Bucknell University
Radiation Safety Program

In furtherance of its scholarly endeavors, Bucknell University ("Bucknell") is licensed by the Commonwealth of Pennsylvania's Department of Environmental Protection to receive, acquire, possess, transfer, and use (collectively, "use") specifically designated types of radioactive material in approved locations. Bucknell's license is amended from time to time; a current version of the license is posted outside each designated laboratory and the office of the ***Radiation Safety Officer*** ("***RSO***").

In addition to designating the types of approved radioactive materials and the locations in which they may be used, Bucknell's license designates ***Authorized Users***. Only faculty and staff listed as authorized Users may use radioactive materials. All Authorized Users users must comply with the terms of the license, Bucknell's ***Radiation Safety Program*** policies and procedures ("Program"), and state and federal laws and regulations in using radioactive materials.

A. Radiation Safety Management

The use of radioactive materials is a highly regulated activity. The RSO is responsible for implementing the Radiation Protection Program at Bucknell University, and ensuring compliance with Bucknell's license and all legal requirements. Contact information for the RSO is as follows:

Gregg Rokavec
Assistant Dir. of Risk Mgmt for EH&S
116A Geiger Service Building
(570) 577-3337 (office)
(570) 412-1156 (mobile)
gar017@bucknell.edu

If an incident or accident requiring the attention of the RSO occurs, the RSO should be contacted immediately to direct the response. If the RSO cannot be reached at the office or mobile numbers listed above, individuals should contact Dr. Mark Haussmann, Professor of Biology (570-577-1124) for assistance. In the event that the RSO and Dr. Haussmann cannot be reached, the individual should immediately contact Public Safety.

In addition to comprehensive oversight of radiation safety at Bucknell, the RSO conducts an annual audit of the Program and inventories radioactive materials every six months, as discussed further below. In addition to the scheduled audit and inventories, the RSO will conduct unannounced periodic compliance checks of areas where licensed materials are used, documenting findings as appropriate.

The RSO monitors all compliance deadlines and functions related to the Program, using a ***Radiation Program Compliance Calendar***. The Compliance Calendar is available to all Authorized Users.

Bucknell has established a ***Radiation Safety Committee*** comprised of the RSO and all Authorized Users. The Committee meets at least once per academic year to discuss the Program, including a review of Bucknell's current license, changes to research protocols and regulations, and procedures and coordination with regard to Ancillary Employees. (***Ancillary Employees*** are those who do not handle but who work in the vicinity of radioactive materials.)

B. Training

Training is a key component of the Radiation Protection Program. All Authorized Users are required to complete an annual online training module assigned through the EDGE platform. The annual training includes information regarding basic principles of radioactivity, radiation terminology, biological effects of radiation, protection from radiation, use of appropriate radiation survey instruments, emergency procedures, and requirements for labeling, storage, and disposal of radioactive materials. In addition, the RSO will provide individualized instruction on procedures for handling specific isotopes and/or conducting particular experiments using radioactive materials as needed. Authorized users are required to complete the training within 30 days of assignment. Failure to timely complete the training may result in removal of the Authorized User from the license and loss of access to radioactive materials. Training deadlines are monitored by the RSO and noted in the Radiation Program Compliance Calendar.

Ancillary Employees are also required to complete annual radiation safety training assigned by the RSO through the EDGE platform. The training for Ancillary Employees includes information related to the general principles of radioactivity, radiation protection, and avoidance of the cleaning and collection of trash materials in designated areas. Ancillary Employees who fail to timely complete the training will be referred to their supervisors for appropriate discipline.

Students may only use licensed materials under the supervision of an Authorized User. Prior to allowing a student to use a licensed material, the Authorized User must provide training on appropriate safety precautions for use of the specific material.

C. Ordering and Receipt of Radioisotopes

Authorized Users who wish to order radioactive materials must do so through the Administrative Assistant in the Department of Biology. The Administrative Assistant will obtain approval from the RSO, who will verify that the requested order is within Bucknell's license limitations, prior to ordering.

