PENNSTATE

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October 13, 2011

Director, Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Attn: Document Control Desk, Mail Stop T2 F1
11555 Rockville Pike
Rockville, MD 20852-2738

License: SNM-95
Docket: 70-113

Dear Mr. Ryder:

The Pennsylvania State University wishes to amend license SNM-95 to allow research with about 46 micrograms of plutonium isotopes. Please contact Eric Boeldt (ejb6@psu.edu) if you have any questions regarding this application

Thank you for your prompt attention to this request.

Sincerely,

Henry C. Foley

Cc: Christopher Ryder, Licensing Project Manager
U.S. Nuclear Regulatory Commission
Fuel Cycle Safety and Safeguards
Fuel Manufacturing Branch
Washington, DC 20555-0001
Mail Stop EBB 2 C40M

NMSS01

NRC FORM 313 (3-2009) 10 CFR 30, 32, 33, 34, 35, 36, 39, and 40

U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0120 EXPIRES: 3/31/2012

Estimated burden per response to comply with this mandatory collection request: 4.3 hours. Submittal of the application is necessary to determine that the applicant is qualified and that adequate procedures exist to protect the public health and safety. Send comments regarding burden estimate to the Records and FOIA/Privacy Services Branch (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects.resource@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0120), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

APPLICATION FOR MATERIALS LICENSE

INSTRUCTIONS: SEE THE APPROPRIATE LICENSE APPLICATION GUIDE FOR DETAILED INSTRUCTIONS FOR COMPLETING APPLICATION. SEND TWO COPIES OF THE ENTIRE COMPLETED APPLICATION TO THE NRC OFFICE SPECIFIED BELOW.

APPLICATION FOR DISTRIBUTION OF EXEMPT PRODUCTS FILE APPLICATIONS WITH:

OFFICE OF FEDERAL & STATE MATERIALS AND
ENVIRONMENTAL MANAGEMENT PROGRAMS
DIVISION OF MATERIALS SAFETY AND STATE AGREEMENTS
U.S. NUCLEAR REGULATORY COMMISSION
WASHINGTON, DC 20555-0001

ALL OTHER PERSONS FILE APPLICATIONS AS FOLLOWS:

IF YOU ARE LOCATED IN:

ALABAMA, CONNECTICUT, DELAWARE, DISTRICT OF COLUMBIA, FLORIDA, GEORGIA, KENTUCKY, MAINE, MARYLAND, MASSACHUSETTS, NEW HAMPSHIRE, NEW JERSEY, NEW YORK, NORTH CAROLINA, PENNSYLVANIA, PUERTO RICO, RHODE ISLAND, SOUTH CAROLINA, TENNESSEE, VERMONT, VIRGINIA, VIRGIN ISLANDS, OR WEST VIRGINIA, SEND APPLICATIONS TO:

LICENSING ASSISTANCE TEAM
DIVISION OF NUCLEAR MATERIALS SAFETY
U.S. NUCLEAR REGULATORY COMMISSION, REGION I
475 ALLENDALE ROAD
KING OF PRUSSIA, PA 19406-1415

IF YOU ARE LOCATED IN:

ILLINOIS, INDIANA, IOWA, MICHIGAN, MINNESOTA, MISSOURI, OHIO, OR WISCONSIN, SEND APPLICATIONS TO:

MATERIALS LICENSING BRANCH
U.S. NUCLEAR REGULATORY COMMISSION, REGION III
2443 WARRENVILLE ROAD, SUITE 210
LISLE, IL 60532-4352

ALASKA, ARIZONA, ARKANSAS, CALIFORNIA, COLORADO, HAWAII, IDAHO, KANSAS, LOUISIANA, MISSISSIPPI, MONTANA, NEBRASKA, NEVADA, NEW MEXICO, NORTH DAKOTA, OKLAHOMA, OREGON, PACIFIC TRUST TERRITORIES, SOUTH DAKOTA, TEXAS, UTAH, WASHINGTON, OR WYOMING, SEND APPLICATIONS TO:

NUCLEAR MATERIALS LICENSING BRANCH
U.S. NUCLEAR REGULATORY COMMISSION, REGION IV
612 E. LAMAR BOULEVARD, SUITE 400
ARLINGTON, TX 76011-4125

PERSONS LOCATED IN AGREEMENT STATES SEND APPLICATIONS TO THE U.S. NUCLEAR REGULATORY COMMISSION ONLY IF THEY WISH TO POSSESS AND USE LICENSED MATERIAL IN STATES SUBJECT TO U.S.NUCLEAR REGULATORY COMMISSION JURISDICTIONS.

