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IRECO Incorporated

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November 5, 1985

U. S. Nuclear Regulatory Commission
Secretary of the Commission
Washington, D.C. 20555

Attn: Docketing and Service Branch

Dear Sir:

ANPRM ON FINANCIAL RESPONSIBILITY

The Carthage Plant of IRECO Incorporated, license number 24-20161-01, operates a gas chromatograph with a Ni-63 detector manufactured by the Perkin-Elmer Corporation.

The attached report shows the low health hazards associated with this type of source in an accident situation. It should also be noted that the Ni-63 is a sealed source and according to Perkin-Elmer no user has ever reported a rupture or leakage in a detector. Based on the health study and the safety track record of this sealed source we feel that the requirement for financial responsibility is unnecessary and should not be applicable to users of the Ni-63 sealed source.

Very truly yours,

IRECO INCORPORATED

W C Sutton

W. C. Sutton
Plant Manager

JRD:pr

Attach.

DS10
Add: Mary Jo Sutton, 62355
William Alexander, 9604 MNBB

1/1

IRECO Incorporated

Acknowledged by card..... NOV - 7 1985

Yale University
UNIVERSITY HEALTH SERVICES
HEALTH PHYSICS DIVISION

Kenneth Price
314 Wright Nuclear Structure
Laboratory, West
260 Whitney Avenue
New Haven, Connecticut 06520
Area Code 203-436-2936

August 18, 1980

Mr. Pat Dorsey
Perkin-Elmer Corp.
Norwalk, Conn.

Dear Mr. Dorsey:

I have enclosed the results of calculations which I feel apply to 10 CFR 32.51, (a), (2), parts ii and iii dealing with normal operation and accident conditions of the gas chromatograph.

If you have any further questions feel free to contact me.

Thank you.

Ken Price
Health Physicist

KP/vc

iness Address:

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ERIENCE - EDUCATIONAL

ree/Year	Institution	Field Study
.S. - 1966	California State College California, Pennsylvania	Physics/Math
.P.H. - 1968	Yale University New Haven, Connecticut	Radiological Health

ERIENCE - PROFESSIONAL

ganization	Years	Position
Northeastern Regional Health Laboratory Winchester, Massachusetts	1967	U.S.P.H.S. Fellow
Lawrence Livermore Laboratory Mercury, Nevada	1968 - 1974	Health Physicist; Nuclear Weapons Testing
Nevada Nuclear Test Site Mercury, Nevada	1972 - 1973	Consultant to the U.S.A.E.C. in conjunction with the Los Alamos Scientific Laboratory
Yale University University Health Services New Haven, Connecticut	1974 - Present	Health Physicist
Nalge Corporation Rochester, New York	1977	Consultant in demonstrating the usefulness of a product for liquid scintillation counting
Radio Station WELI New Haven, Connecticut	1977	Taped a one half-hour interview discussing Nuclear Weapons Testing
Southern Connecticut State College New Haven, Connecticut	1978	Consultant, Electron Microscopes
Perkin-Elmer Corporation Norwalk, Connecticut	1979	Consultant, General Radiation Safety; Advice on Setting up Radioactive Materials Handling Areas; Meter Calibration, Smear Surveys

epartment of Epidemiology and Public Health ew Haven, Connecticut		Public Health: Radiological Health
ale University niversity Health Services ew Haven, Connecticut	1979 - Present	Deputy Director, Health Physics Division
Dyna-Tek Ltd. Park Ridge, New Jersey	1980	Consultant, General Radiation Safety
State of Connecticut Governor's IRAT ~~Energy~~ Response Team emergency	1980	Member of Independent Risk Assessment Team

LICATIONS

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G. R. Holeman, D. McM. Shaw and K. W. Price, "Stray Neutron Spectra and Comparison of Measurement with Discrete Ordinates Calculations", Proceedings of the Second International Conference on Accelerator Dosimetry and Experience, 553, 1969.

K. W. Price and W. C. King, "An Estimate of the Release from the Baneberry Event", University of California Report, UCRL-51095, Classified, 1970.

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K. W. Price and G. R. Holeman, "Health Physics Aspects of the Yale Heavy Ion Linear Accelerator Dismantling Project", Operational Health Physics, Proceedings of the Ninth Midyear Topical Symposium of the Health Physics Society, 499, 1976.

M. M. Gabel, K. W. Price and G. R. Holeman, "Thyroid Monitoring and Minimizing I-125 Uptake", Published in the Proceedings of the Campus Radiation Safety Officers' Conference, N.B.S., SP-456, 1976.

