement of Considerations suggests the Commission gave any thought to whether underwater irradiators of the design Pa’ina proposes would be safe from aviation accidents or natural disasters. As the Licensing Board correctly noted in admitting Safety Contention 7:

The comments relied upon by the Applicant are from the Statement of Considerations to the Part 36 rulemaking discussing panoramic irradiators in which “[t]he radioactive sources ... would be relatively protected from damage because they are generally contained within 6-foot thick reinforced-concrete walls and are encapsulated in steel.” As the Petitioner also points out, the sources in the Pa’ina Hawaii irradiator “would be in a pool with a liner consisting of 6 inches of concrete, with ¼-inch steel on the inside and outside.”

Pa'ina Hawaii, LBP-06-12, 63 NRC at 419 (emphasis added; citations omitted). The Commission's discussions of earthquakes, tornadoes, and other natural hazards likewise assumed a panoramic irradiator, whose six-foot thick "shield walls by their nature are inherently strong." 58 Fed. Reg. 7,715, 7,720 (Feb. 9, 1993); see also id. at 7,720 ("Studies of irradiator shield designs have shown that the shields are inherently able to withstand large earthquakes"), 7,721 ("there was no need for special design requirements because the shielding by its very nature (about six feet thick reinforced concrete) is inherently resistant to tornadoes"), 7,726 ("no siting requirements with respect to possible flooding or tidal waves could be justified on a health and safety basis because flooding of the facility would not destroy the integrity of the shielding walls") (emphasis added). The Commission never considered the safety of the materially different irradiator design that Pa'ina proposes.

The Statement of Considerations simply confirms the Commission's intent to require irradiator license applicants to demonstrate their proposed facilities' safety. In summarizing section 36.13, the Commission noted it "describes information that must be included in a license application if it is to be approved by the Commission." Id. at 7,717 (emphasis added). The Commission then recited 10 C.F.R. § 30.33(a)(2) nearly word-for-word, listing among the mandatory contents of irradiator license applications that "[t]he applicant's proposed equipment and facilities must be adequate to protect the health of workers and the public and minimize danger to life and property." Id. There can be no serious question but that, to comply with Part 36's "comprehensive, formal set of regulations" and warrant approval of its license application, Pa'ina must demonstrate its proposed irradiator satisfies 10 C.F.R. § 30.33(a)(2). Id. at 7,716.

The Statement of Considerations also confirms that "safety issues related to irradiator siting are not, as a matter of law, outside the scope of this proceeding." 8/31/07 Licensing Board

Memorandum at 18. On the contrary, the Commission expressly noted it may be necessary for the NRC “to review [irradiator] siting, on a case by case basis, if a unique threat is involved which may not be addressed by State and local requirements.” 58 Fed. Reg. at 7,725.

Concerned Citizens respectfully submits such unique threats are presented in this case, where Pa’ina proposes to locate its irradiator in a tsunami evacuation zone, on unconsolidated fill that is prone to liquefaction, at a site that is particularly vulnerable to hurricane-related flooding, and where the facility would face up to a 1-in-175 risk of being struck by an airplane. To establish the absence of unique threats, Pa’ina must evaluate the scenarios under which radiation exposure to the public beyond prescribed limits might occur, calculate the likelihood of such events, and compare that likelihood to an established probability threshold. See PFS, 54 NRC at 259 (facility must be designed to withstand “credible” accidents). Such comprehensive and accurate analyses of the likelihood and consequences of aviation accidents and natural disasters are vital to determine whether Pa’ina’s proposed irradiator complies with 10 C.F.R. § 30.33(a)(2).

#### IV. TO PROTECT PUBLIC HEALTH AND SAFETY ADEQUATELY, THE COMMISSION SHOULD ESTABLISH $10^{-6}$ PER YEAR AS THE PROBABILITY THRESHOLD TRIGGERING SITE-RELATED SAFETY ANALYSIS

In establishing the threshold probability for design basis accidents at independent spent fuel storage installations (“ISFSIs”), the Commission emphasized the importance of selecting a standard that is “sufficiently protective.” Id., 54 NRC at 263. In light of the regulatory mandate to ensure Pa’ina’s proposed irradiator is “adequate to protect health and minimize danger to life or property,” the selection of the applicable probability threshold beyond which site-related safety analysis is required likewise must ensure against threats to public health and safety. 10 C.F.R. § 30.33(a)(2); see also 42 U.S.C. § 2013(d) (use of nuclear material must be “consistent ... with the health and safety of the public”).

