

UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

BEFORE THE SECRETARY

In the Matter of	)	
Pa'ina Hawaii, LLC	)	Docket No. 030-36974
	)	
Materials License Application	)	
<hr/>	)	

**DECLARATION OF MARVIN RESNIKOFF, Ph.D.  
IN SUPPORT OF PETITIONER'S AREAS OF CONCERNS**

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 (RWMA), a private technical consulting firm based in New York City. I have researched radioactive waste issues for the past 30 years and have extensive experience and training in the field of nuclear waste management, storage, and disposal. RWMA works, among other areas, primarily on three subjects: transportation and storage of radioactive waste and materials, radiation induced injuries, and decontamination and site remediation of radioactively contaminated facilities. A copy of my resume is attached to this declaration as Exhibit D.

2. I have considerable training and experience in the field of risk assessment involving nuclear and hazardous facilities, serving as an expert witness in numerous personal injury cases in which I estimated radiation doses and the likelihood these exposures caused cancer. These cases involved uranium mining and milling, oil pipe cleaning, X-rays, thorium contamination and other issues. This work involved the use of

computer codes, such as CAP88PC, RADTRAN, RESRAD, RISKIND, MILDOS and HOTSHOT, and spreadsheets employing dose conversion factors, to estimate radiation doses.

3. I investigated the Genesis irradiator licensed by CFC Logistics, Inc. (Docket No. 030-36239) and prepared affidavits in support of the Petitioner's Areas of Concern and Motion for a Stay. I also toured the irradiator licensed by CFC Logistics, Inc., whose design is almost identical to the design proposed for the Pa'ina Hawaii irradiator. The Co-60 suppliers are also the same.

4. I previously assisted a local group in Dickerson, MD regarding Neutron Products, Inc., a company that processed Co-60 into specific forms for irradiation devices.

5. A paper on decommissioning reactors I wrote in 1976 (*Environment*, December 1976) was the first to show that reactors would remain radioactive for hundreds of thousands of years. The importance of our discovery was noted by *Science* magazine in 1982, which is attached hereto as Exhibit E. As part of our work analyzing radioactive waste shipments to low-level waste facilities and waste impacts of the nuclear fuel cycle, I have stayed up-to-date on the decommissioning literature, including more recent Nuclear Regulatory Commission (NRC) reports.. I reviewed decommissioning reports for the Rancho Seco reactor in California, the Big Rock Point reactor in Michigan, the Yankee Atomic reactor in Rowe, Massachusetts, and the Connecticut Yankee reactor in Haddam Neck, Connecticut.

6. In addition RWMA has conducted technical analyses for public interest groups and local governments at each of the proposed low-level waste disposal facilities

across the country, including Martinsville (IL), S. Windsor (CT), Chatham County (NC), Hudspeth County (TX), Ward Valley (CA) and Boyd County (NE). In the process of conducting these analyses, we have examined and used the computer programs MODFLOW, PRESTO-CPG and IMPACTS, used to estimate groundwater flow and risk due to radioactive materials. I served as project manager and focused on the risk assessment sections of our reports.

7. RWMA is involved in several major personal injury cases involving radiation due to uranium mining and milling operations, and oil pipe cleaning operations (NORM). We also serve as technical advisors to the States of Utah and Nevada and several counties in Nevada and California on issues involving transportation, handling and storage of irradiated fuel.

8. I am one of the Petitioner's expert witnesses in support of its petition to intervene in this hearing, which relates to the Materials License Application proposed by Pa'ina Hawaii, LLC for a Genesis II Irradiator in Honolulu, Hawaii. I participated in the drafting of Petitioner's issues of concern.

9. To prepare this affidavit, I reviewed Pa'ina Hawaii's Materials License Application, and other filings in this and other NRC dockets. I am also familiar with NRC regulations and guidance documents related to this application.

