PENNSTATE

(814) 863-3939 / Fax: (814) 865-7225

Radiation Protection Office
Environmental Health and Safety
201 Academic Projects Building
The Pennsylvania State University
University Park, PA 16802
http://www.ehs.psu.edu

December 18, 2013

Director, Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Document Control Desk
11555 Rockville Pike
Rockville, Maryland 20852 - 2738

Re: License Number SNM-95 (Docket Number 070-0113)

Subj: License amendment request for License SNM-95

The Pennsylvania State University requests an amendment of special nuclear material license number SNM-95. In addition to NRC form 313 (Enclosure 1), two versions of Enclosure 2 are also attached – one un-redacted and not for public disclosure and a redacted version for public disclosure.

Please contact me for correspondence or if you need any additional information.

Jeffrey Leavey, CHP
Radiation Safety Officer
201 Academic Projects Building
Penn State University
University Park, PA 16802
814-863-3939
JAL62@ psu.edu

Sincerely,

Jeffrey Leavey, CHP
Radiation Safety Officer

NM5520

PENNSTATE

Neil A. Sharkey
Interim Vice President for Research

The Pennsylvania State University
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University Park, PA 16802

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December 18, 2013

Director, Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Document Control Desk
11555 Rockville Pike
Rockville, Maryland 20852 - 2738

Re: License amendment request for License SNM-95 (Docket: 070-0113)

Dear Sir or Madam,

The Pennsylvania State University requests an amendment of special nuclear material license number SNM-95. NRC form 313 (Enclosure 1) and supporting documentation (Enclosure 2) following the outline presented in NUREG-1520, Rev 1 is attached to this letter. This request is to allow the use of SNM at a new location on campus and the use of specific material in a new application related to detection and identification of SNM.

Thank you for your prompt attention to this request. Please contact Penn State's Radiation Safety Officer, Jeff Leavey (see contact information below) for correspondence or if you need any additional information.

Jeffrey Leavey
201 Academic Projects Building
Penn State University
University Park, PA 16802
814-863-3939
JAL62@ psu.edu

Sincerely,

Neil A. Sharkey

Enclosures:
Application for Material License, NRC Form 313
Supporting information

cc: Robert Paulson, Chair, University Isotopes Committee
Jeffrey Leavey, Radiation Safety Officer, Environmental Health and Safety

NRC FORM 313 (03-2013) 10 CFR 30, 32, 33, 34, 35, 36, 39, and 40

U.S. NUCLEAR REGULATORY COMMISSION

APPLICATION FOR MATERIALS LICENSE

APPROVED BY OMB: NO. 3150-0120 EXPIRES: 05/31/2015

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 Information 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.

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. *AMENDMENTS/RENEWALS THAT INCREASE THE SCOPE OF THE EXISTING LICENSE TO A NEW OR HIGHER FEE CATEGORY WILL REQUIRE A FEE.

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
2100 RENAISSANCE BOULEVARD, SUITE 100
KING OF PRUSSIA, PA 19406-2713

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
1600 E. LAMAR BOULEVARD
ARLINGTON, TX 76011-4511

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
304 Old Main
University Park, PA 16802

3. ADDRESS WHERE LICENSED MATERIAL WILL BE USED OR POSSESSED

The Pennsylvania State University
University Park Campus
University Park, PA 16802

4. NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION

Jeffrey Leavey, CHP, Radiation Safety Officer

BUSINESS TELEPHONE NUMBER	BUSINESS CELLULAR TELEPHONE NUMBER
(814) 863-3939	(845) 235-3836

BUSINESS EMAIL ADDRESS: JAL62@psu.edu

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 (Fees required only for new applications, with few exceptions*) *(See 10 CFR 170 and Section 170.31)* FEE CATEGORY: Exempt AMOUNT ENCLOSED $

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 C RIMINAL 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
Neil Sharkey, Vice President for Research		12/20/13