In accordance with federal regulations, 10 CFR § 20.1906, the Authorized User must test the external surface of the package with a survey meter (if it contains phosphorus-32 or iodine-125) or by wipe tests (if it contains other isotopes) **within three hours of receipt of a package**. When an order for radioactive materials is placed, the Administrative Assistant tracks the delivery timeline. If the Authorized User will not be available within three hours of receipt of the package to test the package, the Administrative Assistant will coordinate with the RSO who will complete the task. If contamination or radiation is detected, the Authorized User must immediately notify the RSO and the supplier. If removable radioactive contamination exceeds the limits of 2200 dpm/100cm2 for beta emitters or external radiation exceeds the limits of 200 mrem/hr), the RSO will promptly notify the final delivery carrier and the Nuclear Regulatory Commission. (See 10 CFR §§ 71.87i,71.47.)

If radiation or contamination is not present on the external package, the Authorized User will open it in accordance with the following procedures:

1. If there is any visible sign of damage to the package, the Authorized User will notify the RSO immediately.
2. The Authorized User must wear disposable gloves and a laboratory coat. All operations must be performed on a tray lined with absorbent paper. If the sample contains P-32 or I-125, it must be opened behind plexiglass shielding. If the material is volatile, it must be opened in a hood.
3. The Authorized User will check the internal packing for contamination with a survey meter (P-32 or I-125) or wipe tests (other isotopes). Wrappings that found to be non-radioactive can be discarded as regular trash after radioactive labels are made illegible.
4. The Authorized User will confirm that the shipment material and amount are consistent with the approved order.
5. The Authorized User will document the receipt, package surveys and wipe tests in the log book in room 217B.
6. The Authorized User will record new materials on the shared inventory sheet.

D. Transfer of Licensed Material

Internal transfer of licensed material from one Bucknell laboratory to another requires approval of the RSO. Transfer of licensed material externally, to another user or location outside of Bucknell, requires approval of the RSO, the Chief of Public Safety, and the General Counsel, will be permitted only in limited circumstances.

E. Storage of Licensed Material

Radioactive materials must be stored only within approved locked rooms or locked receptacles, such as freezers or storage containers accessible only to Authorized Users.

F. Use of Licensed Material

Only current Authorized Users are permitted to use radioactive materials, and they may do so only in licensed areas. Prior to beginning any work with licensed materials, all Authorized Users must complete an Authorized User Certification, which will be maintained by the RSO. Authorized Users must keep accurate records of use, storage and disposal of licensed materials in the appropriate use and waste logs, as directed by the RSO.

Authorized Users must comply with the following safety procedures when working with licensed materials:

1. Wear gloves and a lab coat. When working with large quantities of radioisotopes wear two gloves on each hand so that the outer glove can be discarded quickly in the event of contamination during an operation.
2. Wear personal radiation badge, if applicable.
3. Do not eat, drink, chew gum, or smoke in the lab.
4. Line the work area with absorbent paper and mark off the area with warning tape.
5. If working with a volatile material, work only in the hood.
6. Use appropriate radiation monitoring instruments.
7. Wear double gloves when working with stock solution.
8. Note the removal of radioactive material from stock solution in the use log.
9. Label all radioactive containers accurately with the date, isotope and activity, including pipettes that hold materials.
10. Return isotopes to proper storage areas immediately after use.
11. Pipette by mouth is prohibited.
12. Use time, distance and/or shielding as necessary to protect yourself and others.
13. Dispose of waste properly.
14. Wash hands vigorously with soap after use.
15. If a spill is suspected, deglove and reglove using two gloves per hand. Test all outer perimeters by working from the coldest area to hottest area in order to prevent spreading contamination outward. Strip outer gloves and leave on hot area. Run a wipe test through the counter. If a spill is confirmed, double glove and decontaminate as described in the section below related to procedures for spills and accidents. All materials used in cleaning up the spill, including gloves, must be discarded as radioactive waste. For spills that are outside of the immediately controlled work area, post warning signs and notify the RSO.
16. When work is finished, check the area with a wipe test. If there is contamination, clean the area while wearing gloves, using best practices to avoid further contamination spread, and recheck the area.

G. Emergency Procedures for Spills and Accidents

Authorized Users must notify the RSO immediately of any spill or accidents. The RSO will evaluate the situation, notify the necessary personnel and coordinate actions for handling the incident. Each lab must have the necessary equipment available to handle minor spills, including absorbent materials, a neutralizing spray, and personal protective equipment. Authorized Users are responsible for knowing the location and instructions for use of such equipment.

