

**Rules and Procedures**

for

**Users of Radioactive Material**

at

 **The Pennsylvania State University**

Revision was approved by the

University Isotopes Committee

May, 2018

The Rules and Procedures was originally approved by the University Isotopes Committee in the spring, 2001, and revised in 2010. Beginning Spring 2010, the University Isotopes Committee decided that paper copies of these Rules and Procedures were no longer needed. Instead this document will continue to be available on the EHS web site. Notices of changes will be sent out by email to all supervisors or discussed in the annual refresher training.

Table of Contents

[1 The Pennsylvania State University’s Policy towards Exposure to Radiation and Radioactive Materials 1](#_Toc504603043)

[2 Purpose and Scope 2](#_Toc504603044)

[3 Duties and Responsibilities 4](#_Toc504603045)

[3.1 Vice-President for Research 4](#_Toc504603046)

[3.2 University Isotopes Committee 4](#_Toc504603047)

[3.3 Radiation Safety Officer 5](#_Toc504603048)

[3.4 Authorized Supervisors of Radioactive Material Laboratories 6](#_Toc504603049)

[3.5 Individual Users of Radioactive Material 7](#_Toc504603050)

[3.6 Raising Safety Concerns 8](#_Toc504603051)

[4 Training Requirements 9](#_Toc504603052)

[5 Obtaining Authorization to Use Radioactive Material 10](#_Toc504603053)

[5.1 Exempt Material 10](#_Toc504603054)

[5.2 Generally Licensed Materials 10](#_Toc504603055)

[5.3 All other Radioactive Material 10](#_Toc504603056)

[5.4 Additional Guidance in Submitting Applications 11](#_Toc504603057)

[6 Special Provisions for Authorization to Use Radioactive Material 14](#_Toc504603058)

[6.1 Laboratory Rules for Safe Use of Radioactive Material 14](#_Toc504603059)

[6.2 UIC Policy for Food and Drink in Laboratories. 15](#_Toc504603060)

[6.3 Rules for the Care of Vertebrate Animals Containing Radioactive Material 16](#_Toc504603061)

[6.4 Special Rules for Radioiodinations 18](#_Toc504603062)

[6.5 Special Rules for Phosphorus-32. 19](#_Toc504603063)

[6.6 Requirements for the Use of Sealed Sources 20](#_Toc504603064)

[6.7 Gas Chromatograph Sources 21](#_Toc504603065)

[6.8 Source Material (Uranium and Thorium metal or compounds) 21](#_Toc504603066)

[6.9 Special Nuclear Material 22](#_Toc504603067)

[6.10 Use of Radioactive Material at non-University Park locations. 23](#_Toc504603068)

[7 Public and Occupational Radiation Exposure Limits 24](#_Toc504603069)

[7.1 ALARA 24](#_Toc504603070)

[7.2 Occupational Exposure Limits 24](#_Toc504603071)

[7.3 Public Exposure Limits 25](#_Toc504603072)

[7.4 Exposure Limits during Pregnancy 25](#_Toc504603073)

[8 Personal Monitoring and Bioassay Requirements 26](#_Toc504603074)

[8.1 Dosimeters 26](#_Toc504603075)

[8.2 Bioassays 27](#_Toc504603076)

[9 Contamination Limits and Survey Procedures 28](#_Toc504603077)

[9.1 Contamination Limits 28](#_Toc504603078)

[9.2 Survey Instrumentation 28](#_Toc504603079)

[9.2.1 Portable Hand-Held Instruments 28](#_Toc504603080)

[9.2.2 Liquid Scintillation Coutner 29](#_Toc504603081)

[9.3 Contamination Survey Procedures 30](#_Toc504603082)

[9.3.1 Portable meter scanning 30](#_Toc504603083)

[9.3.2 Wiping 31](#_Toc504603084)

[9.3.3 Smearing 31](#_Toc504603085)

[9.4 Radiation survey 33](#_Toc504603086)

[9.5 Survey documentation 33](#_Toc504603087)

[9.6 Survey meter calibration 34](#_Toc504603088)

[9.7 Radiation lab decommission 34](#_Toc504603089)

[10 Emergency Response Procedures 35](#_Toc504603090)