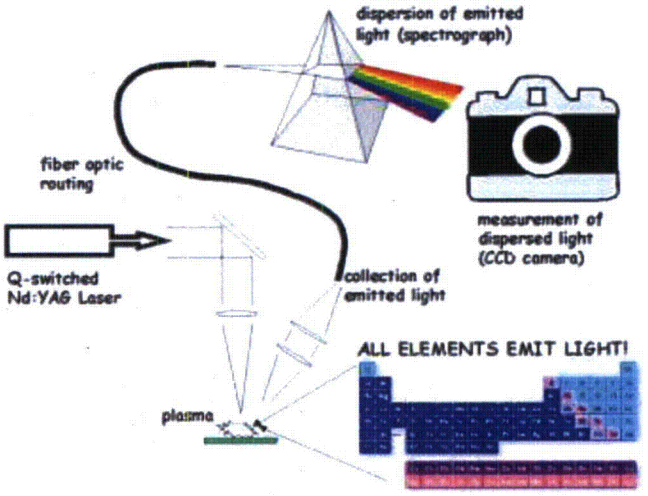
FOR NRC USE ONLY

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

[redacted]

Enclosure 2 - License Amendment Request to SNM-95

Penn State University requests the following changes to license SNM-95 to support new research at the University. The contents of this request follow the general content topics of NUREG-1520, Rev 1.



Purpose for Which Material Will Be Used

Penn State is researching and developing new techniques and equipment for nuclear forensics. The technique being investigated for this license amendment in the Pennsylvania State University's Mechanical and Nuclear Engineering Department is called laser-induced breakdown spectroscopy (LIBS) and offers the capability for rapid, nondestructive, and in situ analysis of materials of interest to the nuclear security field. Basically, this research deals with developing a technique to determine who produced spent fuel or who enriched a particular sample of fissionable material by looking at the minute contaminants and variations in concentrations in great detail.

The technique utilizes a terawatt laser with nanosecond to femtosecond pulse durations to vaporize a minute amount of a target, about [redacted]. The resulting ionization of the target is analyzed using an optical emission spectrometry to determine the elemental and isotopic composition of the materials and contaminates present.

For this research Penn State desires to use currently licensed solid enriched Uranium in further expanding the capabilities of the LIBS technique for nuclear forensics.

A license amendment is being requested to:

1. **Change Condition 9 to read "Authorized place of use: The materials specified in Conditions 6.A and 6.C shall be used in the Breazeale Nuclear Reactor Facility, the Academic Projects Building, or other University Park campus locations approved by the University Isotopes Committee and the Radiation Safety Officer. The authorized examinations and tests may be performed in the Academic Projects Building or the Breazeale Nuclear Reactor Facility or other University Park Pennsylvania locations approved by the University isotopes Committee and the Radiation Safety Officer. The materials specified in Conditions 6.D and 6.E shall be used in locations specified in the application."**

2. **Change Condition 10 to allow the use of materials listed in Condition 6A for LIBS research and development as described in this request. The specific materials in our inventory for this Condition that will be used are:**

[redacted]

a. [redacted]
b. [redacted]

General Information
No change to the following information is being requested: institutional, site description, and personnel information.

Organization and Administration
No change to this information is being requested.

Integrated Safety Analysis
The LIBS system consists of a high vacuum chamber with windows that allow the laser light to enter and the plasma light to escape. The chamber is pumped down using a vacuum pump that draws air from the chamber through a high efficiency particulate (HEPA) filter. The chamber opens from the top.

The LIBS technique does not involve any processing or alteration of the sample being analyzed. The extremely small volume of material removed from the surface by the laser (approximately 3E-9 cm^3) does not re-deposit on surfaces of the vacuum chamber in detectable quantities (this is discussed more fully in the next section). The only event anticipated is a mishandling or dropping event during movement of the sample from storage to the analysis chamber or dropping the sample in the analysis chamber during final placement.

