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The Applied Radiant Energy Corporation

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tlb

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Mr. Earl Wright
Senior License Reviewer
Division of Nuclear Materials Safety
United States Nuclear Regulatory Commission
Region II
101 Marietta Street, N.W., Suite 2900
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Mr. Wright:

This letter is in reply to your request of January 9, 1997, for more information about our Materials License renewal application (revised November 14, 1996) and your letter of February 5, 1997, concerning a pool water heater. (Both letters - Mail Control No. 252009.)

LETTER OF JANUARY 9, 1997

Item 1 - Irradiation of Flammable Methyl Methacrylate:

In your January 9, 1997, letter you make reference to 10 CFR 36.69 on this point. While not completely discounting the potential for source damage from a deflagration in our irradiator, it should be kept in mind that section 36.69 is written mainly with ANSI Category IV (Panoramic, Wet Source Storage Irradiators) rather than our Category III (Self-Contained, Wet Source Storage Irradiators) irradiator in mind.

Reference was also made to documents NFPA 68 and 69.

However, NFPA 68 states that "This guide does not apply to emergency vents for runaway exothermic reactions or self decomposition reactions." The polymerization reaction taking place during irradiation of our containers of wood impregnated with methyl methacrylate is an exothermic reaction.

NFPA 69 states that "This standard shall not apply to the design, construction, and installation of deflagration vents."

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Safety Evaluation of the Irradiation of Methyl Methacrylate

Hazardous Conditions:

1) Uncontrolled Polymerization.

The most likely event that would compromise worker and radioactive source safety is uncontrolled polymerization in the product canister while it is being irradiated.

However, in a letter dated January 30, 1997, ARECO provided information to your office regarding the use of a pool water heater which we determined was necessary to maintain acceptable production rates. This arose from the fact that after the removal of the Cesium-137 WESF capsules our remaining Cobalt-60 source material was not strong enough to maintain satisfactory polymerization rates. Thus, with the present Cobalt 60 loading, the chances of a runaway polymerization are very small. Employment of an irradiator plaque with more Cobalt-60 would offset this built-in safeguard.

Consequences of Uncontrolled Polymerization: Increased temperature and pressure would result from such an event. Elevated temperatures could cause the wood in the container to combust. The auto-ignition temperature of the wood (400°F-500°F) is less than that of the monomer. Increased pressure of unvented or undervented cans could cause their rupture. Due to their design and construction this would likely occur along a weld line. These weld lines are all located on the ends of the canister such that pressure release after rupture would be away from the source plaque. It has been calculated that such failure would occur at a differential pressure of 4-5 psi.

Even though the cans are routinely in close proximity to the source plaque, the effect of any rupture would be mitigated by the surrounding pool water. The surrounding water would also quench any fire, thus preventing any further damage.

Consequences of this type of occurrence would be further alleviated by the 1/16" thick aluminum shroud that envelopes the entire source-containing plaque.

2) High Ambient Temperature in the Canister.

A check of processing records shows that the temperature expected to be reached in any canister from controlled polymerization would not exceed 300°F. The auto-ignition temperature of methyl-methacrylate is 815°F (Material Safety Data Sheet - Rohm & Haas Company). Therefore, auto-ignition of monomer should not present any problems.

Method and Equipment Used to Safely Vent Sample Cans

The method of venting "sample" cans is to connect flexible plastic tubing to them as they are being lowered into the water.

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The cans have several bushings located in their top surfaces which are otherwise sealed by pipe plugs. One of these locations is used to attach a fitting which is connected to a length of polyethylene tubing. This tubing is allowed to loosely coil in the water above the can after it has been sunk near the bottom of the pool in its irradiation location. Thus, access to the pressure in the can is afforded at the surface of the pool. The natural coiling path of the tubing precludes any radiation streaming to the pool surface. The tube continues out of the pool to a manifold where pressure is monitored on a gauge and any excess is vented to atmosphere through a water bubbler. This simple, durable, automatic venting system has no moving parts yet is able to be adjusted to relieve canister pressure at low levels for effectiv personnel and equipment safety.

Temperature of Radioactive Sources:

Due to the nature of the plaque's construction, the pool water is free to circulate around the sources which provides some cooling. The temperature inside the shroud of the Cobalt-60 plaque (immediately adjacent to the elements) was measured by a thermocouple during a typical production irradiation cycle. These measurements show that the radioactive sources would see no more than a 20°F rise over pool temperature which is maintained at 100°F-110°F. At these close-to-ambient temperatures the varying duration of irradiation would have a negligible effect on potential source damage.