10. In my best professional judgment, the applicant has not shown that the public health and safety will be protected and therefore the application should be denied. In addition, due to the potential for a range of events – including, but not limited to, mechanical failures, power outages, airplane accidents, acts of sabotage or terrorism, hurricanes, or tsunamis – to cause a significant release of radioactive material from the

Pa‘ina Hawaii irradiator to the environment, “special circumstances” exist, precluding the NRC’s use of a categorical exclusion from the National Environmental Policy Act’s mandate to prepare either an environmental assessment or environmental impact statement for the proposed license. 10 C.F.R. § 51.22(b); see also id. § 2.335(b); 40 C.F.R. § 1508.4. This declaration discusses the bases for these conclusions.

11. **Loading and Unloading Procedures.** RWMA serves as a technical consultant to the States of Utah and Nevada regarding the transportation, handling and storage of irradiated reactor fuel. The safety issues raised by handling and storage of Co-60 are similar to the safety issues raised by handling and storage of irradiated reactor fuel.

12. Loading and unloading the fresh and used Co-60 pencils present a risk of a cask drop. If a 3 to 6.5 ton cask were to drop on the Co-60 pencils and bend the pencils, the potential for release of Co-60 into the pool water must be assessed. The potential for damage to the pool liner must also be assessed, and its potential impact must also be assessed. Similar to a reactor, where a shipping cask has the potential to pass over the fuel pool and drop onto fuel rods, the irradiator here must have a system to prevent the cask from passing over the Co-60 pencils. This information is missing from the application, contrary to the requirements of 10 C.F.R. § 36.39(c), “the licensee shall design the pool to assure...that a dropped cask would not fall on sealed sources.” The details of the loading and unloading procedures are contained in the withheld materials, GL-201 – GL-206. If the pencils are bent, the applicant must discuss how these bent Co-60 rods will be packaged and sent back to the manufacturer, that is, how the applicant intends to recover from this accident. (10 C.F.R. § 36.53(b)) And similar to the reactor,

the irradiator must have installed a single failure proof crane, so that the crane cannot fail.

13. Based on my experience with loading and unloading irradiated fuel, this stage is the most precarious and susceptible to a major accident if the equipment, training and emergency procedures were not up to this difficult task. For similar reasons, I believe the loading and unloading of Co-60 at the proposed irradiation facility will be precarious and susceptible to a major accident. According to the CFC Logistics license application, a shipping cask containing 200,000 Ci of Co-60 sources would be inserted into the pool. Sources would be removed and placed underwater on one side of the pool, away from the cask. The plenum would be removed before this operation. As the shipping cask, which could weigh between 3 and 6.5 tons, is removed from the pool, it could drop onto the sources, seriously contaminating the pool water. This contamination would have to be removed with ion exchange columns that would become extremely radioactive. The discussion must be in accordance with 10 C.F.R. § 36.57(e). The steel-liner of the pool would become radioactive. Some of this radioactivity could be released to the sanitary sewers and the air. Though the fuel suppliers and presumably the shipping casks are likely the same as the Genesis irradiator in Pennsylvania, the application contains no details about the type and weight of the cask, how the cask is unloaded from the trailer bed and how the cask is attached to the crane and lowered into the water. Similar to operations at Neutron Products Incorporated (NPI) in Dickerson, Maryland, where Co-60 material was shaped to fit different irradiators, Co-60 released to the environment could lead to a significant direct gamma dose, and would be expensive to decontaminate. At NPI, despite the presence of HEPA filters to capture particulates, Co-

60 was found off-site; the direct gamma dose rates were five times NRC regulatory limits. Therefore, I consider the potential for a cask drop accident to pose a serious risk of irreparable harm, violating the requirement in 10 CFR § 30.33(a)(2) that “proposed equipment and facilities [must be] adequate to protect health and minimize danger to life or property.”

14. It is doubtful that the crane is designed to stop where the sources are located since it is the same crane used to move product over the entire pool.

15. Further, the application has no emergency procedures for accidents that may occur during loading and unloading sources. This is contrary to 10 C.F.R. § 36.53(b). The application has no emergency procedures for remedying a cask drop accident. No phone numbers for police, fire and ambulance, assuming they would know what to do. No training. No drills.