If the sample is dropped during transfer from storage to the analysis chamber, no damage to the solid samples is anticipated. All samples will be placed in sealable plastic bags at the storage location and then transported to the laboratory bench where the LIBS analysis chamber is located. The distance between the storage location and the lab bench will be minimized to the extent possible given the secure storage method used and the laboratory configuration. Samples will be bagged separately and transported one at a time by authorized radiation worker(s).

If a sample is dropped inside the analysis chamber, no damage to the solid samples is anticipated. The analysis chamber has a solid bottom and no internal parts that could damage the samples. The vacuum pump draws vacuum from the side of the chamber so it is not possible to drop a sample down the vacuum line. There is a HEPA filter between the chamber and the vacuum pump to prevent any solids from reaching the pump.

Radiation Protection
The use of all licensed radioactive material at Penn State University is regulated by the University Isotope 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*. There is no change to the overall radiation protection program for this amendment request.

[redacted]

Specifically related to the LIBS research, radiation safety impacts were analyzed for contamination and airborne radioactivity. For contamination (both fixed and removable), no detectable levels of radioactivity were found during routine surveys of the laboratory and analysis chamber over the past approximately two years. The LIBS technique has been tested on [redacted] on five separate occasions from February 2012 to July 2013. Routine laboratory surveys (both meter and wipes) were performed six times from February 2012 to September 2013. In all surveys of the lab and internally to the analysis chamber, only background levels of radioactivity were found. The minimum detectable activity (MDA) for the wipes was 50 dpm/100 cm^2 (95% confidence level) which is well below the allowed level of 1000 dpm/100 cm^2 alpha radiation (from Reg Guide 8.24, Appendix A, 2012). In addition, only background levels of radioactivity were detected by GM survey meter measuring both fixed and removable contamination.

[redacted]

The worst case uptake is shown in the following table:

Isotope	Mass of Material Evaporated (g)	Activity Released per Laser Pulse (μCi/pulse)	Worst Case Uptake (μCi)	Stochastic ALI (μCi)
[redacted]	[redacted]	[redacted]	[redacted]	4E-2 (Class Y)
[redacted]	[redacted]	[redacted]	[redacted]	4E-2 (Class Y)

Exposure to the theoretical plume described above is at least a factor of 6 less than the most restrictive annual limit on intake (ALI) from 10 CFR 20 Appendix B. Since the uptake of 1 ALI will result in a committed effective dose equivalent (CEDE) of 5000 mrem, this theoretical exposure would result in a worst case CEDE of approximately 762 mrem.

Because of the theoretical worst case dose assessment above yielded 762 mrem from a year's worth of laser use, actual air sampling was performed using U-natural as the target material to confirm the conclusion that there is no actual airborne concern. Two sampling sessions were performed: the first with [redacted] and sampling the interior of the analysis chamber immediately after opening the chamber. The second sampling session also sampled the interior of the analysis chamber after [redacted] but three cycles of pump-and-purge were done prior to opening the chamber. Throughout the sampling period, a background air sampling pump was running and a breathing zone pump was monitoring the staff member performing the work. The filter material used with all pumps was a 0.45 μm pore size glass fiber filter and the pumps were set to sample at approximately 2.6 L/min. All filters were then analyzed by GM detector, ZnS alpha detector, HPGe gamma spectroscopy, and finally by liquid scintillation counting. All measurements did not find any detectable radioactivity. In

[redacted]

addition, the vacuum system for the analysis chamber has both oil and HEPA filters that have been in place since the start of this project. These were measured by GM and ZnS detectors with no detectable activity found.

Although airborne radioactivity is not expected, as discussed in the preceding paragraph, the LIBS procedure for opening the chamber is to vent and pump down the chamber with air for three (3) cycles. The Radiation Safety staff will repeat air sampling of the chamber and vacuum pump exhaust at the first use of the requested materials and when experimental conditions change.