G. R. Holeman, K. W. Price, L. F. Friedman and R. Nath, "Neutron Spectra From a Sagittaire Medical Accelerator", Proceedings of the Fourth International Conference of the International Radiation Protection Association, Vol. 3, 827, 1977.

G. R. Holeman, K. W. Price, L. F. Friedman and R. Nath, "Neutron Spectral Measurements in an Intense Photon Field Associated with a High Energy X-Ray Radiotherapy Machine", Medical Physics, Vol. 4, No. 6, 1977.

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K. W. Price, G. R. Holeman, R. Nath and L. Friedman, "A Neutron Survey of a 25 MV X-Ray Clinical Linac Treatment Room", Health Physics Society 1978 Annual Meeting, July, 1978.

K. W. Price, R. Nath and G. R. Holeman, "Fast and Thermal Neutron Profiles for a 25 MV X-Ray Beam", Medical Physics Journal, July/August, 1978.

K. W. Price, G. R. Holeman and R. Nath, "A Technique for Determining Fast and Thermal Neutron Flux Densities in Intense High Energy (8-30 MEV) Photon Fields, Health Physics Journal, Vol. 35, August, 1978.

R. Nath, K. W. Price and G. R. Holeman, "Mixed Field Dosimetry, Proceedings of a Conference on Neutrons from Electron Medical Accelerators", NBS Special Publication, 554, United States Department of Commerce, National Bureau of Standards, September, 1979.

R. Nath, K. W. Price and G. R. Holeman, "An Intercomparison of Neutron Measurements for a 25 MV X-Ray, Radiotherapy Accelerator", Submitted to Medical Physics, February, 1980.

K. W. Price, R. Nath and G. R. Holeman, "High Energy X-Ray Spectrum Measurements Using Photo Nuclear Activation Detectors", submitted to the 25th Annual Meeting of the Health Physics Society, February, 1980.

SOCIETIES

Member, National Chapter of the Health Physics Society.
Member, Connecticut Chapter of the Health Physics Society.

HONORS

U.S.P.H.S. Fellowship, Yale University, 1966 - 1968.

SUMMARY

It appears very unlikely that under normal operating conditions of the unit, exposures would result that even approach the limits of 10 C.F.R. 32.51 (a)(2)(ii). An accident situation would yield a surface skin dose in the range of 12 MREM/Hr. due to submersion in a contaminated atmosphere. However, this dose would be to the dead layer of the skin only, due to the low Beta energy of Ni^{63}. Dose to the internal lung tissues due to submersion would be even less, due to the natural breathing process. A total lung dose due to actual deposition of insoluable $Ni^{63}O$ would be in the range of 8 Rem (50 Yr. integrated dose equivalent, acute uptake). Dose to the G.I. tract would be less. The most serious situation occurs when the Ni^{63} foil is placed in direct intimate contact with bare skin. A surface dose rate of ~ 7300 RAD/Hr. would result, but the dose rate falls to zero at about the depth of sensitive skin tissue, the basal cells (.007 cm deep). Skin erythema could result with prolonged contact, but recovery should be certain. If the foil were placed in a pocket, the dose rates would be very much less due to absorption in the material and air.

/s/ Kenneth Price 8/17/80

Health Physicist

RESPONSE TO 10 C.F.R. 32.51 (a)(2)(ii):

Under normal operating conditions, the Ni foil is securred in a cell, and that cell is in the device. The Ni^{63} isotope is electrodeposited onto a Ni foil backing, making it very strongly bound to the foil. The melting point of Ni is 1455 ^{o}C, and the boiling point is 2900 ^{o}C [1] (Ref. 1). Engineering tests indicate a maximum possible temperature in the cell $\leq$ 530 ^{o}C.

Radiation dose rates outside of the cell should be minimal, as Ni^{63} emits Beta radiation of very low energy (E_{max} = 0.066mev, E_{ave} = .017mev). The calculated range [2] of these Beta's is 6.59 mg/cm^{2}. The walls of the cell are greater than the range of the maximum energy Betas which are emitted.

There should be no liberation of airborn Ni^{63} during normal operation, and the only radiation leakage would be very low energy characteristic x-rays and bremsstrahlung which would be absorbed almost entirely within the walls of the cell.

RESPONSE TO 10 C.F.R. 32.51 (a)(2)(iii):

In the event of a catastrophic accident or direct tampering and removal of the Ni foil by an unauthorized individual, several possible exposure routes may result. Three such conditions will be addressed:

(1) Complete vaporization of a 15 mCi Ni^{63} foil and subsequent prompt release into a stagnant laboratory atmosphere, external dose rate to an individual present in the room;

(2) Same as above, but the dose to the lung due to ingestion and retention of Ni^{63};

(3) Removal of the Ni foil from the cell by an unauthorized individual, and dose rate to skin due to direct contact of foil and skin.