1. THIS IS AN APPLICATION FOR *(Check appropriate item)*

- ☐ A. NEW LICENSE
- ☑ B. AMENDMENT TO LICENSE NUMBER **SNM-95**
- ☐ C. RENEWAL OF LICENSE NUMBER

2. NAME AND MAILING ADDRESS OF APPLICANT *(Include ZIP code)*

The Pennsylvania State University
University Park, PA 16802

3. ADDRESS WHERE LICENSED MATERIAL WILL BE USED OR POSSESSED

Mailing address:
228 Academic Projects Building
University Park, PA 16802
(for locations of use, see attached sheets)

4. NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION

Eric Boeldt

TELEPHONE NUMBER

(814) 865-6391

SUBMIT ITEMS 5 THROUGH 11 ON 8-1/2 X 11" PAPER. THE TYPE AND SCOPE OF INFORMATION TO BE PROVIDED IS DESCRIBED IN THE LICENSE APPLICATION GUIDE.

5. RADIOACTIVE MATERIAL
a. Element and mass number; b. chemical and/or physical form; and c. maiximum amount which will be possessed at any one time.

6. PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED.

7. INDIVIDUAL(S) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING EXPERIENCE.

8. TRAINING FOR INDIVIDUALS WORKING IN OR FREQUENTING RESTRICTED AREAS.

9. FACILITIES AND EQUIPMENT.

10. RADIATION SAFETY PROGRAM.

11. WASTE MANAGEMENT.

12. LICENSE FEES *(See 10 CFR 170 and Section 170.31)*
FEE CATEGORY **exempt** AMOUNT ENCLOSED $ **0.00**

13. CERTIFICATION. *(Must be completed by applicant)* THE APPLICANT UNDERSTANDS THAT ALL STATEMENTS AND REPRESENTATIONS MADE IN THIS APPLICATION ARE BINDING UPON THE APPLICANT.

THE APPLICANT AND ANY OFFICIAL EXECUTING THIS CERTIFICATION ON BEHALF OF THE APPLICANT, NAMED IN ITEM 2, CERTIFY THAT THIS APPLICATION IS PREPARED IN CONFORMITY WITH TITLE 10, CODE OF FEDERAL REGULATIONS, PARTS 30, 32, 33, 34, 35, 36, 39, AND 40, AND THAT ALL INFORMATION CONTANED HEREIN IS TRUE AND CORRECT TO THE BEST OF THEIR KNOWLEDGE AND BELIEF.

WARNING: 18 U.S.C. SECTION 1001 ACT OF JUNE 25, 1948 62 STAT. 749 MAKES IT A CRIMINAL OFFENSE TO MAKE A WILLFULLY FALSE STATEMENT OR REPRESENTATION TO ANY DEPARTMENT OR AGENCY OF THE UNITED STATES AS TO ANY MATTER WITHIN ITS JURISDICTION.

CERTIFYING OFFICER – TYPED/PRINTED NAME AND TITLE	SIGNATURE	DATE
Dr. Henry Foley, VP Research & Dean Graduate School	Henry C. Foley	10/31/11

FOR NRC USE ONLY

TYPE OF FEE	FEE LOG	FEE CATEGORY	AMOUNT RECEIVED	CHECK NUMBER	COMMENTS
			$		
APPROVED BY				DATE	

Item 5. Radioactive material to be added to license

Element and mass numbers:

• Plutonium-238	8 uCi
• Plutonium-239	2 uCi
• Plutonium-240	3 uCi
• Plutonium-241	60 uCi
• Plutonium-other trace isotopes total	0.1 uCi

Physical form: Material will arrive as liquid or as a non-dispersible solid.
Chemical form: *Radioactive material dissolved in 0.1 to 0.5 M nitric acid or* radioactive material solidified in glass vials.
The pH of the liquid material will be about 1.

Maximum amount to be possessed: 73 uCi of all isotopes of plutonium (about 46 micrograms)

Radioactive materials used for this research consist mostly of byproduct material rather than Special Nuclear Material. The Pennsylvania Department of Environmental Protection, Bureau of Radiation Protection has approved an amendment to license PA-100 to allow work with the byproduct radionuclides in this material. The concentration of the material received will be below the level classified as Class A waste in accordance with 10CFR61.55.

