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March 8, 2010

USNRC - FSME - Mail Stop T 8 E 24
11555 Rockville Pike
Rockville, MD 20852

Reference: Mail Control No. 022785

Dear Mr. Struckmeyer,

In an email message on February 24th (see last page of this letter), you brought to my attention the fact that our application did not address the provisional requirement of 10 CFR 30.15(a)(8) that: *the levels of radiation from each electron tube containing byproduct material do not exceed 1 millirad per hour at 1 centimeter from any surface when measured through 7 milligrams per square centimeter of absorber.*

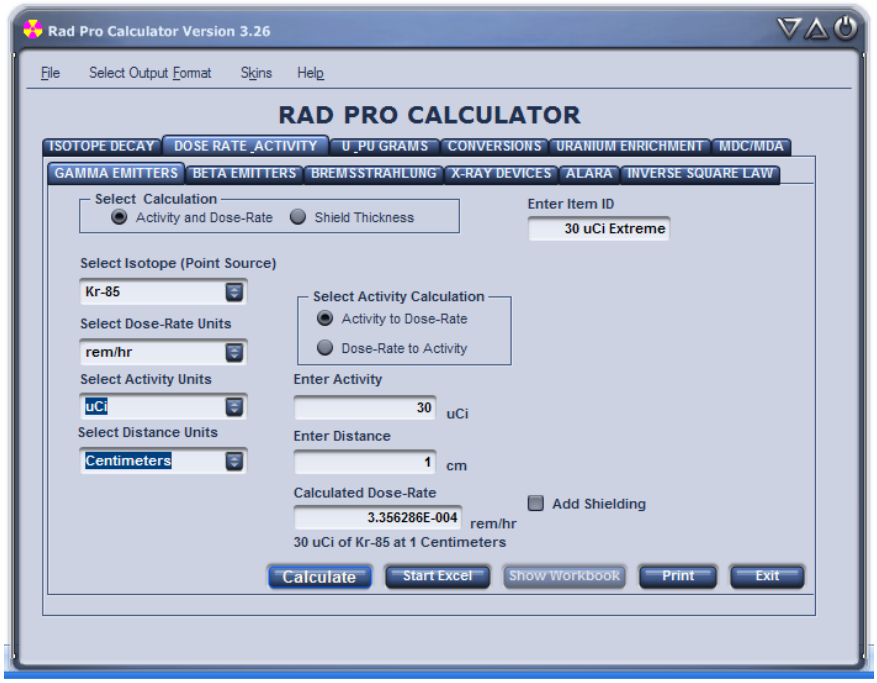
Since receiving your notification, I have prepared a number of "proofs" to satisfy this requirement, the details of which are indicated in the following paragraphs:

1. **Analytical Calculations:** An analytical treatment of the a model electron tube was made by our consulting firm, Integrated Environmental Management, Inc**.** (IEM) using Microshield ® 7.00, a well known radiation dose assessment program (http://radiationsoftware.com/mshield.html). Two scenarios (indicated in the attachments to this letter, were created to determine dose rate at two different distances: On contact and at 30 cm. In both cases the activity of the Kr85 was input at a 30 uCi. This radioactivity value, in actuality, is more than 150 times greater than the actual activity of any one of our electron tubes. In the "on contact" model, with 30 uCi of activity, a value of **0.13 mR/hr** (**0.13mrad/hr**) was determined. If we scale this value to a more realistic activity level of approximately 0.2 uCi per lamp, the radiation dose decreases to approximately **0.001 mrad/hr**, far below the 1 mrad/hr limit referenced in the regulations. Please note that this modeling uses some extreme parameters: The aluminum clad shown in the calculation sheet is a substitute input value for the glass envelope of the electron tube at 0.02" thickness. Actual wall thickness is approximately 0.04". Furthermore, please consider that this model is for an on contact situation. At 1 cm with an absorber, the radiation dose rate will be lower.