[10.1 Radiological Incidents: 35](#_Toc504603091)

[10.2 Injuries: 36](#_Toc504603092)

[10.3 Fires 36](#_Toc504603093)

[10.4 Laboratory Spill Procedures 36](#_Toc504603094)

[11 Radioactive Waste Disposal 39](#_Toc504603095)

[11.1 General Rules 39](#_Toc504603096)

[11.2 Radioactive Waste Categories / Classifications 40](#_Toc504603097)

[11.3 Collection Processes for Different Radioactive Waste Classifications 40](#_Toc504603098)

[11.3.1 Solid Waste (DAW) 40](#_Toc504603099)

[11.3.2 Liquid Waste 42](#_Toc504603100)

[11.3.3 Liquid Scintillation Vial Waste 43](#_Toc504603101)

[11.4 Animal Waste 44](#_Toc504603102)

[11.5 Mixed Wastes 44](#_Toc504603103)

[11.6 Sealed Sources: 45](#_Toc504603104)

[11.7 Stock Vials 45](#_Toc504603105)

[11.8 Sharps 45](#_Toc504603106)

[11.9 Biohazardous Radioactive Waste 46](#_Toc504603107)

[12 Purchasing or Receiving Radioactive Material 47](#_Toc504603108)

[13 Transporting Radioactive Material 49](#_Toc504603109)

[14 Procedures to Identify and Report Safety Component Defects 50](#_Toc504603110)

[15 Sources of More Information 51](#_Toc504603111)

# The Pennsylvania State University’s Policy towards Exposure to Radiation and Radioactive Materials

It is the policy of Penn State University, as established by the University Isotopes Committee, that the release of radioactive material and the exposure of people to ionizing radiation be kept **A**s **L**ow **A**s **R**easonably **A**chievable (ALARA). The University ALARA policy is based on the following three principles:

1. Exposures of personnel to radiation or the release of radioactive material to the environment may not exceed the limits in the federal and state regulations.
2. Unplanned exposure of personnel or uncontrolled releases to the environment that exceed 10% of permissible limits will be investigated by the Radiation Protection Office of Environmental Health and Safety to determine whether the exposures or releases were ALARA and whether action is required to limit future exposures or releases. Planned operations with estimated exposures or releases that exceed 10% of the permissible limits will be subject to an ALARA review by Radiation Protection staff prior to beginning the operation.
3. Exposures and releases that do not exceed 10% of the permissible limits are low enough that no further consideration of ALARA is necessary.

Signed by

NEIL SHARKEY 05/23/2018

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Neil Sharkey, Vice-President for Research Date

# Purpose and Scope

The Rules and Procedures in this document have been adopted by The Pennsylvania State University to provide for the safe use of radioactive material at the University. They are distributed to help inform workers at the University about how to meet the requirements of federal and state regulations, license and insurance conditions, and University requirements. It is the intent of the University that these Rules and Procedures allow as much freedom as possible for experimenters while assuring that the release of radioactive materials and the exposure of personnel to ionizing radiation be kept as low as reasonably achievable.

These Rules and Procedures have been approved by the University Isotopes Committee (UIC), which is responsible to the Vice-President for Research, the United States Nuclear Regulatory Commission (NRC), and the Pennsylvania Department of Environmental Protection (Pa DEP) for the safe handling of all radioactive materials and for assuring compliance with all applicable regulations. In addition, these Rules and Procedures document Penn State’s Radiation Protection Program.

These Rules and Procedures cover the possession, use, and transfer of all licensed radioactive material on University-controlled property by University personnel or others and by University personnel at other locations. This includes the non-University Park locations, but not the Milton S. Hershey Medical Center or the College of Medicine located at the Hershey campus. The medical center and the College of Medicine are covered by rules which are administered by committees separate from the UIC.

It is not the intent of these Rules and Procedures to cover naturally occurring radioactive materials in their normal concentrations and chemical states, or those materials such as smoke detectors, luminous dials, or rare earths. Nor do these Rules apply to the purchase and use of exempt radioactive materials such as sealed counting standards. However, the UIC may require authorization to possess or use such material if the potential hazard is comparable to licensed material. Environmental Health and Safety (EHS) should be consulted before acquiring any radioactive material to determine whether a Penn State authorization is required.