This minor addition to PSU's allowed inventory will have no effect on the funds necessary for decommissioning. The Class A waste generated by this project will be an insignificant increase in the cost of radioactive waste generated annually under this and other PSU licenses. At the end of this project, all equipment and facilities will be surveyed and decontaminated or released in accordance with "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material," April 1993. This process is identical to closeouts of other laboratories that have used radioactive materials at other locations on campus. At PSU twenty to forty of these closeouts are performed each year.

Equipment that cannot be decontaminated will be disposed as radioactive waste.

Records required for decommissioning are retained as required by 10 CFR 70.25(g) in Environmental Health and Safety (EHS) offices in the Academic Projects Building.

PSU's decommissioning cost estimate is updated every three years. If the situation warrants due to contamination issues, changes in the cost estimate will be made during the next scheduled review.

Item 6. Purpose for which material will be used

Licensed radioactive material at Penn State is used for research and development, as defined in 10CFR70.4, and for instruction of students.

The purpose of this particular research is to investigate the feasibility of using PSU's Compton Suppression System (CSS) in a novel spent nuclear fuel reprocessing safeguards detection system called the Multi-Isotope Process (MIP) monitor. Based at the Pacific Northwest National Laboratory (PNNL), the MIP project aims to detect subtle changes in radionuclide distributions in spent nuclear fuel reprocessing streams using gamma ray spectra.

The detected radionuclide distributions can be correlated to variables such as the spent fuel burn-up and the acid concentration, organic ligand concentration, temperature, etc. present during various stages of spent nuclear fuel reprocessing. Although different samples of spent nuclear fuel may seem similar in their macro properties, differences in the day-to-day operations of a nuclear reactor, the time the fuel has been allow to decay, and particular reprocessing recipes provide enough variation in the proportion of certain radionuclides to develop signatures for individual samples of spent nuclear fuel. This kind of analysis is part of a large research area known as nuclear forensic attribution analysis, where a sample (or a collection of samples) is analyzed in great detail to determine the process history and origin of the nuclear material, allowing authorities to supervise material from legal nuclear reprocessing operations and to identify and track illicit nuclear materials. This nuclear forensics can be considered as tracking the "DNA" or the fingerprint of nuclear material.

PSU's Compton Suppression System provides a significant reduction of the background counts in the Compton continuum, giving increased counting sensitivity for lower energy gamma-rays. Counting the MIP samples of spent nuclear fuel with the CSS is expected to identify radionuclides with lower-energy gamma-rays that would normally be hidden in the high Compton continuum created by prevalent, high-energy gamma-rays from isotopes like 137Cs. Identification of additional radionuclides for use as signatures would greatly enhance the capabilities of the MIP project and aid in the development of PSU's nuclear forensics program.

Sample evaluation via the Compton Suppression System is best done at PSU for several reasons. First, the physical limitations of the CSS, such as its size and the fragility of the detector, preclude simple transport of the system to PNNL. Second, the CSS is regularly used at PSU for additional research endeavors and for the instruction of graduate students. Indeed, the evaluation of the spent fuel samples at PSU is important not only for this collaboration with PNNL, but for the development of Penn State's trace isotope detection capabilities for future nuclear forensics, safeguards, and materials management research at this university. The US Department of Energy has recently selected PSU, MIT, and Texas A&M for the development of the Nuclear Security Education Program that includes the Nuclear Forensics and Radiochemistry Laboratory. This education program and the collaboration with PNNL are the building blocks for PSU's continued research efforts in the area of nuclear forensic attribution analysis.

In summary, the procedures for the use of this material are:

1. Old radioactive spent fuel samples will be received at PSU for analysis. Each sample will have an activity of 0.1 - 10 uCi in about 20 grams of carrier. The major constituents and the approximate calculated percentage of activity will be about:

Cs-137	25%
Ba-137m	25%
Sr-90	14%
Y-90	14%
U-all	<.01 %
Pu-241	10%
Pu-238	1 %
Am-241	4%
Cm-244	4%

Multiple samples will be received. The concentration of each of these samples upon receipt will be below the level classified as Class A waste in accordance with 10CFR61.55. Since there are no plans of any sort to concentrate this material, the resulting waste will be classified as Class A waste.
When the Annual Limits of Intake (ALI) are analyzed, the plutonium will represent about 15% of the oral ingestion hazard and about 17% of the inhalation hazard in each sample.

