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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
Pa'ina Hawaii, LLC	)	Docket No. 30-36974-ML
	)	ASLBP No. 06-843-01-ML
Material License Application	)	
	)	

NOTICE OF FILING ORIGINAL DECLARATION OF MARVIN RESNIKOFF, Ph.D. IN SUPPORT OF INTERVENOR CONCERNED CITIZENS OF HONOLULU'S AMENDED SAFETY CONTENTION 7

Attached hereto is the original, signed declaration of Marvin Resnikoff, Ph.D., filed on May 2, 2008 in support of Concerned Citizens of Honolulu's Amended Safety Contention 7.

Dated at Honolulu, Hawai'i, May 6, 2008.

Respectfully submitted,

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TEMPLATE = SECY-043

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of Pa'ina Hawaii, LLC Material License Application	)))))	Docket No. 30-36974-ML ASLBP No. 06-843-01-ML

DECLARATION OF MARVIN RESNIKOFF, Ph.D., IN SUPPORT OF CONCERNED CITIZENS' AMENDED SAFETY CONTENTION 7

Under penalty of perjury, I, Dr. Marvin Resnikoff, hereby declare that:

1. I am a physicist with a Ph.D. in high-energy theoretical physics from the University of Michigan and also the Senior Associate of Radioactive Waste Management Associates, a private technical consulting firm based in New York City. I previously filed declarations in support of Concerned Citizens of Honolulu's Request for Hearing and Concerned Citizens' contentions regarding the draft and final versions of the environmental assessment and of the Topical Report on the Effects of Potential Natural Phenomena and Aviation Accidents at the Pa'ina Hawaii, LLC Irradiator Facility ("Topical Report"). My credentials to discuss risk assessment and other technical issues related to Pa'ina Hawaii, LLC's proposed irradiator were previously stated in my prior declarations and will not be repeated here.

2. As described in greater detail below, in my opinion, Pa'ina's decision to locate its proposed irradiator immediately adjacent to active runways at Honolulu International Airport ("HNL") creates an unusually elevated risk the facility – together with the one million curies of Cobalt-60 ("Co-60") for which Pa'ina seeks a license –

would be struck by an airplane. Depending on the methodology used, the annual likelihood of an aviation accident involving the irradiator would be 1-in-2,786 or 1-in-1,757 (nearly one-in-175 over the license's ten year period). Moreover, should an accident occur, there are several reasonable scenarios of potential consequences resulting in radiation exposures in excess of applicable safety standards and off-site releases of contaminated pool water.

3. Pa'ina's license application does not address the threats to safety posed by an aviation accident involving its proposed irradiator. Instead, Pa'ina relies on the Topical Report to demonstrate safety. That document, however, significantly underestimates the probability of an aircraft striking Pa'ina's proposed irradiator and fails to provide any meaningful analysis of the potential consequences of an aviation accident. Because of the Topical Report's many flaws, Pa'ina cannot rely on it to establish its proposed irradiator design would be adequate "to protect health and minimize danger to life or property," as required by 10 C.F.R. § 30.33(a)(2).

4. **Probability of Aircraft Impact into Proposed Pa'ina Irradiator.** Using the Department of Energy ("DOE") standard, DOE-STD-3014-96, "Accident Analysis for Aircraft Crash into Hazardous Facilities," I calculated the expected accident frequency (i.e., the number of accidents per year) of an aircraft impacting the proposed Pa'ina irradiator. The DOE standard is similar to the Nuclear Regulatory Commission ("NRC") methodology (NUREG-0800) I employed in the NRC proceedings regarding the proposed Private Fuel Storage spent fuel storage facility at Skull Valley, Utah. Since NUREG-0800 is designed primarily for potential facilities located at some distance from an airport, not for facilities like the Pa'ina irradiator which would be immediately

adjacent to active airport runways, I question the Center for Nuclear Waste Regulatory Analyses's ("CNRWA's") decision to rely solely on NUREG-0800 for the Topical Report's analysis.