These Rules and Procedures do apply to radioactive compounds such as uranium and thorium acetate, oxide, or nitrate.

These Rules and Procedures do **not** apply to the operation of the Breazeale Nuclear Reactor except as specifically made a part of the reactor operating license. Radioactive material contained in reactor fuel elements, operating components, or supporting structure is exempted from these regulations and is covered by the reactor operating license. Other radioactive material produced by the neutrons generated by the nuclear reactor comes under the control of the UIC upon removal from the reactor.

These Rules and Procedures are intended for use by everyone who works with radioactive material covered by these Rules. An electronic copy is available on the Penn State EHS Web site and can be downloaded at https://ehs.psu.edu/radioactive-materials/radioactive-materials-requirements-guidelines for your reference.

# Duties and Responsibilities

## Vice-President for Research

The Vice-President for Research is the senior University official responsible to the NRC and the Pa DEP for the safe use of radioactive materials. The Vice-President for Research appoints the UIC members to oversee the use of radioactive materials within Federal and State regulations, and University policies and to perform those functions required of a radiation safety committee by Federal and State regulations and Penn State University’s licenses to possess and use radioactive material.

## University Isotopes Committee

The UIC is responsible for administering the licenses issued to the University for the use of radioactive materials and for insuring that such use meets federal and state regulations, and University policies. The Vice-President for Research has empowered the UIC to act as they deem necessary to ensure compliance with regulations and to ensure that all licensed radioactive material is used in a safe manner.

The Committee is made up of faculty members representing areas of research and teaching that are the predominant users of radioactive materials along with a member who represents senior management. The Committee is responsible for administering the licenses issued by the NRC and the Pa DEP to the University for the use of radioactive materials and for ensuring that such use meets the requirements of all University policies, state and federal regulations.

The UIC has the responsibility to review all requests for the use of radioactive materials (Request for Authorization to Use Radioactive Material) and to approve or disapprove such requests. The Committee has the authority to withdraw its authorization to use radioactive material and to order an experimenter to take whatever action the Committee considers necessary to correct unsafe conditions or a violation of a license or regulation. The Committee will normally request a prior review by EHS of all requests for authorization to use radioactive material. The Committee may seek assistance from other experts in the review of proposals involving areas outside the expertise of the membership.

The UIC meets to review all requests for authorization to use radioactive material which could present unusual hazards or that involve procedures which could result in significant exposure of personnel to radiation or the release of radioactive material. The Committee will normally consider requests for authorization to use routine amounts and types of radioactive materials outside of a Committee meeting.

The Committee has the responsibility to specify training requirements for users of radioactive material, to list requirements for radiation and contamination surveys, and to formulate the University Rules and Procedures for the use of radioactive material. The Committee Chair will convene meetings of the Committee whenever he or she deems it necessary, but at least quarterly. The Chair will call a meeting of the Committee as soon as convenient after receiving a request for a meeting from any Committee member, the Radiation Safety Officer or any experimenter who wants a full Committee review of an action taken by the Committee or by EHS.

## Radiation Safety Officer

The Radiation Safety Officer (RSO) (university title – Manager of Radiation Protection) is responsible for ensuring the safe use of radioactive material at all Penn State locations, except the Milton S. Hershey Medical Center or the College of Medicine located at the Hershey campus. The RSO is responsible for managing the radiation safety program; identifying radiation safety problems; initiating, recommending, or providing corrective actions; verifying implementation of corrective actions; and ensuring compliance with all applicable regulations. The RSO has been delegated the authority to meet these responsibilities by the Vice-President for Research.

The RSO has the authority to immediately stop any operation involving the use of radioactive material in which health and safety may be compromised or may result in non-compliance with regulations.

The staff of EHS – Radiation Protection has the authority to enter any laboratory to carry out inspections to determine compliance with licenses, regulations, or a user's authorization to use radioactive material.

On matters of radiation safety the RSO reports to the Vice-President for Research through the UIC.

EHS is administered by the Senior Vice-President for Finance and Business through the Associate/Assistant Vice-President, Office of Physical Plant, who provides additional administrative support for its programs which include the radiation protection program.