2. Samples will be received as non-dispersible solids or as liquids by EHS, surveyed as required by 10CFR20.1906, and the inner container surveyed for contamination. The material will be added to PSU's inventory then transferred to the researcher in charge of the material.
3. Samples will be stored to prevent unauthorized access or removal.
4. The liquid samples may be subdivided into multiple samples prior to analysis. If performed, the equipment used will be promptly surveyed and decontaminated as necessary.
5. All work with uncontained radioactive material will be performed over bench paper/diapers in an effluent hood or glove box. Researchers will wear laboratory coats, safety glasses, and gloves. The area where the work is performed will be surveyed for radioactive contamination after each use of the material.
6. Samples will be placed into small robust containers prior to analysis in the Compton Suppression System (CSS). These over-packed samples will be surveyed for contamination prior to analysis in the CSS.
7. After analysis, the samples will be securely stored until the research is complete.
8. Samples will then be disposed in accordance with 10 CFR 61 and waste vendor requirements.

Item 7. Individuals responsible for radiation safety program

Penn State is committed to having qualified individuals in its radiation protection program. The current Radiation Safety Officer (RSO) is Eric Boeldt. Mr. Boeldt is a Certified Health Physicist with about thirty years' experience as a health physicist. Mr. Boeldt serves on the University Isotopes Committee and pre-reviews all applications for the use of radioactive material to ensure the proposed work will not be dangerous to personnel or the environment and is in conformance with regulations. He is used as a resource for radiation safety by radiation workers. He is responsible for establishing and implementing the radiation protection program.

Mr. Boeldt has overseen students working with over 70 mCi of uncontained high energy beta emitters, volatile and non-volatile photon emitters, the production of curie quantities of encapsulated solid, liquid, and gaseous beta/gamma emitters, and work with curie quantities of sealed sources. Mr. Boeldt has not worked with plutonium, but has worked with uCi amounts of uncontained curium-244.

Mark Linsley, the Associate Health Physicist and alternate RSO, is a Certified Health Physicist with over twenty years of experience in the radiation protection field. Mr. Linsley will be assisting with the oversight of this project. He has also worked with uCi amounts of uncontained curium-244.

The primary Authorized User for this project is Kenan Unlu, PhD. Dr. Unlu is a professor of Nuclear Engineering and the Director of the Radiation Science and Engineering Center. He has been authorized to supervise use of radioactive material at PSU since 2004 and has had about 30 years overall experience working with radioactive material. He has supervised use of

unsealed radioactive materials in a laboratory setting in mCi amounts of beta and photon emitters.

Dr. Amanda Johnsen will provide direct oversight of this project. Dr. Johnsen has over eight years of experience working in radiological facilities at national laboratories with up to gram quantities of actinides. She has worked with actinide separations, stock solution purifications, inert atmosphere glove boxes, and has supervised research conducted in radiological hot cells.

Individuals who will be using the radioactive material described in this application are in the College of Engineering or the College of Earth and Mineral Sciences. Health physics personnel are in the Office of Physical Plant which is completely independent from the two academic colleges. All Health Physicists (HPs) have the authority, and duty, to stop any work with radioactive material which they view as inappropriate, dangerous, contrary to regulations, or contrary to PSU requirements. Only the University Isotopes Committee (UIC, Penn State's radiation safety committee), in consultation with the RSO, can reauthorize continuation of work with radioactive materials.

Item 8. Training for individuals working with this material

Each person working with this radioactive material will have completed PSU's standard training which is provided to all users of radioactive material as described in this license. In addition, persons using this material will receive individual hands on training by the RSO or Associate HP on handling and surveying techniques. The radioactive material discussed in this application will not be used until non-radioactive dry-run and/or short lived isotope experiments have been performed to the satisfaction of the RSO.

Penn State has designed and implemented a training program for employees and students that complies with 10CFR19 and 20. This program has been approved by the University Isotopes Committee and the RSO. All individuals who in the course of employment are likely to receive in a year an occupational dose in excess of 100 mrem will receive instruction in accordance with 10CFR19.12. In addition, all individuals who will work with radioactive material will receive prior training by HP personnel that covers the following topics: Nomenclature; Radioactivity and Radiation; Types of Radiation; Radiation Units; Background Radiation; Biological Effects of Radiation; Half-Life and Decay; Radiation Safety Protection Techniques; Radiation Surveys; Radiation Dose and Exposure; Radiation Dose Limits; ALARA Considerations; Dosimetry and Bioassays; Radioactive Material Authorizations and Ordering Radioactive Material; Radioactive Material Security; Radioactive Waste; University, State, and Federal Regulations; and Repercussions of Violations of Regulations. A passing grade of 70% is required on the exam.

