PENNSTATE

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Environmental Health and Safety

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March 29, 2012

Document Control Desk
Director, Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
ATTN: Christopher Ryder
One White Flint North
11555 Rockville Pike
Rockville, Maryland 20852-2738

Subject: RAI for amendment to SNM-95 (TAC NO. L33189) dated March 8,2012

Dear Mr. Ryder,

On March 8, 2012, you requested more information from me regarding a license amendment submitted by Penn State University. I hope this letter provides you with sufficient information. In order to help keep this communication clear, I have inserted your specific requests for information within this letter in ***bold italics.***

RAI # 1. Discuss the following aspects of the ventilation system that will be used during the handling of the special nuclear material (SNM) solution, including, but not limited to the following:

1.1. Operating parameters (e.g., volumetric flow rate).
1.2. How the parameters are verified.
1.3. Frequency that the parameters are verified.
1.4. Applicable action limits.
1.5. Corrective actions if the action limits are exceeded.

See Regulatory Guide 8.24, Section 1.12 for the general types of information being requested. The information is needed to verify compliance with Title 10 of the Code of Federal Regulations (10 CFR), Parts 20.1701 and 70.22(a) (7).

Contrary to work discussed in Regulatory Guide 8.24, *Enriched Uranium-235 Processing and Fuel Fabrication Facility,* university facility ventilation systems are not normally utilized as reliable engineering controls for controlling the concentration of air contaminants. Although in new research facilities an attempt is made to design for building ventilation to aid the minimization of air contaminants, reliance on these systems is not considered prudent. This situation is even worse in older buildings that have been reconfigured and or repurposed multiple times in the last fifty years. Many buildings were built prior to the popularity of central

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air conditioning with opening windows and an attempt at occupant controlled climates. Even newly renovated ventilation systems, such as the Radiation Science and Engineering Center, where fresh air is designed to be inserted into the halls and removed from the labs, will be readily defeated by occupants opening windows in different configurations. Thus no credit should be taken for room ventilation in minimizing or controlling air concentrations in these facilities.

RAI # 2. Discuss the following aspects of the effluent hoods that will be used during the handling of the SNM solution, including, but not limited to the following:

2.1. Operating parameters (e.g., flow rate at the face of hoods).

2.2. How the parameters are verified.

2.3. Frequency that the parameters are verified.

2.4. Applicable action limits.

2.5. Corrective actions if the action limits are exceeded.

See Regulatory Guide 8.24, Section 1.12 for the general types of information being requested. The information is needed to verify compliance with 10 CFR 20.1701 and 70.22(a)(7).

Fume hoods are a standard engineering control used to minimize exposure to uncontained materials at Penn State. Fume hoods are inspected annually and their face flow rate measured using a calibrated velometer. Hoods are removed from service if they do not meet the minimum standard or exceed the maximum standard as shown in the table below. Fume hoods outside the required 100 – 150 feet per minute range but within the 80-250 feet per minute acceptable range are not removed from service but the information is passed to Office of Physical Plant maintenance personnel for repair. Contrary to the 1979 Regulatory Guide, most recommendations now suggest that 100 – 150 feet per minute is the optimum flow rate for safe work within an effluent fume hood. Flows above 150 fpm tend to generate unacceptable turbulence and interfere with laboratory work.

No work with uncontained materials that require a fume hood may be performed in a hood that has been removed from service. The exhaust system must be repaired and the face velocity retested before the hood is returned to service.

Prior to each use, laboratory workers will verify proper air flow direction and approximate air flow rate with a mechanical indicator. Hoods will be used with the hood sash at a height that provides the correct air flow.

Face velocity Feet per minute	Result of test	Immediate Action
< 80	Fail	Hood removed from service
80 – 100	Pass, hood needs adjustment	OPP contacted to provide maintenance
100-150	Pass	None required

150-250	Pass, hood needs adjustment	OPP contacted to provide maintenance
> 250	Fail	Hood removed from service

RAI # 3. Discuss the operational parameters of the glove boxes that will be used during the handling of the SNM solution, including, but not limited to the following:

3.1. Operating parameters.
3.2. How the parameters are verified.
3.3. Frequency that the parameters are verified.
3.4. Applicable action limits.
3.5. Corrective actions if the action limits are exceeded.

See Regulatory Guide 8.24, Section 1.12 for the general types of information being requested. The information is needed to verify compliance with 10 CFR Part 20.1701 and 70.22(a)(7).