## Authorized Supervisors of Radioactive Material Laboratories

Laboratory supervisors apply to and receive approval from the UIC for authorization to use radioactive material. The supervisor is usually a member of the University faculty or staff (including emeritus members). He or she is responsible for all activities making use of radioactive material obtained under the supervisor's authorization to use radioactive material. The supervisor is responsible for the actions of all personnel working under his or her authorization. The responsibilities of the supervisor include, but are not limited to, the following:

* The supervisor is responsible for ensuring the health and safety of everyone whose work he or she controls.
* The supervisor must ensure that all persons using radioactive material under his or her authorization complete all radiation safety training and annual retraining required by the UIC.
* Supervisors must ensure, by periodic monitoring, that all individuals using radioactive material under the supervisors’ authorizations are properly trained in the techniques to be used in the supervisor’s laboratory.
* Supervisors must notify EHS immediately in the event of any radiological emergency.
* Supervisors are responsible for the decontamination of any facilities contaminated by material used under the supervisor's authorization to use radioactive materials. EHS staff will supervise and assist in such decontamination.
* Supervisors are responsible for maintaining a current record of the radioactive materials in their possession.
* Supervisors are responsible for the secure storage of all radioactive materials.
* Supervisors are responsible for preparing, classifying, and describing radioactive waste, as required by these rules and EHS, prior to the collection of the waste for disposal.
* Supervisors are responsible for directing all purchases, transfers, and shipments of radioactive materials to EHS for processing and approval.
* Supervisors must notify EHS and must arrange for someone to assume responsibility for their authorizations prior to terminating employment at the University or for leaving the area for more than six consecutive weeks.
* Supervisors shall report to their laboratories immediately upon being notified of an emergency (fire, contamination, flood, equipment malfunction, large spill, etc.) and must provide all possible advice and assistance with regard to the hazards from radiation or radioactive material.
* The UIC expects that all supervisors authorized to use or store radioactive material will promptly respond to annual EHS requests for an itemized inventory of the supervisor’s store of radioactive material and certify the results of such inventory in a timely manner.
* The UIC expects that all supervisors authorized to use or store radioactive material will promptly ensure that all laboratory members comply with annual retraining requirements and certify completion in a timely manner to EHS.
* The UIC expects all laboratory supervisors of radioactive material to promptly pay an equal share of the Pa DEP license fee if a license fee collection notice is distributed. Those who do not authorized payment of this fee will have their authorizations to use radioactive material revoked.

## Individual Users of Radioactive Material

Each individual user, including each supervisor, is ultimately responsible for the safe use of the radiation sources to which he or she has access. Each individual shall:

* Keep his or her exposure as low as reasonably achievable.
* Read, be familiar with, and comply with these Rules and Procedures applicable to his or her work.
* Be familiar with the nature of his or her area's radiation sources, the extent of their potential risk and use the proper means of using them safely.
* Wear assigned personal monitoring devices in an approved manner.
* Monitor his or her area for contamination before and after each use of radioactive material.
* Immediately initiate the cleanup of minor spills.
* Dispose of radioactive waste in an approved manner.
* See that sources, containers, and the area are properly labeled and posted.
* Assist his or her supervisor in maintaining required records and inventories.
* Take no action that would interfere with the responsibilities of his or her laboratory supervisor.
* Prevent unauthorized persons from accessing radiation sources in his or her area.
* Protect service personnel, allowing no maintenance or repairs of area facilities or equipment unless the material or area has been checked for radioactive contamination.
* Notify his or her supervisor and EHS of any unexpected problems.
* Be prepared to handle accidents or injuries with common sense and in the spirit of the Emergency Procedures. He or she shall notify and seek the assistance of his or her immediate supervisor and EHS as soon as possible in emergencies.
* The UIC expects that all individuals who use or store radioactive material will promptly comply with annual retraining requirements and certify completion in a timely manner to EHS.