(1.) The assumption is made that complete vaporization of 15 mCi of Ni^{63} is instantaneously released into a lab which is 10' X 10' X 8' and that there is no ventillation and no reduction with time of the Ni^{63} air concentration. Because Ni^{63} is a low energy Beta emitter, no internal exposure will result due to submersion of an individual into this atmosphere[3]. (Deposition in lung will be discussed later.) From reference 3, the external Beta dose rate conversion factor at the skin surface is:

$$1.56 \times 10^{8} \ \frac{(\text{MREM/YR})}{(\mu\text{Ci/cm}^{3})} \ .$$

The concentration of Ni^{63} in the room would be:

6.62×10^{-4} uCi/cm^3 ,

yielding a skin surface dose rate of :

11.8 MREM/HR .

The dose rate to the internal surface of the lung would be less due to the natural breathing process. In an accident situation where such a release might occur, it is very unlikely an individual would be present for an extended period of time. At any rate, it is very improbable that the limts in table 32.24, Column IV of 10 C.F.R. 32 would be exceeded. It should also be pointed out that what skin dose did result would be to the uppermost dead layer, as the range of the Ni^{63} maximum energy Betas in tissue is 6.59×10^{-3} cm, and the depth of the sensitive basal layer of the skin is 7.00×10^{-3} cm and the lens of the eye 0.3 cm (ICRP 30).(4)

(2.) Again, the 15 mCi of Ni^{63} is released into a lab (10' X 10' X 8') with no ventillation, yielding a constant concentration of 6.62×10^{-4} uCi/cm^3. The Ni^{63} would be released as NiO, which is insoluable in water and only slightly soluable in acid. NiO is a Class W inorganic compound according to the ICRP task group on lung dynamics(5). A mean particle diameter of 1 um will be

assumed as suggested in ICRP 30[4]. The ICRP lung model was used in calculating the resultant lung dose[4]. The following assumptions were made in the calculations:

(a) Ni^{63} is released as $Ni^{63}O$, which is insoluable in water, with an AMAD of 1 um, and is a Class W compound.

(b) In an accident condition, a maximum likely individual residence time was set equal to one hour.

(c) Standard man breathing rate, light activity, 9600 liters/8 hours, or 1.2×10^{6} cm^3 breathed in one hour[6].

(d) Initial Ni^{63} concentration 6.62×10^{-4} uCi/cm^3 with no ventillation assumed.

(e) No clearance from lung is assumed during the one hour of uptake, and no respiratory protection assumed.

Using the appropriate factors from the lung model, the total initial amount of activity deposited in the total lung system is~ 500 uCi. ICRP 2 suggests a maximum permissible total body burden of soluable Ni^{63} of 900 uCi[7]. Based on the results of the calculations, the total dose commitment to the lung from a one hour exposure is 8.2 REM. If this is averaged over a period of 50 years, this results in about 164 MREM/YR. This is approximately equal to the

U.S. population average exposure per year of 170MREM/YR. Again, the maximum allowable doses as given in table 32.24, Column IV of 10 C.F.R. 32 would not be exceeded. The dose commitment to the G.I. tract would be very much less due to the short residence time in the gut.

(3.) The approximate Beta absorbed dose rate at various depths in tissue was calculated assuming 15mCi uniformly distributed on a 2.4cm disc, in direct contact with bare skin[8]. The results of the calculations are given below; also given are the centimeter depths in tissue for which the absorbed dose was computed.

Tissue Depth, cm	RAD/HR
0.0010	7308
0.0050	.839
0.0066	.022
>.0066	~ 0

The dose rate near the immediate surface of the skin is quite large and falls off with depth quite rapidly. However, the dose is to the non-functional dead layer of the skin, as the depth of the skin tissue basal layer is ~0.0070cm[4]. A possible skin reaction (i.e. skin erthema) could occur if the foil were in direct intimate contact with the skin. However, the damage would be localized to the immediate area of the foil and recovery would be expected. Any clothing and subsequent air space (i.e. foil in a pocket) would reduce the absorbed dose greatly.

REFERENCES

(1) Handbook of Chemistry and Physics

(2) Radiological Health Handbook

(3) Health Physics, Vol. 38, April, 543-621.

(4) ICRP Report 30

(5) Health Physics, Vol. 12, 1966

(6) ICRP Report 23

(7) ICRP Report 2

(8) Radiation Dosimetry, Hine and Brownell