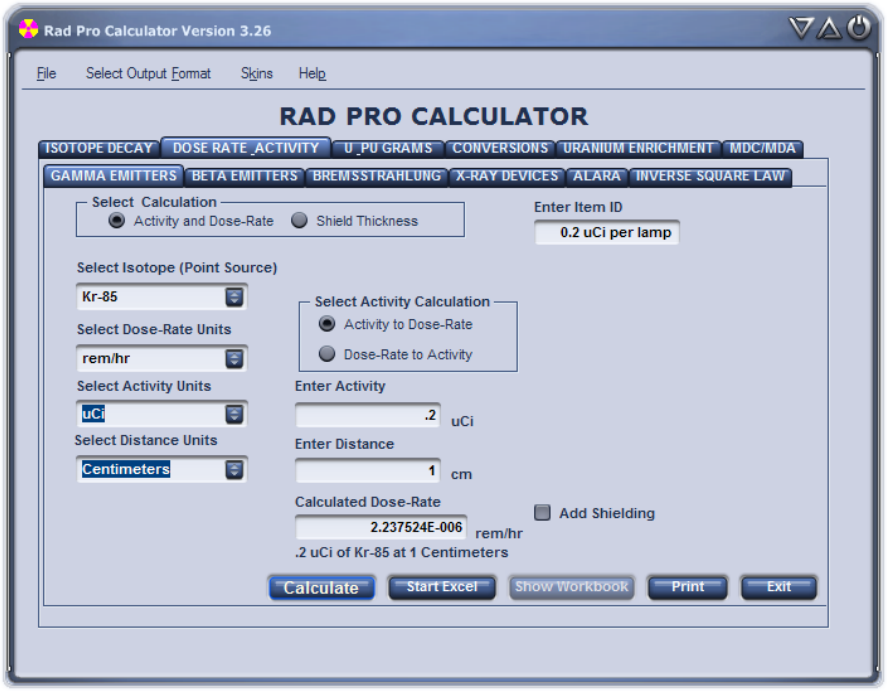
2. **Analytical Calculations:** Using a different program called ProRad Version 3.26, with inputs of radioisotope Kr85, activity levels: 30 uCi (exempt limit) and 0.2 uCi (actual), we calculated dose rates as follows:

a. 30 uCi at 1 cm / no shielding = 0.336 mrem/hr
b. 0.2 uCi at 1 cm / no shielding = 0.0022 mrem/hr

Both values are significantly lower than the limit in the CFR which accounts also for an absorber.



0.336 mrem/hr – one lamp at 30uCi at 1 cm – no shielding



0.0022 mrem/hr – one lamp at 0.2uCi at 1 cm – no shielding

3. **Measurement Data**: Our lamp supplier has provided to us some data representing actual measurements of individual lamps at 1 cm *without shielding*. The measurements were made with a calibrated EG&G Berthold GM Radiation Meter Model LB 1236. The background environmental radiation dose rate was first measured and then subtracted from the sample readings to determine the actual absolute radiation dose rate from the electron tubes. Please see Figure 1.

   Observable from these data is the realization that there is little difference between ambient radiation levels and those of the measured samples at 1 cm. The maximum radiation level detected according to this methodology was **0.0007 mrad/hr.**

   As an experiment, the supplier fabricated a test sample containing approximately 6x the normal concentration of Kr85. This lamp was measured in the same manner as the other lamps. After subtracting background radiation, this special test sample (which we estimate contained about 1.2 uCi of activity), gave a final dose rate of **0.0032 mrad/hr** without shielding. **All measured values were considerably lower than the limit of 1mrad/hr.**

   An explanation and discussion of the measurement procedures and the results is also included as a separate attached document: "**Measuring of radiation levels of electron tubes with byproduct material".**

4. **Measurement Data**: Another set of measurements were conducted at Cosmedico Light, Inc... Please see Figure 2.

   Using a Gamma Scout ® Radiation GM type Detector (GAMMA-SCOUT GmbH & Co.) with a setting of "Gamma + Beta + Alpha", measurements were conducted at 1 cm from a variety of electron tubes. Additionally, measurements were made on multiple lamps in stock cartons. Refer to photos included in this letter.