5. My report, a true and correct copy of which is attached hereto as Exhibit "1" and is incorporated herein by reference, details the methodology and calculations I employed to determine the probability of an aircraft impact into the proposed irradiator. In summary, I concluded that the yearly probability using DOE's national crash statistics would be 3.59E-04 (1 in 2,786). If HNL-specific crash rates are used, the yearly probability increases to 5.69E-04 (1 in 1,757).

6. Both crash rates are significantly higher than the yearly probability set forth in CNWRA's Topical Report, 2.0E-04 (1 in 5,000). There are many reasons for the Topical Report's substantial understatement of the risk of an airplane striking the proposed Pa'ina irradiator. First, CNWRA relies on airplane crash data that are more than thirty years old and not applicable to all aircraft. In contrast, the DOE data I used are applicable to all aircraft, including air taxis (which currently constitute over 20% of aircraft operations at HNL), and are updated to 1996. In addition, the Topical Report fails to account for the fact that air crash rates for HNL are higher than the national average, as I did in my alternate calculations using HNL-specific crash rates.

7. Second, the methodology CNWRA used for the Topical Report looks solely at the distance a proposed facility is from the end of the runway, failing to take into account that landings have a higher crash rate than takeoffs.

8. Third, the methodology CNWRA used for the Topical Report employs an equal probability of an air crash to all locations in the vicinity of an airport, and this is not

correct. To take one example, for military aircraft, planes fly parallel to the runway, then make a U-turn and land. The side where military planes first fly is called the "pattern" side. Accordingly, my analysis assumed that the pattern side is over the ocean. This type of fine detail is missing from the Topical Report's analysis.

9. Fifth, the number of aircraft operations at HNL used in the Topical Report's calculations understates the actual number of current operations, and also fails to account for anticipated future growth during the time period for which Pa'ina seeks a materials license. Although unstated in the report's analysis, it appears CNWRA used the average number of aircraft operations at HNL over the five years preceding the report's preparation in 2007, which would reflect the substantial decrease in the number of operations at HNL following September 11, 2001. Since the number of operations at HNL did not begin to increase until the last few years and, as the Federal Aviation Administration has determined, is expected to increase by another 20% during the 10-year period of Pa'ina's license application, the number of operations CNWRA uses in its calculations is unrealistically low. A more realistic, but still conservative, assumption is to use current operational levels. My analysis took this approach, using the most recent numbers then available, which are from airport operations in 2005.

10. **Consequences of Aircraft Impact into Pa'ina Irradiator.** Whether the Board accepts the Topical Report's crash rate or those presented in my report, there would be a significant risk of an airplane crash involving Pa'ina's proposed irradiator over the ten-year term of the requested license. The Topical Report fails, however, to take into account realistic accident scenarios and does not provide data or calculations to

demonstrate the design of Pa'ina's proposed irradiator would be adequate "to protect health and minimize danger to life or property," as required by 10 C.F.R. § 30.33(a)(2).

11. An aviation accident could damage the pool structure under the floor level, with the impact of airplane or building debris tearing the welds or puncturing the pool liner, resulting in loss of irradiator pool shielding water. Attached hereto as Exhibit "2" are calculations I performed to analyze the velocity at which a jet engine commonly used in commercial aviation (GE model CF6-80C2) would pierce the pool liner (which consists of only six inches of concrete sandwiched between ¼-inch steel), allowing shielding water to escape. My analysis demonstrates that the engine would have to travel at only 38.5 miles per hour to breach the liner.

12. Commercial airplanes commonly land and take-off at 160 miles per hour. Thus, it is clearly plausible that an aviation accident would result in the engine striking the pool liner at speeds far in excess of 38.5 miles per hour.

13. Since the irradiator facility's floor level is also the minimum water level necessary to retain shielding integrity for the Co-60 sources, a breach of the pool structure due to an airplane crash would reduce the irradiator's passive shielding. The Topical Report states (at page 1-2) the depth of the water table is 2.4 meters (8 feet) below the facility floor, and, thus, its assertion that sea water infiltrating through a breach would adequately shield the Co-60 sources is unsupported. In fact, any break in the pool lining below the floor level could dangerously reduce the shielding of the sources.