16. In 1980 a shipping cask containing irradiated fuel from the Connecticut Yankee reactor overheated, and contaminated the Battelle Columbus Laboratory fuel pool with fission products and Co-60. The contamination in the pool set off the air monitors, and led to major radiation exposures. On the basis of this accident, on behalf of the Sierra Club, I petitioned the NRC to replace air within casks with an inert gas so the contents would not oxidize. While the petition was ostensibly denied, the NRC did order all shippers to inert shipping casks with helium or nitrogen. The physical and chemical properties of irradiated fuel are admittedly different from Co-60 sources at Pa‘ina Hawaii, but the possibility of radioactivity becoming airborne in an accident are similar to what may occur at Pa‘ina Hawaii. If the Co-60 sources were damaged in an accident, Co-60 could become airborne and be released from the cask.

17. **Thermal Considerations.** The applicant has not shown that the system will not overheat. The thermal projections based on worst case assumptions are redacted. These should be provided. As far as can be ascertained, the helium system surrounding the Co-60 pencils is static. Apparently the heat will be dissipated through the helium to the plenum walls and then to the pool water. It is not clear how the temperature will be continuously monitored within the plenum. If the plenum overheats, there is danger that radioactive material will be released to the pool water. The Co-60 could then become airborne, be released to the air within the irradiator facility and subsequently to the external environment. The gamma dose rates would become elevated within the irradiator building. The ion exchange resins would become highly radioactive, and have to be transported to a low-level radioactive waste landfill. This would be contrary to 10 CFR § 36.57(e). The applicant has not proposed shutdown criteria, if the Co-60 concentrations in the pool water or air above the pool reach certain specific concentrations.

18. When the plenum rack is loaded with Co-60 pencils, the loading is done underwater with long handling tools. The plenum is then fit over the rack and helium is pumped in and water out of the plenum. At this point the Co-60 rods will heat up and the water on the Co-60 will evaporate. The applicant does not discuss the effect of this evaporation process and whether radioactive materials will enter the helium environment and the pool water. Reviss, one of the suppliers listed in Pa'ina Hawaii's application, has previously expressed concern about the potential damage to the Co-60 pencils in this evaporation process, requesting that there be no ingress of water droplets into the plenum and that, "there is absolutely no liquid water present in normal operation and that the

atmospheric humidity in the plenum chambers can be demonstrated to be indistinguishable from the humidity of air in the surrounding neighbourhood.”

19. It is not clear who is carrying out the thermal calculations. In a previous reincarnation of the Genesis II irradiator in Pennsylvania, Reviss, one of the fuel suppliers, provided the thermal calculations. Neither the designer, Gray\*Star, nor the applicant have the expertise to analyze the thermal conditions in the plenum.

20. In addition, while Gray\*Star designed the Genesis II irradiator, it is not clear who is actually supplying the components; the Co-60 pencils are being supplied either by Nordion (Canada) or Reviss, who has Co-60 generated in Russia. How the NRC ensures the quality assurance of the process without actually inspecting the Canadian and Russian facilities is not spelled out in the application. According to 10 CFR § 36.59(b), leak testing of the source must be carried out.

21. **Security.** It is well-known that Cobalt-60 is an attractive target for terrorists, because it can be used to make dirty bombs. It is also well-known that in general, nuclear facilities are a target of the Al Qaeda organization. If cobalt-60 were stolen from the proposed facility<sup>1</sup> or if the facility were attacked, cobalt-60 could be released into the environment, causing adverse health effects and spreading contamination that would be expensive to clean up. To put the amount of radioactivity in each Co-60 pencil into perspective, a person standing one meter from an unshielded one curie source of Co-60 would receive a dose of 1.37 mrem/hr, using specific gamma ray dose constants.<sup>2</sup> While the applicant has not stated how much radioactivity will be in the proposed facility, drawing from the previous Genesis application, we know that 17,000

---

<sup>1</sup> If Co-60 were fashioned into a dirty bomb and directly dispersed into the environment.

<sup>2</sup> Shleien, B. *et al*, *Handbook of Physics and Radiological Health*, Williams and Watkins, Baltimore, 1998, Table 6.2.2.

Ci of Co-60 would be in each pencil, providing an LD50 dose in one minute. Though the previous Genesis irradiator was designed to operate with one million Ci, it had the capacity to hold up to 256 sources, or 4.35 million curies. The total amount of radioactivity in the Pa'ina Hawaii irradiator has not been specified.