The low temperatures to which ARECO exposes the sources will not cause degradation of the stainless steel used for encapsulation.

Item 2 - Sealed Source Leak Test Procedures:

In your letter you refer to the ability to be able to detect the presence of .005 microcuries of removable activity from a potentially leaking source. 10 CFR 36.59(a) gives this figure as the detection limit when testing dry-source-storage sealed sources. 10 CFR 36.59(b) deals with sealed sources in pool irradiators. This subsection states that leak checking may be done either by using a radiation monitor on a pool water circulating system or by analysis of a sample of pool water but gives no numerical value for the level of contamination in the water that must be detected.

Since ARECO was first in possession of Cesium-137 sources we have positioned an HP-270 probe leading to an Eberline Smart Alarm on the cation demineralizer bed to detect dissolved radioactive material in the pool water. This continuous monitor was designed to give warning of a leaker when the level of pool water contaminati n was still low. From the results of lab experiments conducted in September 1986 prior to the arrival of the Cesium-137 WESF capsules, it is calculated that the cation bed would have collected about 20 microcuries from the pool water when the alarm would sound.

A more sensitive test for leakers is carried out in connection with the weekly pool room survey. A one liter pool water sample is collected during the survey.

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boiled down to near dryness, scanned for radioactivity using the E-520 survey meter with a HP-260 "pancake" probe and the results are recorded.

The background count in the facility is usually 30-80 cpm; 50 cpm over background should be handily detected. If the efficiency of the pancake probe is taken as 1% we can give a figure of 5,000 cpm (actual) that can be detected. As Cobalt-60 emits two gammas per disintegration this would be 2,500 dpm or about 42 dps. This is 1.1×10^{-3} microcuries. Since this amount of removable contamination would come from 1,000 ml, the contamination concentration would be 1.1×10^{-6} microcuries/cc. No sample has ever shown counts greater than background.

Twice a year swabs are rubbed across the face of the irradiator plaque and these swabs are sent to Health Physics, Inc. (HPI) to be tested for the presence of radioactive material contamination. The detection limit to the analysis system employed by HPI is .0005 microcuries. No detectable contamination has ever been found on any of the smear samples submitted.

Item 3 - Condition of Sealed Sources:

In telephone conversations you expressed concern about our "BNL source strips" because of their age and asked for any documentation dealing with their fabrication. I have never seen any such records here at ARECO. The final encapsulation for these sources was done at Babcock and Wilcox (B&W) here in the Lynchburg area. I, therefore, asked Mr. Hubert Davis, Director of the Advanced Technology Laboratory at B&W, who is responsible for their hot cell records, to search for any such logs. Unfortunately, as this work was done over 30 years ago, he was unable to come up with any such accounts.

One indication that there are no leaking radioactive sources in our irradiator pool is an examination of the records of our weekly irradiator pool room survey. This survey employs an Eberline E-520 Geiger survey meter with a HP-270 probe. If any Cobalt from a leaking element were dissolved or suspended in the pool water it would end up in the cation bed of the demineralizer system or in the diatomaceous earth filter. Two positions on the cation bed and two on the filter are contact scanned every week during this survey. The records show that radiation levels found at the surface of the deionizer bed and the filter are presently, as always, at background (.02-.04 mr/hr).

This fact plus the water sample analysis records and the results of the six-month smear tests all indicate that there are presently no leaking sources in the pool.

Item 4 - Pool Debris Monitoring:

All debris that is taken from the pool via vacuuming or other procedures has always been monitored for radioactivity before being discarded. However, the results of the scanning have not always been recorded up to now. Henceforth, the results of all such debris scannings shall be recorded.

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LETTER OF FEBRUARY 5, 1997

In this letter you ask for criteria documentation for pool water heating at various source loadings. The criterion for when pool water heating is needed is if the heat supplied to the pool by decay heat, ambient air, and the heat of polymerization is insufficient to maintain the temperature of the water at 110°F.

I trust that this information is sufficient for your need for additional information concerning our license renewal. If you have any questions regarding this material, please phone me at 804-385-5300.

Yours truly,

THE APPLIED RADIANT ENERGY CORPORATION

James J. Myron Ph.D.

James J. Myron, Ph.D.
Vice President
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