To determine the appropriate probability threshold for Pa'ina's irradiator, the Commission should focus on the nature of "the 'public health and safety risks'" it poses and compare those risks to other NRC-licensed facilities for which standards have already been established. PFS, 54 NRC at 265 (quoting 60 Fed. Reg. 20,879, 20,883 (Apr. 28, 1995)). In PFS, the Commission concluded that the "risks posed by ISFSI storage ... are very different from the risks posed by the safe irradiation of the fuel assemblies in a commercial nuclear reactor, which requires the adequate protection of the public ... in the conditions of high temperatures and pressures under which the reactor operates." Id. (quoting 60 Fed. Reg. at 20,883). The Commission based its conclusion on the fact that "the danger presented by irradiated fuel 'is largely determined by the presence of a driving force behind dispersion,' such as heat and pressure." Id. (quoting 60 Fed. Reg. at 20,883). "[T]he absence of ... a driving force, due to the absence of high temperature and pressure conditions in an ISFSI ...[,] substantially eliminates the likelihood of accidents involving a major release of radioactivity from spent fuel stored in an ISFSI." 60 Fed. Reg. at 20,883. Consequently, the Commission held "the Board reasonably refused to employ the  $10^{-7}$  reactor design standard, and instead set the standard [for ISFSIs] at  $10^{-6}$ ." PFS, 54 NRC at 265.

Since irradiators likewise do not operate "in the conditions of high temperatures and pressures under which [a nuclear] reactor operates," the Commission should adopt the  $10^{-6}$  (one-in-a-million) standard applicable to ISFSIs as the probability threshold for irradiators. Id. (quoting 60 Fed. Reg. at 20,883). The key consideration is to ensure radiation doses remain below Part 20 limits in the event of an aviation accident or natural disaster. There is no justification to subject the public to greater risk merely because the facility at issue in this proceeding is an irradiator, rather than another non-reactor facility. See 60 Fed. Reg. at 20,882-

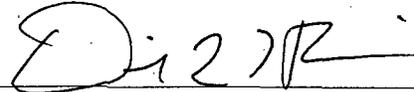
83 (“NRC regulations as applied should achieve a comparable level of protection for the public health and safety,” regardless of the type of NRC-licensed activity).<sup>10</sup>

V. CONCLUSION

For the foregoing reasons, Concerned Citizens respectfully submits that, in the circumstances presented, 10 C.F.R. § 30.33(a)(2) requires a safety analysis of the threats to Pa’ina’s proposed irradiator from aviation accidents and natural disasters and that  $10^{-6}$  (one-in-a-million) per year is the appropriate probability threshold beyond which site-related safety analysis is required.

Dated at Honolulu, Hawai‘i, November 7, 2007.

Respectfully submitted,



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<sup>10</sup> Exposing the public to elevated risks would be particularly improper in this proceeding, where Pa’ina’s proposed irradiator would not confer any substantial public benefit. See Final EA at 8-9. Unlike cases involving the operation of nuclear reactors that provide energy to the public power grid or facilities to store waste from reactor operations, Pa’ina merely proposes an alternate way to get a ripe papaya to supermarkets in the continental United States. Society should not have to bear any cost for such an undertaking.

UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of )  
Pa'ina Hawaii, LLC )  
Materials License Application )  
\_\_\_\_\_ )

Docket No. 30-36974-ML  
ASLBP No. 06-843-01-ML

**SUPPLEMENTAL DECLARATION OF GEORGE PARARAS-CARAYANNIS,  
Ph.D. IN SUPPORT OF CONCERNED CITIZENS OF  
HONOLULU'S CONTENTIONS RE: FINAL SAFETY EVALUATION REPORT**

Under penalty of perjury, I, Dr. George Pararas-Carayannis, hereby declare that:

1. In my September 12, 2007 declaration, I focused on the statements the Nuclear Regulatory Commission Staff made in its August 17, 2007 Safety Evaluation Report ("SER") (ADAMS Accession No. ML072260186) regarding the risks that earthquakes pose to the irradiator Pa'ina Hawaii, LLC proposes to build and operate on Palekona Street in Honolulu. As discussed in that declaration, the Staff has no basis to conclude that the actions Pa'ina proposes to take would be adequate to avoid liquefaction or that a horizontal separation of six inches between the sides of the irradiator pool and the building slab would provide adequate isolation during a seismic event. Based on my decades of experience in the field, I have concluded there is a substantial risk of liquefaction from an earthquake at Pa'ina's selected site and there is no basis for the SER's assumption about what constitutes "a seismic event typical of the area," undermining its conclusion the irradiator design would provide "adequate isolation" in the event of an earthquake.