22. In sum, the applicant is placing a major sabotage target into the local community without an evaluation of the risk to the community. The effect of an accident distributing 17,000 Ci of Co-60 has been analyzed by the Federation of American Scientists. See Public Interest Report, vol. 58, No. 2, March/April 2002, attached hereto as Exhibit F and incorporated herein by reference. Their report estimates that, if a single Cobalt “pencil” were dispersed by an explosion at the lower tip of Manhattan, an area of approximately one-thousand square kilometers would be contaminated, and tens of thousands of New York City residents could die.

23. **Tsunami and Hurricanes.** Tsunami and wave run-up from a major tropical storm/hurricane are threats to the proposed facility, as experienced with the tsunami in SE Asia and hurricanes along the Gulf Coast. The proposed facility is only 7.7 feet above sea level. A major rush of water could badly damage the irradiator building and short out the electricity. This would expose the nearby public and emergency workers to radiation exposure. The facility must also be designed to withstand hurricane velocity winds. The application has no discussion of the potential for such emergency events and the procedures that would be implemented, in violation of 10 C.F.R. § 36.53(b)(9).

24. **Air crash.** Since the proposed irradiator will be located adjacent to the Honolulu airport, the applicant must analyze the likelihood and consequences of an air

crash, either on take off or landing. In our experience, no nuclear facility has ever been located in such close proximity to an airport runway, in this case, Reef Runway, which has also been designated as an alternate landing site for the space shuttle. According to the National Transportation Safety Board, in the 23-year period between 1982 and 2004, on average 2.17 accidents per year occurred at the Honolulu International Airport (HNL). See NTSB Aviation Accident Database Query, attached hereto as Exhibit G and incorporated herein by reference. This does not include lower level accidents, aircraft incidences. This is an extremely high accident rate for a nuclear facility located in such close proximity to the runway. It is important to note that jet planes in distress at adjacent to Hickam Air Force Base may land at the Honolulu airport, because the runways may be much longer. The applicant must determine the likelihood and consequences of an air crash, and determine whether the location is appropriate for such a facility, and if not, whether the facility can be hardened to mitigate the consequences of an accident. In general, for nuclear reactors and high-level waste facilities, the NRC Commissioners have established an accident probability of one in a million. This risk calculation involving an air crash must include the loss of aircraft fuel. An air crash and combustion of jet fuel implies the facility will be exposed to the external environment, safety systems will be disabled and Co-60 will be released to the external environment. The possibility of such an accident and its consequences are not discussed in the application. Information regarding the location of the proposed licensee's facilities and details of the surrounding area has similarly been redacted. Under the National Environmental Policy Act, an agency must prepare at least an environmental assessment to analyze any potentially significant harm, without regard to a threshold risk level.

25. **Transportation.** Transportation of Co-60 pencils to the proposed facility has not been discussed in the application. Co-60 will either arrive by plane or boat. The cask itself may weigh 3 to 6.5 tons, but this part of the application is missing. The specific casks that will be employed are not discussed in the application. Unlike nuclear reactors where the details of the fuel cycle – production of nuclear fuel (the environmental impact of uranium mining and milling, enrichment and conversion) and the environmental impact of waste disposal – must be listed, as Table S-3, and the impact of transportation, listed as Table S-4, no such details are included in the application. In particular, if the shipping cask is transported by plane, the impact of an air crash must be assessed. The transportation cask is likely designed to withstand a 30 foot drop. Obviously planes fly higher than 30 feet. If the cask is transported by ship, a discussion of the modal transfers and the likely exposure to workers, inspectors and the public must be evaluated. If the sources arrive by ship, they must be transported by truck through residential communities.

26. **Redacted application.** The application has a great deal of material redacted, presumably for either proprietary or security reasons. But the bases for redactions have not been spelled out. In my 30 years experience with NRC license applications and documents, NRC staff require signed affidavits attesting to the basis for a redaction, usually proprietary or security materials. Here the staff have accepted the application with redactions. The effect is that the public and affected parties are not able fully to evaluate the environmental impacts and determine how their interests may be affected.