Individuals working with the SNM discussed in this license amendment will also receive additional instruction specific to that material. This personal training will be provided by the RSO or Associate HP. It will cover at least the following topics:

- Specific locations where material may be used,
- Requirement to adhere to approved procedures while using the material,
- Postings and labeling required for this material,
- Security requirements of this radioactive material,
- Access and egress controls,
- Requirements for receipt of this material,
- Inventory control and documentation,
- Annual limits of intake of these materials,
- The specific dangers for ingestion or inhalation,

- Radiation hazards, exposure limits, and health risks, specific to this material
- Transporting material between authorized laboratories and buildings,
- Procedures allowed during use of this material,
- Personal Protective Equipment (PPE) required whenever handling this material,
- Special precautions to use while handling the material,
- Where to position the hood sash while working with radioactive material,
- Radiation detection meter selection and operation,
- Measuring applicable radiation levels,
- Measuring contamination levels with GM and alpha probes,
- Techniques for surveying personnel and the laboratory facility,
- Spill or other emergency response,
- Who to contact in case of an emergency,
- How to contact spill/emergency responders,
- Contamination control and contamination limits,
- Decontamination processes and techniques,
- Waste handling requirements for this material,
- Effluent hood operation and operational check,
- Glove box techniques and operational check (if applicable), and the
- Public relations aspects of working with this material.

No individual will work with this material until he/she physically demonstrates to the RSO or Associate HP the ability to safely handle this material, perform comprehensive surveys after use, and demonstrate decontamination processes. This demonstration follows the standard procedure established by the University Isotopes Committee for work with amounts or types of radioactive material more hazardous than the norm. Documentation of this training will be retained.

Individuals working with this material will receive refresher training at least every two years. At that time the training program will be evaluated for its effectiveness and adequacy.

Item 9. Facilities and Equipment:

This material will be used at the Radiation Science and Engineering Center (RSEC) or the Academic Projects Building at University Park, PA 16802. In the event that specialized equipment not available at the RSEC is needed to analyze the sample, it will be used in a suitable laboratory at University Park, PA approved by the Radiation Safety Officer (RSO).

The RSEC has many suitable laboratories available for using this amount of material. Any laboratory approved will have equipment and facilities suitable for the needs of these tasks such as work benches, sinks, doors, available space for waste storage, secure space for sample storage, radiation detection meters to survey for contamination, bench paper, and personal protective materials and equipment. Although multiple suitable laboratories are available for this work the exact locations have not yet been determined and will be approved by the RSO prior to beginning work.

Work with this material in un-encapsulated form will be performed in an area without other individuals present who are not involved with aspects of this research.

Researchers will wear laboratory coats, disposable gloves, and safety glasses whenever working with this uncontained material Contamination detection equipment will be present and in use whenever this radioactive material is handled.

Radioactive material will be stored in high strength screw-top containers. These containers will have sufficient strength to endure a three foot drop onto an essentially unyielding surface. The material used in these containers will not be susceptible to chemical degradation in the 0.1 to 0.5 M nitric acid (pH about 1) in which the radioactive material will be dissolved. Representative samples of containers will be tested for ease of handling, leak tightness, chemical susceptibility, and mechanical strength by the researcher and RSO prior to use. These containers may be used as secondary (over-pack) containers rather than primary containers. In that case the inner container will be a leak-tight container that will not react chemically with the radioactive material and the inner container will be surveyed when removed from the over-pack

Storage containers will be surveyed for contamination prior to being placed into storage and upon removal from storage.

Similar high-impact resistant containers will be used as secondary containers when samples are transported between laboratories.

Work with uncontained radioactive material under this amendment will be performed over laboratory bench paper (absorbent paper with plastic backing) within an effluent hood or glove box. Work with sealed containers of this material will not require work within a hood or glove box after the container has been surveyed and found to have no external contamination. Effluent hoods and glove boxes will be checked for operability prior to each use.

Work performed to sub-sample or otherwise manipulate the material will be performed with dedicated equipment (pipets, syringes, holders, etc.) that will not be released for other projects until surveyed and decontaminated as necessary. The vials/containers holding the radioactive material for this procedure will be held in the equivalent of an appropriately sized test-tube rack to ensure that the vials/containers cannot be accidentally knocked over. Work will be performed in an effluent hood or in a glove box over plastic backed absorbent bench paper to absorb spills and ease decontamination.