Atmospheric pressures inside glove boxes will be maintained less than the surrounding air pressure whenever uncontained radioactive material is inside the glove box. The exact technique for performing this check will vary by glove box. Some models have pressure/vacuum gauges; some old models have differential pressure gauges. This negative air pressure will be verified prior to each use of the device and periodically during operation. If the pressure inside becomes greater than or equal to the outside pressure, the radioactive material must be secured and research stopped until the negative pressure is restored. Glove boxes that are unable to maintain a negative pressure will be removed from service until repaired.

RAI # 4. Describe the controls that will be in place to ensure the materials are securely stored when not in use; and supervised during research. The information is needed to verify compliance with 10 CFR Parts 20.1801 and 20.1802.

At Penn State, all radioactive material is required to be secured from unauthorized access at all times. The material must be under *constant* surveillance or within a locked storage area at all times. "At all times" includes brief interludes when the researcher leaves the room for phone calls, breaks, lunch, or similar activities.

The methods of securing radioactive material at PSU vary by lab supervisor and lab facilities. Some principal investigators (PIs) maintain a locked lab even when the room is occupied. Other PIs arrange special locked storage locations for radioactive materials within their labs and only insist on locked doors at night and when radioactive material is not located within the locked areas. Radioactive waste is also secured to these standards.

Penn State's radiation safety committee does not detail how security of radioactive material is maintained but has established a performance-based approach to this question.

RAI # 5. Provide the evaluations for airborne effluent releases cited in the amendment request that demonstrate effluents will not exceed the constraint on air emissions found in 10 CFR 20.1101(d)—and which justify no effluent monitoring nor treatment. The information is needed to verify compliance with 10 CFR Parts 20.1101(d) and 20.1302.

PSU annually verifies compliance with 20.1101(d) and 20.1302 by utilizing the worksheets and screening factors provided in NCRP Report No. 123 *Screening models for Releases of Radionuclides to Atmosphere, Surface Water, and Ground.* Completion of these worksheets show that the maximally exposed individual receives about 0.7 mrem per year based upon screening level II. For calendar year 2011, the calculated mrem per year using this method resulted in a hypothetical exposure of 0.06712 mrem. The table below is a small part of NCRP No 123's worksheet for the material requested under this license. As you can see, the possession limit of this material adds about 0.0057 mrem to the calculated exposure of the nearest exposed person.

The approximate 0.7 mrem per year referred to above results from all work performed under the Pennsylvania Broadscope license, the nuclear reactor license, and the Special Nuclear Materials license. This number varies slightly year by year. Various NRC inspectors have suggested calculation methods that would result in a reduction of this calculated exposure.

	Amount to be received	**Release Rate**	**Effective Concentration I-A-5**	**Screening factor from Table 1.1 NCRP 123 II**	**Wind Speed and Building Factor II-E-2**	**Exposure per year II-F-3**
	Ci	**Bq/sec**	**Bq/m^3**	**Sv/ Bq/m^3**	**Bq/m^3**	**Sv/yr**
Cs-137	1.50E-05	1.73E-05	1.45E-05	2.2E-01	1.49E-08	3.28E-09
Sr-90	1.50E-05	1.73E-05	1.45E-05	1.9E-01	1.49E-08	2.84E-09
Am-241	2.40E-05	2.78E-05	2.31E-05	1.0E+00	2.39E-08	2.39E-08
Cm-244	2.40E-05	2.78E-05	2.31E-05	5.4E-01	2.39E-08	1.29E-08
Pu-238	8.00E-06	9.25E-06	7.71E-06	8.9E-01	7.96E-09	7.09E-09
Pu-239	2.00E-06	2.31E-06	1.93E-06	1.0E+00	1.99E-09	1.99E-09
Pu-240	3.00E-06	3.47E-06	2.89E-06	1.0E+00	2.99E-09	2.99E-09
Pu-241	6.00E-05	6.94E-05	5.78E-05	2.0E-02	5.97E-08	1.19E-09
Eu-154	4.00E-06	4.63E-06	3.85E-06	1.2E-01	3.98E-09	4.78E-10
Cs-134	2.00E-06	2.31E-06	1.93E-06	1.3E-01	1.99E-09	2.59E-10
Pm-147	2.00E-06	2.31E-06	1.93E-06	3.2E-05	1.99E-09	6.37E-14
Np-239	2.00E-07	2.31E-07	1.93E-07	8.5E-05	1.99E-10	1.69E-14
				Sv/year for spent fuel		5.69E-08
				mrem/year for spent fuel		0.00569
PSU's NCRP calculation for 2011 **not including** the spent fuel					mrem/year =	0.6712
PSU's NCRP calculation for 2011 **including** the spent fuel					mrem/year =	0.6769