27. **Loss of electricity.** Contrary to 10 C.F.R. § 36.53(b)(6), the licensee has no emergency procedures for accidents involving a prolonged loss of electricity. Without clear measures for recovering from a prolonged loss of electricity, the safety of neighboring members of the public cannot be assured. The licensee does not appear to have an emergency electric generator in case of an extended power failure.

28. Moreover, the license application does not analyze the range of accidents that would arise from a loss of electricity. While the application does discuss the possibility of the loss of electricity supply in terms of overheating of sources, other credible accidents are not considered. For instance, movement of product near the plenum containing Co-60 sources occurs under bells inserted under water; the bottom of the bell is open, but water cannot enter due to a compressed helium supply. In the event that power is lost while a bell is underwater, the product could become water-logged and distribute itself within the pool, thereby clogging the filters and the water circulation system. In the changeover to new filters, Co-60 could bypass the containment system and be released as wastewater. The applicant does not discuss this potential accident, or any procedures for recovering from this loss of electricity accident in which product floats in the pool.

29. Moreover, in discussing the possibility of the loss of electricity supply in terms of overheating of sources, the application fails to provide specific information regarding the heat rate and the number of hours till the source cladding degrades. The application should contain detailed information on how rapidly the sources will heat up and the consequences of overheating. This information is needed to know how long the electricity may remain off before a serious accident ensues. In the event of overheating,

the cladding around the sources could fail, contaminating the air and overloading the HEPA filters. Co-60 could be released to the external environment.

30. **Damaged helium line.** Contrary to 10 C.F.R. § 36.53, the licensee has no emergency procedures for accidents involving a break in the compressed helium line. This would allow water to enter the bells, and degrade the product.

31. **Transportation accidents: safety and environmental impact.** Cobalt-60 sources, in transit from Canada or Russia to the Pa'ina Hawaii plant, would not be well-protected from a terrorist attack. The NRC does not require armed escorts for Co-60 sources. Yet, potential saboteurs have significant fire power at their disposal. The TOW2 and MILAN anti-tank missiles have a range of one km and can penetrate one meter of steel, far more steel and lead than the walls of a shipping cask. The newer Russian Koronet missile, used by former Iraqi armed forces, can penetrate 1.2 meters of steel and can be aimed precisely at a distance up to 5 km. These weapons have the ability to penetrate a shipping cask and disperse its contents. NUREG-0170, the document that potential NRC licensees cite in supporting its safety assurances, is silent on these safety and security issues.

32. A Cobalt-60 cask shipment, attacked within a city, could cause major environmental pollution and cancer fatalities. Local residents would clearly have a greater risk than other persons. While shipments could leave Canada or Europe by a number of routes, once they get close to the facility, the route options are decidedly limited. Such an accident would subject the airport passengers and workers and residents of neighboring communities to irreparable harm. In addition to adverse health effects caused by contamination, such an accident would have significant economic impacts.

Based on an analysis done by us for the State of Nevada, it is reasonable to estimate that the decontamination of an accident involving a spill of 200,000 curies of Cobalt-60 costs could easily exceed \$1 billion.

33. The environmental impact of shipping Co-60 sources has not been seriously investigated by the applicant, nor the NRC, and is a major deficiency of the application. The application is silent on transportation aspects.

34. **Liability Insurance.** The applicant has offered the minimum \$113,000 financial assurance for decommissioning, but this would clearly be inadequate if a major accident were to occur. Nuclear reactors are insured for billions of dollars under Price-Anderson, but Pa'ina Hawaii does not appear to be insured for credible accidents.

35. If the Petitioner's concerns are admitted for litigation, I would testify regarding my opinion in support of their conclusions. The technical facts and analyses described in paragraphs numbers 11 through 34 provide an abstract of the testimony I would give, based on the information that has been furnished to date. I would expect to be able to expand upon and refine my testimony, after having an opportunity to review materials produced by Pa'ina Hawaii and the NRC Staff.

\\  
\\  
\\  
\\  
\\  
\\  
\\  
\\

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 30<sup>th</sup> day of September, 2005.

---

Dr. Marvin Resnikoff, Senior Associate  
Radioactive Waste Management  
526 West 26th Street, Room 517  
New York, NY 10001  
Phone (212) 620-0526  
Fax (212) 620-0518