In the event of contamination, personnel will follow PSU's standard procedures. PSU's procedure requires that readily disposable materials will be placed into the radioactive waste container. Items that are not readily disposable will be decontaminated with commercially available cleaning solutions that have been found to work with this sort of material. Products such as Scrubbing Bubbles, Formula 409, Fantastic, L.A. Awesome, or Lysol's Tile/Tub Cleaner have all been shown to be effective decontamination solutions in laboratory settings. The material is sprayed/foamed onto the contaminated area, wiped with disposable paper towels, resurveyed to detect beta/gamma emissions, allowed to dry, and resurveyed for alpha contamination.

Personal protective equipment that becomes contaminated will be disposed or decontaminated as is appropriate for the amount and type of contamination and the PPE that became contaminated.

If skin, hair, or personal clothing become contaminated, personnel will follow PSU's standard procedures. The affected area is immediately blotted dry then washed with copious amounts of water and the RSO notified. If decontamination with tap water is not successful stronger soaps and decontamination materials will be used with special care taken to not damage the skin. Depending upon circumstances, the spill material may be neutralized.

In the event of a liquid spill not onto absorbent paper, the spill will be immediately covered with absorbent paper to absorb as much liquid as possible. This material will then be placed in the radioactive waste containers and decontamination will proceed.

Whenever radioactive contamination is found, the laboratory supervisor and RSO will be immediately notified, and the area will be decontaminated and resurveyed in accordance with

"Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material."

If decontamination is not possible, the contaminated area or equipment will be disposed or, with the permission of the RSO, the contamination will be encapsulated until the equipment is no longer needed. Equipment containing encapsulated radioactive material will be obviously labeled and inventoried in PSU's decommissioning plan until disposed.

When transported between the preparation room and the counting laboratory the material will be placed in a secure over-pack with suitable padding (paper towels or plastic bubble-wrap for example) to prevent damage in the event that the container is dropped. If the material needs to be transported by motor vehicle between buildings, the material will be transported in accordance with NRC and Department of Transportation (DOT) regulations.

PSU has policies to ensure that equipment and materials removed from restricted areas to unrestricted areas are not contaminated above the specified release levels in NRC Branch Technical Position, "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material," April 1993. Potentially contaminated objects for unrestricted use are surveyed to detect the presence of fixed or removable contamination prior to removal from the laboratory. Objects will be surveyed with a pancake GM and wipes will be taken to be counted in a liquid scintillation counter.

Access to the rooms where this radioactive material will be used is controlled by the professor in charge of the research. Health Physics staff have access at all times. The room(s) will be posted for use of radioactive material in accordance with 10CFR20.1902. All radioactive material will be labeled in accordance with 10CFR20.1904 and University requirements. Areas in which uncontained radioactive material is used will be clearly demarcated with yellow "radioactive material" tape or signs.

Radioactive waste will be placed in PSU's standard radioactive waste containers supplied by the Radiation Safety office. Containers for solid waste are 18 gallon metal cans double lined with plastic bags. Liquid waste is normally stored in robust 10 liter plastic containers supplied by the Radiation Safety office. Solid and liquid containers have been used and reused many times in the last twenty-five years and there have been no reports of leaks regardless of the contents. Waste will always be secure from unauthorized removal or access. When a waste container is full, it is transferred to secure EHS radioactive material storage facilities in the Academic Projects Building in compliance with DOT and NRC regulations.

Item 10. Radiation Safety Program

As stated in PSU's renewal application, use of all specifically licensed radioactive material at PSU is regulated by the University's radiation safety committee, called the University Isotopes Committee (UIC). All work with radioactive material must comply with the UIC approved "Rules and Procedures for the Use of Radioactive Material at the Pennsylvania State University." This document has been previously submitted to the NRC.

Equipment

Penn State's Environmental Health and Safety (EHS) office and the Principle Investigator have numerous portable and stationary instruments to monitor radiation and contamination levels for this material. This equipment includes liquid scintillation counters,

numerous pancake style GM meters, two 100 cm^2 ZnS(Ag) alpha probes, and numerous meters for measuring radiation levels.