RAI # 6. The application states that all work will be performed over bench paper. The liquid samples consist of the radionuclides in 0.1 to 0.5 M nitric acid. Clarify that the absorbent paper is chemically compatible with the acidic solution. The information is needed to verify compliance with 10 CFR Part 70.22(a)(7), requiring proposed procedures to protect health and minimize danger to life or property.

This acid is insufficiently strong to cause the paper to ignite or to dissolve the underlayment of plastic. The bench paper will of course be surveyed after each use of radioactive material and promptly disposed if contaminated. Visible/obvious spills will be immediately treated with materials from an acid spill kit and promptly disposed, then the area will be surveyed for contamination.

RAI # 7. The application states that the material will be handled according to approved procedures. Discuss how the existing procedures for handling other radionuclides bound handling plutonium (high recoil energy upon decay causes plutonium to readily disperse). The information is needed to verify compliance with 10 CFR Part 70.22(a)(7), requiring proposed procedures to protect health and minimize danger to life or property.

The "procedures" used at PSU when dealing with radioactive material refers to the whole safety policy not the specific step-by-step details of how an experiment or task is performed. Because this is research, the step-by-step procedures used are continuously subject to change. In industrial settings, the specific ideal steps are worked out long before construction begins. In research settings procedures are broader and more open to interpretation as long as they fall within established safety parameters.

Researchers are instructed to follow this continuous quality improvement process for their procedures to maximize data integrity and safety and minimize waste and exposure.

"Plan your procedure	Detail the steps that must be performed, including the order in which they must be completed. Plan on using long handled tools to maximize your distance. Plan to work behind a shield. Neatly write up your procedure to help you remember the seemingly small things that could ruin your experiment and your evening if not properly performed.
Practice the steps	Practice, practice, practice. Set up at your work site, complete with shield and long-handled tools, then repeatedly perform all the required steps. Watch yourself to see if you are storing your tools or materials in an awkward location. This prior practice will speed your work and reduce your exposure time. In addition, it will reduce the likelihood of spilling or performing the steps in the wrong order. Pay particular attention to steps that require physical dexterity and are high risk.
Prepare for the work	Be certain that you have all the tools and materials present. Do you have enough gloves and pipette tips? Did you pre-heat the hot plate? Did you reserve the centrifuge? Do you have ice? Is the centrifuge cold? Did you thaw everything you need? Did you pre-label all of the little tubes so you will not confuse product A with product B?
Survey the area	A quick pre-use survey may save you lots of decontamination time. If the

	previous worker left the bench contaminated, you do not want to be responsible for spreading the problem or cleaning up that person's mess.
Do the work	Schedule plenty of time so you don't have to rush, particularly the first few times. We have all tried to hurry simple tasks that caused us to waste a lot of time (speeding tickets waste time and money). Eliminate as many distractions as possible prior to starting. Every time you have a couple free minutes review your procedure, check for problems, and survey your hands.
Survey and clean the area	When done, survey your area, yourself, and the soles of your shoes. Then clean the area for the next person. Return equipment to the assigned storage area.
Critique your performance	Think what steps you could have done differently to minimize your exposure. Could you build a little tool to help you hold the stock vial? Does your lab need to purchase a different shield or pipette with a longer handle?

Spending time organizing your work processes will save you time and effort in the long run, and it will probably also provide you with more reliable results."

Individuals working with the material described in this license amendment will follow this process in a manner similar to those individuals here at PSU working with mCi amounts of byproduct material. Other than slight differences of detection efficiency and meter probe, this general safety process for working with radioactive material is the same when working with byproduct material or with special nuclear material.

The consequences of spilling plutonium are significantly more serious than spilling short lived isotopes. Due to these increased consequences, individuals working with spent fuel mixtures will have more extensive training than those working with P-32 or S-35. This additional training is discussed in the original amendment application,

I hope that this additional information is sufficient for your needs. If you have any further questions or concerns please contact me at ejb6@psu.edu or 814.865.6391.

Sincerely,

Eric J Boeldt

Eric Boeldt
Radiation Safety Officer