## Raising Safety Concerns

All persons working with radioactive material or radiation producing equipment who have concerns about their personal safety, the safety of the general public, or the safety of the environment should promptly report the matter to their supervisor. If the supervisor is unable to answer the person’s concerns to his or her satisfaction, he or she is encouraged to contact EHS to report the situation. EHS has been directed by the UIC to investigate and take appropriate actions. If the person raising the concern is not satisfied with the action(s) taken by EHS, the person is free to contact the NRC or the Pa DEP with his or her concerns. In any case, the person raising the concern may not be retaliated against in any way by his or her supervisor, EHS, or the University. Such retaliation is unlawful (see 10CFR30.7) and is contrary to maintaining a safety-conscious environment. Any person who feels that he or she has been retaliated against should promptly report this matter to the RSO, or to a member of the UIC.

# Training Requirements

Each laboratory supervisor is responsible for assuring that he or she and all those working under his or her authorization have received sufficient training necessary to safely handle radioactive materials. At a minimum, all persons using radioactive materials must successfully complete the training program given by EHS. This applies to authorized supervisors, faculty, staff, students and visitors. This training may be exempted by the UIC for people using small quantities of radioactive material for a short period of time, and are under the direct supervision of an authorized user of radioactive material, such as students in laboratory courses, tour groups, maintenance personnel, etc.

The Committee will require additional instruction or training for those working under specific authorizations that present unusual radiation safety or regulatory problems (for example, high activity sealed sources, special nuclear material, gases, or large amounts of I-125, P-32, U, or Th).

The required training will normally be provided by EHS staff. Instruction will include the explanation of the regulations in 10CFR19, 10CFR20, 10CFR21, the rules in this document, and all relevant license restrictions. Specific instruction in rules for the transportation of radioactive material may be required in some circumstances.

In addition, everyone who works with radioactive material, or who is issued a radiation dosimeter for access to the Radiation Science and Engineering Center facility, is required to complete the annual retraining provided by EHS. The UIC expects that all supervisors authorized to use or store radioactive material will promptly comply with annual retraining requirements and certify completion in a timely manner to EHS. Failure for a laboratory group to comply with the retraining requirement may result in the suspension of the laboratory’s authorization to use radioactive material.

Anyone who has not completed three or more consecutive annual retraining sessions must again attend the initial Radionuclide Safety Training program given by EHS. This could happen if someone did not work with radioactive material for three years, or left the University for that time.

Individuals only using Generally Licensed sources (such as krypton-85 deionizers and nickel-63 gas chromatograph sources) are exempted from the above listed training requirements. Individuals only using Exempt Material (e.g. small check sources/standards) are also exempted.

# Obtaining Authorization to Use Radioactive Material

## Exempt Material

In general, persons using radioactive material distributed as an Exempt Quantity or Exempt Concentrations of radioactive material as defined in 10CFR30.18, are exempt from these Rules. This mainly applies to small radioactive check sources and standards. Contact EHS for clarification prior to ordering any radioactive material.

## Generally Licensed Materials

The NRC and Agreement States issue General Licenses to anyone who purchases certain devices that contain radioactive material. These devices include self-luminescent EXIT signs containing tritium, gas chromatographs containing nickel-63, and dust de-ionizers containing krypton-85. In addition, many liquid scintillation counters have Generally Licensed sources. Contact EHS prior to acquiring any of these devices. Authorized supervisors who have one or more of these devices must submit a completed *“Registration of Generally Licensed Devices”* form to UIC for approval.

The NRC also issues General Licenses to users of radioactive uranium and thorium compounds. However, Penn State must comply with some requirements in the regulations. In general, the UIC requires users of uranium and thorium compounds to receive an approved "Request for Authorization to Use Radioactive Material".

## All other Radioactive Material

Penn State faculty or staff wishing to become Authorized Supervisors of radioactive material laboratories must request permission to do so by submitting a completed "Request for Authorization to Use Radioactive Material" form to UIC. This request must be signed by the individual who is directly responsible for the work. That person will be named as the laboratory supervisor and has the responsibilities listed in the Duties and Responsibilities section. Authorization forms and instructions may be obtained from the EHS Web page (<https://ehs.psu.edu/radioactive-materials/radioactive-materials-requirements-guidelines>), or the Office for Research Protection (ORP) website (<https://www.research.psu.edu/uic/applications>), or by calling EHS. Supervisors should discuss each proposed use of radioactive materials with an EHS staff member **prior** to submission of a request.