2. I have now reviewed Pa'ina's answer to Concerned Citizens' contentions, which was filed on October 1, 2007. In its answer, Pa'ina does not contest that liquefaction might occur. Instead, it claims no damage would result even in the event of complete liquefaction of all the soil around the pool. The SER did not make a similar claim, relying instead on "[a]ctions that the applicant will take to avoid soil liquefaction," and, accordingly, I did not previously have occasion to address it. For the following reasons, I conclude Pa'ina has not adequately demonstrated that liquefaction would not pose a safety risk.

3. Liquefaction, but mainly strong ground motions, enhanced in the unconsolidated sediments of Pa'ina's chosen site could cause cracks in the pool structure, allowing escape of pool shielding water and/or radioactive material. Notably, even in the absence of liquefaction, enhancement of ground motions could occur in alluvial deposits like those underlying the Palekona Street site. Thus, damage to the structure could occur with full liquefaction, partial liquefaction or no liquefaction at all. Liquefaction may result in the settling, sinking, tilting and/or cracking of the entire structure or in its separation from the superstructure above it. Damage could occur from strong ground motions caused by the seismic surface wave, which travels much like a sea wave. The rupture geometry of the seismic source region can affect the directivity and frequency of the surface seismic waves. Furthermore, the surface waves could separate into trains of certain periods.

4. Waves of certain periods could enhance the ground accelerations – both vertical and horizontal – in the alluvial sediments of the Palekona Street site, causing significant damage. For example, I conducted the survey of Mexico City following the

catastrophic 1985 earthquake and found that most of the damage was due to maximum ground accelerations caused by a single monochromatic surface seismic wave traveling within a 30-foot layer of sediments. Similar conditions exist at the site Pa'ina has proposed for its irradiator.

5. To determine the potential for liquefaction and strong ground motions to cause structural failure of the proposed irradiator, one would need to make a number of assumptions regarding the vertical and horizontal seismic accelerations and then estimate how dynamic forces would affect the structural integrity of the pool structure. It is a problem of earthquake engineering that requires the introduction of input variables into a numerical or a scaled physical model, and then interpretation of the output results for adequacy of design.

6. While Pa'ina claims it performed such an analysis, the March 9, 2006 letter it cites fails to provide – and Pa'ina has not otherwise disclosed – the underlying data or calculations. Accordingly, it is not possible to conduct a comprehensive peer review of the assumptions Pa'ina made in support of its conclusion the pool structure would not be damaged in the event of total liquefaction. In the absence of supporting data and calculations, any reliance by the Staff on Pa'ina's analysis in concluding the proposed irradiator would be safe (and there is no suggestion in the SER that the Staff did rely on this analysis) would be based on blind faith, rather than reasoned inquiry.

7. While Pa'ina has not disclosed all of its assumptions, we do know that a key one – that effective peak ground acceleration would not exceed 0.15g – is flawed, rendering the rest of Pa'ina's analysis unreliable. As discussed in my September 12, 2007 declaration, there is no basis for Pa'ina's (and the Staff's) assumption that the

specified effective peak ground acceleration of 0.15g of Uniform Building Code seismic zone 2A designation is applicable to the reclaimed land at Pa'ina's preferred site, which has substrata of unconsolidated alluvial sediments. Unlike magnitude, which represents a single quantity of an earthquake's energy release, intensity does not have a single value for a given earthquake. Rather, it can vary significantly from place to place depending on substrata soil conditions. The potential horizontal seismic ground motions on which Pa'ina relied represent statistical estimates for the entire southern coast of O'ahu which may not be valid for the alluvial material at the proposed facility site. In addition, it does not appear Pa'ina took into consideration the potential focusing effects of seismic energy on O'ahu.

8. Due to the flaws in the underlying analysis, there is no basis for Pa'ina's assumption about the peak ground acceleration to which the proposed irradiator might be subjected. Accordingly, the value of 102 lbs/cf may not actually be the maximum pressure that would be exerted against the pool structure, as Pa'ina assumes. Since the maximum assumed peak acceleration of 0.15g could be enhanced in alluvial sediments, the 144 lbs/cf design pressure of the pool's wall could well be exceeded, threatening a rupture of the pool lining. A study far more extensive than the cursory analysis Pa'ina has performed would be necessary before the Staff could make an informed decision whether the pool structure would rupture in the event of liquefaction. The easiest way to warrantee safety is to chose an alternate site for the irradiator far from the shoreline and on solid ground.