Radiation Surveys

Radiation surveys are not necessary for the level of radioactive material requested under this amendment in order to comply with the requirements of 10CFR20, Subpart F. That said, radiation and contamination surveys are performed at least quarterly by EHS in all areas in which radioactive material has been in use since the last quarterly survey and audit. These audits check for radiation and contamination levels as well as looking for compliance with other NRC and PSU requirements. The meters used by EHS for radiation measurements are calibrated annually with a Cs-137 NIST traceable calibration source. Documentation of EHS surveys and calibrations are retained in accordance with 10CFR20.2103. Radiation and contamination surveys are performed in compliance with RSO approved written procedures.

Contamination Surveys

Contamination surveys are performed by PSU's researchers after each use of radioactive material. In addition, for the material in this license amendment, the researcher will survey sample containers prior to placing them in storage and immediately upon removal from storage. These surveys are the main method of identifying un-intentional releases, spills, and contamination.

The primary contamination detection equipment for this material during actual use will be a pancake style GM probe attached to a meter (the typical meter at Penn State is a Ludlum Model #3 with a Ludlum 44-9 probe). The meter and probe are sensitive to the alpha, beta, and gamma radiation which will be emitted from this material. This meter/probe combination will be able to detect about 25 alpha dpm in the 12 cm square active area of the probe (about 180 alpha per minute in 100 square cm.). At completion of work with uncontained material, the area will also be surveyed with a 100 square centimeter open area alpha probe equivalent to Ludlum's model 43-90. This ZnS(Ag) probe has a 20% efficiency for Pu-239 alpha particles and a background rate of 0 – 3 counts per minute. The minimum detectable count rate for this meter will be about 10 - 20 counts per minute, which provides a minimum detectable activity (mda) of 50 – 100 alphas per minute per 100 square cm.

Contamination survey meters are calibrated to monitor the amount of contamination present in counts per minute. The operator is required to check the battery and the operability of each meter prior to each use with a small check source. Alpha meters are supplied with a small exempt alpha source for this calibration check. Operators will convert cpm to particles per minute based upon the calibration factor on the specific meter.

Additionally after each use of un-contained material, researchers will use filter paper or cloth wipes to wipe an area of about 100 square centimeters. These wipes will be counted in a liquid scintillation counter. The LSC will have an efficiency of about 100% for all the radionuclides in this material and will have a minimum detectable activity of about 30 emissions per minute. Wipe samples will be obtained from work surface, equipment used, and the floor in the immediate vicinity. If the net contamination detected by the LSC is over about 200 cpm, the energy spectrum of the emissions will be able to determine if the contamination is alpha, beta, or photon emissions.

If contamination is found, the researcher will immediately contact EHS for assistance in decontamination and follow-up surveys.

In areas where radioactive contamination is found, attempts will be made to decontaminate to background levels in accordance with standard PSU practice. If decontamination to background levels is not possible the area will be decontaminated in

accordance with "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material," April 1993 as discussed elsewhere in this application.

In the event of an unintentional release or spread of radioactive material, researchers are instructed to stop the spill, warn others in the area, contact the RSO, isolate the area, and minimize exposure and the spread of contamination. EHS will respond to aid in the cleanup and perform the post decontamination survey.

Confirmatory contamination surveys and regulatory compliance audits are performed and documented quarterly by EHS staff wherever radioactive material has been used since the previous quarter. These surveys will utilize pancake GM and alpha probes. Additionally wipes will be taken for analysis in a liquid scintillation counter.

External Occupational Exposure

Personal external radiation monitoring is not necessary for the level of radioactive material requested under this amendment in order to comply with the requirements of 10CFR20.1502. If the situation warrants, monitoring will be performed to comply with 10CFR20.1502(a) utilizing gamma and beta detection dosimeters with current NVLAP accreditation. Radiation workers in the RSEC are issued, and required to wear, NVLAP accredited personal dosimeters (currently supplied by Landauer) while working with radioactive material. Dosimetry results are reviewed by the RSO, and maintained in the EHS offices. Radiation workers are notified if their results indicate they received more than 100 mrem in a quarter or year. Annual reports are made to individuals in accordance with 10CFR19.13(b). An investigation to determine the cause of the exposure will be instigated whenever an individual exceeds 10% of the applicable annual limit in accordance with PSU's ALARA procedures.

Internal Occupational Exposure

As stated in Regulatory Guide 8.25 Section 1.1 (June 1992), Penn State will evaluate the need for regular room air sampling and monitoring for internal occupational radiation exposure when a researcher will handle dispersible radioactive materials in quantities that during a year will total more than 10,000 times the ALIs for inhalation (the sum of the fractions of the ALI's of each nuclide rule applies). If the need arises, Penn State will monitor the ambient air of radiation workers with personal breathing zone monitors. Air sampling equipment will be calibrated and maintained in accordance with manufacturer's instructions. No airborne radioactive material areas are expected from the use of this material.