1. Procedures for Minor Incidents

Personnel Exposure and/or Contamination

a. If hands are contaminated, flush thoroughly and wash with soap and lukewarm water.

b. The RSO will evaluate the extent of the incident and determine if additional actions are needed.

Laboratory Contamination

a. Authorized User must notify persons in the immediate work area that a spill has occurred and of any necessary precautions they should take.

b. Cover spill with absorbent paper to prevent spread of contamination.

c. All materials used to clean up a spill must be collected in a plastic radiation disposable bag and disposed of in the appropriate radioactive waste container.

d. The Authorized User must complete a survey of the area to verify that radiation levels are at a background level.

e. The Authorized User must promptly provide a written summary report of the incident to the RSO following clean-up.

2. Procedures for Major Incidents

Personnel Exposure and/or Contamination

a. The RSO will evaluate the incident and alert emergency personnel as necessary.

b. Radiation monitoring surveys shall be conducted on all personnel involved and on the affected laboratory to determine the extent of exposure and/or contamination.

c. Contaminated clothing shall be removed and stored for further evaluation by the RSO.

d. If skin is contaminated, the affected area must be flushed thoroughly and washed with soap and lukewarm water.

e. Personal badges will be sent for immediate processing.

f. Bioassays will be arranged at a medical facility if internal contamination is suspected.

g. The RSO will contact the Pennsylvania Bureau of Radiological Health if additional assistance is necessary.

h. The Authorized User must provide a written summary report to the RSO that includes the cause and extent of the incident, the emergency procedures initiated, and the methods of cleanup utilized.

Laboratory Contamination

a. All persons not involved in the spill must vacate the room immediately.
b. The Authorized User must immediately initiate any necessary action to prevent the spread of contamination, including confining the movement of any personnel who are potentially contaminated.
c. The RSO shall be notified immediately and shall provide any additional equipment needed for cleanup and decontamination.
d. The laboratory area will be closed until decontamination is complete.
e. All materials used in cleanup must be placed in plastic bags and disposed of in the appropriate radioactive waste container.
f. Upon completion of cleanup, the Authorized User and/or RSO will conduct surveys to verify that the radiation levels are at background levels.
g. The RSO will contact the Pennsylvania Bureau of Radiological Health if additional assistance is necessary.
h. The Authorized User must provide a written summary report to the RSO that includes the cause and extent of the incident, the emergency response measures initiated and the methods of cleanup utilized.

H. Personnel Monitoring

Bucknell uses a commercial service that provides dosimetry to the extent deemed necessary for personnel utilizing radioactive materials. The RSO, Biology Administrative Assistant, and Authorized Users conducting research with licensed material for a period of more than six consecutive months will be enrolled in the commercial badge/ring dosimeter program. Other Authorized Users and Ancillary Employees will be enrolled as deemed necessary on a case-by-case basis.

In cases where contamination has been suspected, the film badges are exchanged immediately. Personnel working with millicurie amounts of Phosphorus-32 for a period greater than six months will make use of extremity dosimeters such as ring film badges. At present, no experiments are planned that require an individual to handle more than 500 microcuries of Phosphorus-32 at any given time.

At present, all experiments with tritium utilize microcurie amounts, although materials are sometimes ordered in millicurie amounts. If it is determined that an individual will use millicurie amounts of tritiated material in an experiment or is exposed to millicurie amounts of tritium due to an incident in unpacking a shipment of material, that individual will be monitored by urine bioassay as directed by the RSO.

I. Surveys

After using radioactive materials, an Authorized User must survey the immediate area with a GM meter and/or conduct a wipe test. Results indicating levels of radiation below 150 dpm, as determined by liquid scintillation counting, are considered acceptable.

Wipe tests are to be conducted in accordance with the following procedure. In each test, a piece of filter paper is wiped across a one foot path, and the paper is counted in scintillation fluid. Channels are set for each isotope that has been used and one channel is set with the windows fully open. Standards and a blank are also run. The results of the third channel (with windows fully open) are recorded on the survey sheet. The printout from the counter showing all counts, channel settings and counting parameters is stapled to the survey sheet and maintained with the use log.