As part of the radiation protection procedures for LIBS use of the requested materials, the laboratory personnel will perform contamination surveys using a pancake style GM detector attached to a meter (typically a Ludlum Model 3 and a 44-9 detector). The detector is sensitive to the alpha, beta, and gamma radiation, which will be emitted from this material, and able to detect about 25 alpha dpm in the 12 cm^2 active area of the probe (equivalent to approximately 180 alpha dpm/100 cm^2). At completion of a day's work, the use areas will also be surveyed with a 100 cm^2 open area alpha detector equivalent to a Ludlum model 43-90. This ZnS(Ag) detector has an approximately 20% efficiency for Pu-239 alpha particles and a background rate of 0 – 3 counts per minute. Any readings above background will require an immediate wipe down of the affected area and a re-survey.

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.

All gloves, towels, and other items used during laboratory work to handle the requested materials will be treated as radioactive waste. Any items used for decontamination will be treated as radioactive waste.

External personal dosimetry (10 CFR 20.1502) is not necessary for the level radiation emitted by the radioactive materials requested under this amendment.

Security of Requested Radioactive Materials

All radioactive material is required to be secure from unauthorized access at all times via constant surveillance or within a locked storage area. Generally, the University Isotopes Committee does not detail how security of radioactive material is maintained but has established a performance-based approach to addressing security.

[redacted]

[redacted]

[redacted]

During the first opening of the storage cabinet for the day, an alpha survey for contamination using the ZnS(Ag) detector will be performed prior to removing any material(s).

[redacted]

Access to the rooms where this radioactive material will be used is controlled by the PI and lead researcher. Health Physics staff have access at all reasonable times. The room(s) will be posted for use of radioactive material in accordance with 10 CFR 20.1902. All radioactive material will be labeled in accordance with 10 CFR 20.1904 and University requirements.

Nuclear Criticality Safety

[redacted] if all materials were to be placed in one location, is insufficient to produce a critical mass.

Chemical Process Safety

No chemicals will be used with the materials requested therefor a safety review is not needed.

Fire Safety

Standard laboratory fire safety precautions are used in all Penn State laboratories. Because of the high powered laser used in the laboratory, no flammable materials or chemicals are used with the LIBS technique that would warrant an increase in the level of fire protection. Fire extinguishers are available in all Penn State buildings.

Emergency Management

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.

[redacted]

Penn State University maintains a hazardous materials response team that is able to assist with any incidents on campus.

Environmental Protection
No LIBS activities will generate releases to the laboratory or campus environment.

Decommissioning
At the end of experiments using the requested materials, the materials will be returned to the Breazeale reactor for permanent storage. Following Penn State's standard procedure for laboratory terminations, all radioactive wastes will be removed and a termination survey will be performed by Radiation Safety staff.

The estimated mass of waste to be generated is 10 pounds which includes bench paper, gloves, vacuum hoses, vacuum filters, paper towels used for cleaning, etc. This waste will contain an estimated 10 nCi of U materials and will be disposed of as long lived waste.

Management Measures
Radioactive material use laboratories and spaces are inspected and surveyed by Radiation Safety staff on a quarterly basis, meter and wipe samples are taken, and the results reviewed by the Radiation Safety Officer (RSO). The LIBS laboratory will be inspected and surveyed within the first month of beginning use of the requested materials and then quarterly thereafter.

The standard radioactive materials laboratory inspection consists of, but not limited to:

1. Overall housekeeping and appearance of the laboratory
2. Proper storage and security of radioactive materials
3. Postings and labeling are correct
4. Proper personal protective equipment is being utilized
5. If required, logbooks and other paperwork is complete and
6. A meter and wipe survey are done.

Safety issues are reported to the Radiation Safety Officer for resolution. If necessary, the RSO may escalate issues and problem to the University Isotope Committee (UIC). All Radiation Safety staff have "stop work" authority and the UIC may also suspend or terminate a PIs authorization if necessary.