14. My calculations, attached as Exhibit "3," show that, if the shielding water were to drain to the level of the surrounding water table, the dose at floor level would be greater than 14 rem/hr. In only twenty-two minutes, any irradiator personnel or

emergency responders on the scene would be subjected to more than the annual occupational dose limit of 5,000 millirem/year.

15. In cases in which more shielding water were removed from the irradiator pool, either from the force of an explosion or through evaporation in a fuel fire, radiation doses would be far higher. If all water were removed from the irradiator pool, my calculations show that the likely dose would be over 107,000 rems/hr. Emergency personnel could receive an LD50 dose in less than one minute.

16. Whether the water level fell to groundwater level or the irradiator pool were completely dry, emergency responders and irradiator personnel could be seriously injured from radiation exposure.

17. The risks to emergency responders would be even greater in the event that the force of an airplane crashing into the facility and/or the ensuing fire and explosion of aviation fuel severely injured or killed the irradiator's safety personnel and led to loss of radiation detectors. In this entirely plausible scenario, it would be impossible to implement necessary emergency procedures. In the absence of necessary guidance and radiation survey instruments, firefighters, police and other emergency responders could unwittingly receive extremely high radiation doses.

18. The Topical Report also ignores the potential for contamination of the pool water in the event that an airplane crash breaches the sources. While the report asserts that Co-60 sources that can satisfy the criteria set forth in 10 C.F.R. § 36.21 and ANSI test 65646 would be robust enough to survive an aviation accident, CNWRA never performed any calculations to back up that claim. For example, the report does not quantify the impact of flying airplane debris or building girders following a collision to

allow a comparison with the impact associated with a 2.5 cm-diameter, 20-kg steel weight dropped from a height of 1 meter, the more stringent of the two impact standards. It is not intuitive that an exploding airplane would exert no more force on the irradiator's sources than a weight falling from the height of a tabletop.

19. Attached hereto as Exhibit "4" are calculations I performed that show that, in fact, the impact associated with an aviation accident would far exceed the standards the Co-60 sources must meet. For the purposes of these calculations, I assumed that a commercial jet engine (GE model CF6-80C2) was dropped onto the sources from 18.5 feet, the height of the water in the pool, and had no additional velocity. This is a very conservative assumption since, in an airplane crash, the engine would fall from a much greater height. Taking into account the buoyancy of the pool water (which, prior to the impact, would not yet have drained out), the energy imparted by a commercial jet engine falling from the top of the irradiator pool would be over 7,500 times the energy imparted by a 20-kg weight falling from a height of one meter, the standard applicable to the sources Pa'ina proposes to use. The impact would be far greater if the jet engine fell from a height greater than the top of the irradiator pool, as would undoubtedly be the case in any aviation accident involving the facility.

20. The foregoing analysis makes clear that, in the event of an aviation accident, the forces that would applied to the Co-60 sources would be many orders of magnitude beyond those for which the sources were designed. It is not only plausible, but probable, that the impact would not only rupture the source encapsulation, but shatter the plenum and the sources themselves, contaminating the pool water. The contaminated

water could then escape the facility though ruptures in the pool lining, spreading radioactive contamination to the groundwater and nearby Ke'ehi Lagoon.

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 New York, New York on this 2nd day of May, 2008.

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CERTIFICATE OF SERVICE

The undersigned hereby certifies that, on May 6, 2008, 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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In addition, the undersigned hereby certifies that, on May 6, 2008, a true and correct copy of the foregoing document was duly served on the following via e-mail:

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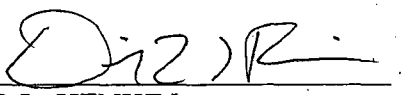
Dated at Honolulu, Hawai'i, May 6, 2008.



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