Requests for authorizations will be assigned an authorization number by staff in the ORP, then forwarded to EHS for pre-review, and then submitted to the UIC with a recommendation for approval, disapproval, or approval with conditions.

All Authorized Supervisors must have a college degree at the bachelor level or equivalent training and experience in the physical or biological sciences or engineering, and at least forty (40) hours of training and experience in the safe handling of radioactive materials, the characteristics of ionizing radiation, units of radiation dose and quantities, radiation detection instrumentation, and biological hazards of exposure to radiation appropriate to the type and forms of byproduct material to be used. In general, only faculty will be authorized to supervise laboratories that will be working with radioactive materials. Under certain special circumstance with UIC’s approval, a staff or postdoctoral fellow, who meets the degree and experience requirements for an Authorized Supervisor, might also be authorized to supervise laboratories that will be working with radioactive materials. In addition, in order to be an Authorized Supervisor, the qualified individual must have lab space that can be posted for the use of radioactive materials.

Requests for authorization will be approved for a specific time period, usually one to three years. For continuing work, a new request must be submitted prior to expiration of an authorization. This is to ensure that each authorization is periodically reviewed and reflects current usage. If a request to continue work under an existing authorization is received before the authorization expires, the work may continue until the Committee acts on the new request.

The applicant will be notified of the Committee action by the return of a copy of the authorization request with approval and expiration dates and noting the action taken.

Modifications to procedures (including using a different chemical form) may require an amendment to the authorization. Discuss changes with EHS to determine if an amendment is necessary

## Additional Guidance in Submitting Applications

These notes may aid in the writing of applications to use radioactive material. In all cases contact EHS for details.

* Use of radioactive material in humans is not allowed under Penn State’s PA DEP or NRC license. Contact EHS for details on the method for obtaining such approval. Expect at least a one year delay for approval of any request to use radioactive material in humans.
* Field use involving intentional release of radioactive material to the environment is currently not permitted under Penn State's PA DEP or NRC license. Approval for field release of radioactive material may be granted by the PA DEP or NRC on a case-by-case basis. Expect at least a one year delay for approval of any request for field release of radioactive material.
* Researchers using radioactive material in live animals must obtain permission from both the Institutional Animal Care and Use Committee (IACUC) and the UIC prior to beginning work. Contact the ORP (https://www.research.psu.edu/orp) for details. Specific requirements for using radioactive material in live animals are included in another section of these procedures.
* When a supervisor requests permission to use radioactive material in a laboratory, the UIC assumes that the supervisor has already obtained his or her department’s approval to use that facility.
* Approval of an authorization request by the UIC for use or production of radioactive material at the University research reactor does not commit the reactor facility to provide the material or allow the use of radioactive material in the reactor facility. These arrangements must be made directly with the reactor facility staff.
* Labeling proteins or other materials with radioiodine involves special restrictions and precautions. See the section in these procedures on special iodination requirements.
* Using phosphorus-32 in amounts greater than 185 MBq (5 mCi) at any one time requires special handling techniques and special training that will be provided by a Radiation Protection staff member. See the section on special phosphorus-32 requirements.
* Uranium and thorium compounds, in general, are treated like any other radioactive materials at Penn State.
* A large self-contained cobalt-60 irradiator is available on campus for the gamma irradiation of cells, small animals, and other items. This equipment is subject to additional PA DEP license restrictions not specifically addressed in these rules; contact EHS for more information.
* Portable soil moisture and density gauges, which typically contain radioactive americium or cesium, come under special regulations. This equipment is subject to additional PA DEP license restrictions not specifically addressed in these rules. Contact EHS for more information.
* Because they are fissile, plutonium, uranium-233, and uranium-235 are defined as "special nuclear material". These materials have special handling and control requirements. Nearly all proposals to use these radioactive materials will require an NRC license amendment and considerable prior planning. Contact EHS well in advance of planning to use this material.
* The applicant may be responsible for any special fees that apply to his or her use of radioactive material that are specifically imposed by the NRC or the Pa DEP.