   The results of these measurements indicate again that any "signal" from the lamps is practically indiscernible from back ground radiation levels which are in the range of about 0.014 mrad/hr. The highest radiation dose rate that we could measure in our sample set was **0.001 mrem/hr (0.001 mrad/hr).**

5. **Anecdotal Information:** On March 5th, 2010, the Commonwealth of Massachusetts, Dept. of Public Health, Radiation Control Program conducted an inspection pursuant to our state Materials License. During the visit, the inspector made a survey of our warehouse stock. Measurements made with a calibrated Ludlum Model 3 with No. 447 GM Probe within 1 cm of a large number of electron tubes actually yielded readings that were at, or somewhat lower than, the measurements made in an area about 30 feet from our radiation materials stocking area. As this was not an official measurement session, only a fast survey, I will not present the readings here. But we witnessed measurements that were consistent with the findings previously presented in this letter: Even on a high resolution-high sensitivity scale, we could see virtually no difference between ambient radiation levels and those from our electron tubes.

Mr. Struckmeyer, based on the information provided herein, I am confident that the radiation dose rate from the electron tubes that will be distributed by Cosmedico Light is significantly lower than the 1 mrad/hr specified by the pertinent regulation. Even under a simulated worst case situation (30 uCi activity – the exempt quantity limit), all indications are that the 1mrad/hr dose rate will be easily met.

Please review my responses and the actual measurement data presented here and if you have any questions, please do not hesitate to contact me.

Respectfully submitted,

Steven Schlitt

Director of Engineering
Radiation Safety Officer
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cc – Kevin Apgar - Cosmedico

Radiation Dose Rate - Cosmedico Electron Tubes (UV sunlamps)

Note: Background radiation must be subtracted from Tube Measurements

		Sample Electron Tube measured at 1 cm NO Absorber				Background Measurement - Open Air				Sample Dose Rate minus Background Dose rate (mrem)	Sample minus Background (mrad) 1 mrem equates to 1mrad for beta and gamma
Test Lamp No.	**Kr85 Activity (uCi)**	Measured Value in uSv	Measurement Period (Hrs)	Calculated Dose Rate (uSv/hr)	Dose rate in mrem/hr	Measured Value in uSv	Measurement Period (Hrs)	Calculated Dose Rate (uSv/hr)	Dose rate in mrem/hr	Sample dose rate in mrem/hr	Sample dose rate in mrad/hr
900044455	0.0332	0.06	0.50	0.12	0.012	0.06	0.5	0.12	0.012	0.0000	0.0000
919220245	0.0572	0.06	0.50	0.12	0.012	0.06	0.5	0.12	0.012	0.0000	0.0000
938668945	0.1809	0.07	0.50	0.14	0.014	0.06	0.45	0.13	0.013	0.0007	0.0007
900361241	0.0656	0.06	0.50	0.12	0.012	0.06	0.5	0.12	0.012	0.0000	0.0000
900677041	0.0332	0.06	0.50	0.12	0.012	0.06	0.5	0.12	0.012	0.0000	0.0000
Test sample with 6X higher pressure than normal		0.13	0.84	0.155	0.0155	0.06	0.49	0.122	0.012	0.003	**0.0032**

Instrumentation: EG&G Berthold Model LB 1236

Meaurement of gamma

FIGURE 1

Radiation Dose Rate - Cosmedico Electron Tubes (UV sunlamps)

