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30-17824

January 3, 2018

ATTN: Document Control Desk/Exempt Distribution
Director, Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

This letter is written in order to comply with Title 10 CFR Part 32, Specific Domestic Licenses to Manufacture or Transfer Certain Items Containing Byproduct Material, effective December 17, 2007.

Licensee: Detector Electronics Corporation
6901 W. 110th Street
Minneapolis, MN 55438

License Number: 22-18199-02E

Authorized use:
Our products were transferred for use under 10 CFR 30.15(a)(8)(iv) as required by 10 CFR 32.16(a)(2).

Product Description:
This Product Transfer Report is for our gas filled source tube which is the only radioactive item we transfer to customers. It is used for generating ultraviolet light in our fire detection systems. The following amount of Krypton-85 transferred since our last reporting period was 2.264 Millicuries and covers the time frame of 1/1/17 – 12/31/17.

Radionuclide per tube:
Each source tube contains approximately 1 microcurie of Krypton-85 gas. This has been calculated via Mass Spectrometry Analysis (see Attachment G-7). The number of units produced in 2017 was 2,264. Therefore, we calculate the amount of Krypton-85 transferred to be 2.264 Millicuries, as mentioned in the Product Description paragraph.

Sincerely,

Khanh Nguyen
Radiation Safety Officer
952.829.8721

NMSS03

ATTACHMENT G-7

Detector Electronics

Kr-85 Electron Tube Characteristics

1. Kr-85 Tube Activity

Activity of the Kr-85 in a tube is best determined by determining the amount of Kr-85 introduced into the tube and not by measurement of the radiation emitted from the Kr-85 in the tube.

The specific activity of the Kr-85 in the supply tank is 50 mCi/L at atmospheric pressure (760 Torr). The tube in which the Kr-85 is introduced is evacuated to 4 micoTorr (a virtual vacuum), and the tube is backfilled to 10 Torr of Kr-85.

The universal gas law applies: PV=nRT where

P=pressure
V=volume
n=quantity (Kr-85 activity) of gas
R=gas constant plus unit conversions
T=Temperature

For the supply tank - Equation 1:

$$760 \text{ Torr} \times 1 \text{ L} = 50 \text{ mCi} \times RT$$

For the tube – Equation 2, where the tube volume is 0.6 ml and A is the activity in the tube:

$$10 \text{ Torr} \times 0.6 \text{ ml} = A \times RT$$

The temperature T will be constant during the transfer. Dividing Equation 2 by Equation 1 the result is:

$$A = 0.4 \text{ µCi Kr-85}$$

A supply tank of Kr-85 will last for no longer than nine months. The half life of Kr-85 is 10.765 years. The activity of Kr-85 will have decreased 4.7% over the nine month use period. Therefore, the tubes should be within ±3% activity range, but the transportation values will be based on highest activity manufactured.

2. Specific Activity of Kr-85 in Electron Tube

The electron tube described above filled with 10 Torr of Kr containing Kr-85 is backfilled to a pressure of 30 Torr with an 80% Neon and 20% Hydrogen gas mixture. Assuming an ambient temperature of 72^0 F and 0.6 ml volume then the mass of the gas mixture in which the Kr-85 is uniformly distributed is 38.5 µg. Thus, the specific activity of the 0.4 µCi Kr-85 in the electron tube is 10,600 µCi/g.

ATTACHMENT G-7
Page

Detector Electronics

Kr-85 Electron Tube Characteristics

3. Radiation Units

For the purposes of this report 1 Roentgen = 1 rem since Kr-85 is a beta and gamma emitter.

4. Occupational Services Report

4.1. Radiation Levels: Kr-85 Tubes at 1 cm

Radiation levels were measured for 10 Kr-85 tubes at 1 cm through 7 mg/cm^2 using a Fluke 450B ion chamber. The results are shown in the attached Occupational Services report in Table 2, and are summarized below.

1 cm	
Ten Tubes	mR/hr
Average	0.18
Maximum	0.20
Minimum	0.14

Thus the Kr-85 electron tubes meet the NRC 10 CFR 30.15(a)(8) requirements that the radiation levels do not exceed 1 millirad per hour at 1 centimeter from any surface when measured through 7 milligrams per square centimeter of absorber, since the milliR to millirad conversion is less than one.

4.2. Radiation Levels at 10 cm

4.2.1. Kr-85 Electron Tubes

Radiation levels were measured for 10 Kr-85 tubes at 10 cm through 7 mg/cm^2 using a Fluke 450B ion chamber. The results are shown in the attached Occupational Services report in Table 2, and are summarized below.

10 cm	
Ten Tubes	mR/hr
Average	0.04
Maximum	0.05
Minimum	0.02

4.2.2. Kr-85 Modules

Occupational Services reported no detectable of radiation at 10 cm from each of the two modules.

Detector Electronics

Kr-85 Electron Tube Characteristics

4.2.3. Ultra Violet Test Lamp
Occupational Services reported no detectable of radiation at 10 cm from the Ultra Violet Test Lamp

4.3. Package Surface Radiation Levels

Maximum radiation levels were measured on the surfaces of four packages as shown in Table 1 of the attached Occupational Services report and below:

Instrument	Package Surface Exposure Rate mR/hr				
	Background	Package of 10 tubes 0024005-001	Package 1 Module 003240-001	Package 2 Module 007450-003	Package of Ultra Violet test lamp.
Fluke 450B	0.01	0.20	0.01	0.01	0.01
Ludlum 3 with 44-9 Pancake Detector	0.015	0.45	0.015	0.015	0.015

The above table demonstrates that the four maximum package surface radiation levels do not exceed 0.5 mrem/hr for the four packages, and therefore meet the maximum package surface radiation level criteria for a radioactive material excepted package. The difference between the Fluke ion chamber reading of 0.20 mR/hr and the corresponding pan cake probe reading of 0.45 mR/hr is because of the difference in detector size and the over response to low energy photon gamma radiation by a GM tube.

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