9. Pa'ina's claim that the six-inch separation between the sides of the irradiator pool and the building slab would "insure[] isolation ... even in [the] worst-

scenario that was assumed for the purpose of this analysis” is similarly flawed since it is also based on the unsupported assumption that the peak ground acceleration to which the proposed irradiator might be subject would be 0.15g. As discussed in my September 12, 2007 declaration, the Lana‘i earthquake of 1871, the Maui earthquake of 1938, and the 1948 earthquake offshore of Honolulu all produced greater than Modified Mercalli Force V Intensities. In the event of another earthquake of similar intensity, the unconsolidated alluvial sediments at Pa‘ina’s preferred site could experience peak ground accelerations far in excess of 0.15g. Pa‘ina has failed to establish that its irradiator design would survive such an event.

10. Pa‘ina fails to appreciate the significance of the discussion in my September 12, 2007 declaration of the Lana‘i earthquake of 1871. Regardless of the intervening upgrades to the building code, the mere fact the 1871 earthquake caused extensive damage to buildings on a location with relatively stable substrata conditions is indicative of the potential harm to structures at locations with far less stable conditions, such as the reclaimed land Pa‘ina proposes for its irradiator, should an earthquake of similar magnitude and intensity occur again.

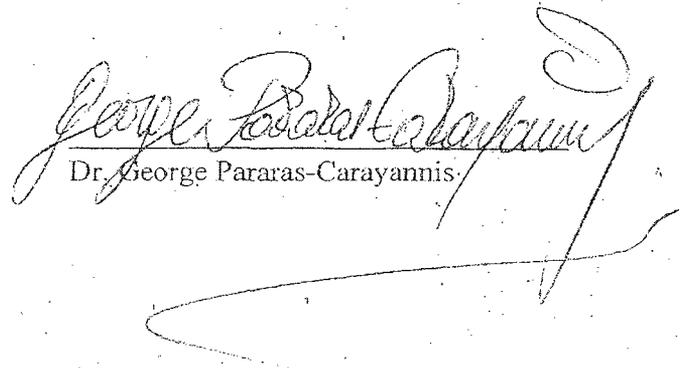
11. One cannot assume, as Pa‘ina apparently does, that, if an earthquake similar to the one in 1871 occurred again, there would be no damage to Punahou School buildings or other buildings on O‘ahu simply because the building code was upgraded to a zone 2A designation. To assume a code upgrade alone provides adequate protection from future earthquakes is erroneous. In California, the building codes were upgraded after the Long Beach earthquake of 1933 destroyed schools in the area. The codes were upgraded again after the destructive 1971 San Fernando Valley earthquake. Everyone

had a false sense of safety and believed the 1971 codes were adequate, until the 1994 Northridge earthquake struck, with devastating effect.

12. The lesson is that mere compliance with whatever building code happens to be in effect is no guarantee of safety. Particularly when a project with the potential for significant harm to public safety and the environment in the event of a structural failure is involved, as here, detailed analysis of the soil conditions at the specific proposed site is vital to assess whether public safety would be threatened in the event of an earthquake. Neither Pa'ina nor the Staff performed such an analysis, precluding the Staff from making an informed decision about whether Pa'ina's proposed irradiator would be "adequate to protect health and minimize danger to life or property," as 10 C.F.R. § 30.33(a)(2) requires.

I declare under penalty of perjury that the factual information provided above is true and correct to the best of my knowledge and belief, and that the professional opinions expressed above are based on my best professional judgment.

Executed at Athens, Greece on this 5<sup>th</sup> day of October, 2007.

  
Dr. George Pararas-Carayannis

CERTIFICATE OF SERVICE

The undersigned hereby certifies that, on November 7, 2007, a true and correct copy of the foregoing document was duly served on the following via e-mail and first-class United States mail, postage prepaid:

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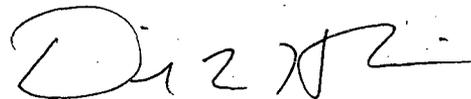
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Dated at Honolulu, Hawai'i, November 7, 2007.



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