Note: Background radiation must be subtracted from Tube Measurements

		Sample Electron Tube measured at 1 cm NO Absorber				Background Measurement - Open Air				Sample Dose Rate minus Background Dose rate (mrem)	Sample minus Background (mrad) 1 mrem equates to 1mrad for beta and gamma
Test Lamp No.	**Kr85 Activity (uCi)**	Measured Value in mrem	Measurement Period (Hrs)	XXXX	Dose rate in mrem/hr	Measured Value in mrem	Measurement Period (Hrs)	XXXX	Dose rate in mrem/hr	Sample dose rate in mrem/hr	Sample dose rate in mrad/hr
HP lamp 24200 in warehouse - multiple cartons	-	0.008	0.56		0.0143	0.021	1.5		0.014	0.0003	0.0003
HP lamp 24200 in warehouse - multiple cartons (2nd Meas.)	-	0.005	0.35		0.0143	0.003	0.22		0.014	0.0006	0.0006
Single lamp: Type 24200	0.1970	0.004	0.28		0.0143	0.006	0.43		0.014	0.0003	0.0003
Single Lamp: Type 24008	0.1944	0.011	0.83		0.0133	0.003	0.24		0.013	0.0008	0.0008
Single Lamp: Type 24200 - Overnight	0.1970	0.205	13.50		0.0152	0.003	0.20		0.015	0.0002	0.0002
Single Lamp: Type 24003	0.1728	0.030	1.97		0.0152	0.037	2.47		0.015	0.000	0.0002
Single Lamp: Type 24103	0.0648	0.011	0.75		0.0147	0.019	1.40		0.014	0.0011	0.001

Measurements made 3/3/10 - 3/8/10

Single lamps measured in Unit 1 office area. Multple lamps measured at the warehouse.

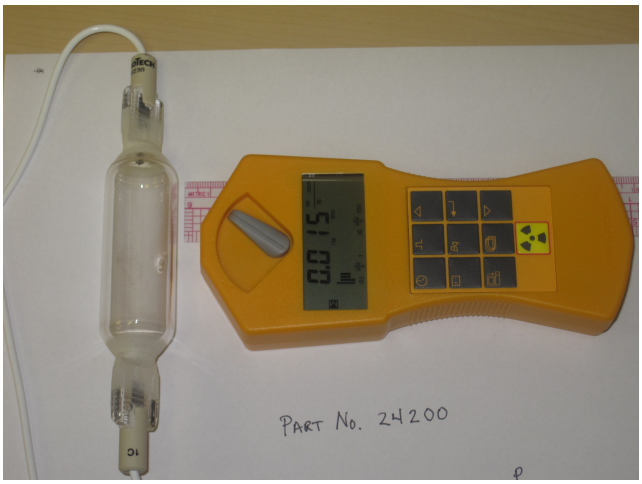
Instrumentation: Gamma Scout (Ser No. 037097)

Detection: gamma & beta radiation / no absorber used.

Figure 2

Measurements made at Cosmedio Light, Inc.

Multiple lamps being measured in warehouse



Single lamp at 1 cm - NO Absorber (switch to right) - detection gamma and beta

Single lamp at 1 cm - NO Absorber (switch to right) - detection gamma and beta

REFERENCE EMAIL
FEB 24, 2010

From: Struckmeyer, Richard [mailto:Richard.Struckmeyer@nrc.gov]
Sent: Wednesday, February 24, 2010 8:43 AM
To: Steve Schlitt
Subject: Quick question

Mr. Schlitt:

I have not yet been able to thoroughly review your responses; however, a quick look brought up one issue that you may (or may not) be able to resolve quickly:

In my letter of Jan. 15, I wrote: "Title 10, Code of Federal Regulations, Section 32.14(b)(7) requires that the radiation level and the method of measurement for products for which limits on levels of radiation are specified in § 30.15; 10 CFR 30.15(a)(8) specifies such limits for electron tubes."

I may have misunderstood your response, but it does not appear that you addressed the following from 10 CFR 30.15(a)(8) :

***And provided further*, That the levels of radiation from each electron tube containing byproduct material do not exceed 1 millirad per hour at 1 centimeter from any surface when measured through 7 milligrams per square centimeter of absorber.**

If you have addressed this, please let me know exactly where I can find it.

I may have additional questions, but I'd prefer to get this one to you rather than wait until I can review everything you provided.

Thank you,

Richard K. Struckmeyer
Division of Materials Safety and State Agreements
Office of Federal and State Materials and Environmental Management Programs
U.S. Nuclear Regulatory Commission