If an incident occurs that potentially results in airborne contamination, the research will be immediately halted until corrective actions are implemented and procedures revised to prevent recurrence. If such an event occurs, nose swabs will be taken and analyzed to determine if there was a possibility of airborne contamination. If nose swabs indicate the presence of radioactive material, urine and fecal samples will be obtained to determine internal exposure. These samples will be sent to an outside certified laboratory for analysis.

No procedures have been prepared for summing internal and external exposures at PSU because both internal and external exposures are expected to be well below the requirements of 10CFR20.1202.

Effluent Air Monitoring

Effluent air monitoring is not planned for this situation. Exhaust from the effluent hood will be monitored if calculations indicate that releases may be in excess of the limits in 10CFR20 Appendix B or the constraint on air emissions found in 10CFR20.1101(d). Preliminary calculations indicate that PSU will be able to easily comply with this constraint.

Respiratory Protection Program

Penn State has no respiratory protection program for radioactive material use and will not use personal respirators for protection against airborne radioactive material. Work with this radioactive material will be performed in an effluent hood or glove box whenever the material is not in a sealed container.

Item 11. Waste Management

The radioactive material samples will be retained in their robust containers until the completion of the research. At that time the material will be packaged into waste shipment containers in consultation with radioactive waste material vendors.

Potentially contaminated laboratory waste (bench paper, pipet tips, gloves, etc.) will be promptly placed into radioactive waste containers. When filled, these containers will be transferred to the EHS secure radioactive waste storage facility in accordance with DOT regulations. This waste will be shipped for disposal in accordance with waste broker and NRC requirements.

The concentration of the material received will be below the level classified as Class A waste in accordance with 10CFR61.55. Since there are no plans of any sort to concentrate this material, the resulting waste will be classified as Class A waste.

Criticality Calculations

The amount of radioactive material available for use under this license is of forms and amounts to preclude the possibility of forming a critical mass. The addition of this approximately 46 micrograms of plutonium has no significant effect on the potential for criticality with the material already authorized under this license.

Accident Analysis

The maximum likely accident is the complete dropping/spillage of one of the samples that we receive from the supplier. Each sample will have an activity of 0.1 to 10 uCi and a volume of 1 to 20 ml.

Procedures and practices used to minimize the adverse impact of such a spillage are:

1. Procedures require that each sample will be surveyed before placing into storage and when removing from storage.
2. Procedures require that each sample is stored in an over-pack (secondary container) while being transported.
3. Procedures require that the researcher wear gloves, lab coat, and eye protection whenever working with un-contained material.
4. Procedures require that work with un-contained material is performed over plastic backed absorbent paper in an effluent hood or glove box.
5. Procedures require that the researchers regularly survey themselves and the work area during use of radioactive material using a pancake GM probe
6. Procedures require that the researchers survey themselves and the work area after each use of radioactive material using a pancake GM probe and a 100 square cm alpha probe.
7. Small samples, about 20 ml or less, result in spills that cannot flow down drains.

8. Over-packs or secondary containers provide extra structural integrity to the actual containers.
9. Researchers will be trained in proper notification and spill response procedures.
10. Researchers will have decontamination and spill mitigation supplies available.
11. In the event of a significant contamination event, PSU may hire an outside vendor to aid or perform the decontamination.

Procedures to be followed if a spill occurs include:

1. Researcher will immediately stop the spill by covering it with absorbent paper,
2. Researcher will isolate the area to prevent the spread of contamination,
3. Researcher will warn others in the area and contact EHS for assistance,
4. Researcher will allow no one to leave the area until complete personal surveys have been performed,
5. Researcher will minimize exposure by decontaminating the area with EHS assistance.

Conclusion

The Principal Investigators, the Radiation Safety Officer, and the University Isotopes Committee (UIC) feel that the training and experience of the individuals mentioned above and the facilities and operating procedures are adequate to prevent exposure of personnel or the release of radioactive material during handling. The accidental release of radioactive material is always possible, but detailed operator training, frequent Radiation Safety oversight, and frequent surveying should prevent contamination incidents. In addition, the UIC and RSO feel that sufficient controls have been implemented to immediately detect and promptly mitigate the release of radioactive material.

**** End of application ****