Authorized Users conduct wipe tests on sealed sources as required.

J. Instrument Calibration

The RSO is responsible for ensuring that all survey instruments are properly calibrated in a timely manner. The RSO maintains calibration expiration dates and advanced reminders in the Radiation Program Compliance Calendar.

K. Waste Disposal

Individual laboratory waste must be placed in a marked radioactive waste container that is suitable for hand carrying. Each waste container must be clearly labeled for the isotope for which it is designated.

Once a laboratory waste container is filled, it is transported to the radioactive waste storage room (Biology 1) by the Authorized User or the RSO. The RSO maintains organization in this room such that long-lived isotopes and short-lived isotopes are separated and stored on different sides of the room.

All waste must be properly logged in on the applicable waste log in the disposal room. The RSO will review waste logs every 2 weeks and will maintain a record of such reviews. Reoccuring deadlines related to the review of waste logs will be maintained with appropriate advanced reminders in the Radiation Program Compliance Calendar.

1. Short-Lived Isotopes

Bucknell's license allows for the holding of radioactive material with a physical half-life of less than 120 days for decay in storage. The following isotopes are handled in this manner:

phosphorus-32 (half-life = 14.3 days), phosphorus-22 (half-life = 25 days), sulfur-35 (half-life = 88 days), and iodine-125 (half-life = 60 days).

Each storage container is limited to one isotope which is clearly labeled on the container. When a storage container is full, the date of the last addition is recorded, and the container is stored for at least 10 half-lives of the isotope it contains. When the day period is complete, the RSO conducts a final survey using a survey meter to ensure that the isotope has reached a background level of radiation. In addition, the RSO will test liquid waste that contained sulfur-35 or phosphorus-33 by liquid scintillation counting. Levels of less than 100 dpm above background levels per mL are deemed acceptable. The RSO will conduct wipe tests on solid waste from containers that contained sulfur-35 or phosphorus-33. Levels of less than 100 dmp (above background levels) per 100 cm2 are deemed acceptable.

After the RSO determines that the results of the final survey are acceptable, the waste is discarded as hazardous waste or regular trash, depending on the nature of its contents.

2. Long-Lived Isotopes

Long-lived isotopes are held for disposal by a commercial radioactive waste vendor. Solid waste is stored in 55 gallon drums, and liquid waste is stored in 5 gallon metal cans. Each container is restricted to one isotope.

Liquid scintillation fluid containing 0.05 microcurie or less of hydrogen-3 or carbon-14 per gram of medium is disposed as hazardous waste as permitted by federal regulation (10 CFR 20.2005(a)). The RSO tests containers of fluid to be disposed of in this manner by scintillation counting before disposal to confirm that the level of radioactivity is at or below the permissible level. Scintillation fluid that contains levels of hydrogen-3 or carbon-14 greater than 0.05 microcurie/g of medium is stored for disposal by a commercial radioactive waste vendor.

L. Inventory and Audit Requirements

The RSO will conduct physical inventories of radioactive materials every six months using the inventory sheet template form RPP-002. Inventory due dates are noted in the Radiation Program Compliance Calendar. Authorized Users must be present to assist the RSO in conducting the inventory. The RSO will sign and date the completed inventory sheet after conducting the physical inventory and will maintain inventory records in hard copy and electronic format for five years.

The RSO will conduct an annual Program audit in the spring semester of each academic year by no later than May 31. The deadline for completion of the annual Program audit is maintained in the Radiation Program Compliance Calendar. The RSO will document follow up actions related to any items found to be unsatisfactory during the audit. Authorized Users must

be present to assist the RSO in conducting the annual audit and will assist with any required follow up actions, as deemed necessary by the RSO.

M. Required Postings

The RSO is responsible for maintaining required postings of the current license/amendment outside of the RSO office and in each lab. In addition, the RSO will maintain a current "Notice to Employees" in areas where radioactive materials are used and/or stored, checking the Pennsylvania Department of Environmental Protection website for required posting updates every three months. The RSO maintains this deadline in the Radiation Program Compliance Calendar.

Last updated: September, 2017
Effective date: October 11, 2017