Generally licensed devices have slightly reduced authorization requirements. Please contact the EHS for details. These devices include sources in gas chromatographs, krypton-85 gas in tubes, and tritium containing self-luminous EXIT signs.

# Special Provisions for Authorization to Use Radioactive Material

## Laboratory Rules for Safe Use of Radioactive Material

The following rules apply to all users of radioactive material.

1. Radioactive materials may only be possessed or used in accordance with authorizations issued by the UIC unless specifically exempted by the UIC.
2. Persons working in laboratories in which radioactive material is used must be familiar with the regulations and radiation safety procedures. New personnel must contact EHS to arrange for required safety instruction before starting work with radioactive materials.
3. Orders for shipment of radioactive materials to and from the University and transfers between supervisors within the University must be processed through EHS.
4. Inventory forms for radioactive materials must be kept current. Completed inventory forms must be returned to EHS when the material has been used up or has decayed to an insignificant activity level.
5. Persons using radioactive materials are responsible for conducting routine surveys to detect contamination or excessive radiation levels each time unsealed radioactive materials are used.
6. Persons using radioactive materials are responsible for the immediate decontamination of facilities which become contaminated.
7. Pipetting by mouth is prohibited in laboratories.
8. Persons working with dispersable radioactive material, not in a closed container, must wear laboratory coats, or other protective clothing and appropriate protective gloves.
9. Eating, drinking, and the storage of food or beverages is prohibited in areas where unsealed radioactive materials are used or stored. EHS staff have been directed by the UIC to immediately stop all work with radioactive materials under any authorization which covers the areas where food or drinks were found. Use of radioactive materials must not resume until the laboratory supervisor has taken action to correct the problem and has received written approval to start work from the UIC.
10. Radioactive materials must only be discarded into appropriately labeled radioactive waste containers. EHS staff have been directed to immediately stop the use of radioactive materials in any laboratory in which radioactive material is found in normal trash, biohazard waste, or recycling containers. The use of radioactive material may not resume until the laboratory supervisor has taken action to correct the problem and has received written approval to start work from the UIC.
11. All unattended containers holding more than 1 μCi of radioactive material must be labeled with the radiation trefoil, “CAUTION, RADIOACTIVE MATERIAL” the radionuclide present, the date, the activity, and the name of the person responsible for the material. Equipment that may become contaminated or normally contain radioactive material must be labeled with the radiation trefoil and “CAUTION, RADIOACTIVE MATERIAL”.

Stricter labeling requirements apply to Sr-90, Cd-113m, Gd-148, Hf-178m, Hf-182, Pb-210, Bi-210m, Po-210, and most materials with atomic number greater than 87 other than natural uranium or thorium; contact EHS for details.

1. Licensed radioactive material in storage must be secure from unauthorized removal or access. Radioactive material not in storage must be controlled and under constant surveillance.

Locking the room which contains radioactive material **or** storing the materials in a locked cabinet, refrigerator, shield, or storage box meets this requirement. If a room containing radioactive materials is occupied, the radioactive materials must be under the constant surveillance of the occupants, or the room must be locked. Radioactive material that is an integral part of a non-portable piece of equipment (*e.g.* liquid scintillation counter internal standard) is considered secure. Laboratories left unattended are in compliance with this requirement if the laboratory door is locked **or** all radioactive materials, including wastes, are in locked storage areas.

1. The loss or theft of radioactive material must be immediately reported to EHS.

## UIC Policy for Food and Drink in Laboratories.

(Approved by UIC: November 21, 2000)

1. Except as stated below, no foods or beverages may be stored, prepared, or consumed in areas in which the use or storage of radioactive material is authorized. Nor may food or beverage containers be washed in these laboratory areas.
2. No radioactive material or equipment previously used with radioactive material may be stored in areas designated for food consumption, nor may containers previously used for radioactive material be washed in areas designated for food consumption.
3. Food or beverages may not be stored in containers usually used for radioactive material storage.
4. Food consumption in an office, within a room authorized for the use of radioactive material, is permitted as long as the office has a door in a floor-to-ceiling wall.
5. The storage and consumption of food is allowed in an area within a room authorized for radioactive material use only if the area is clearly separated from areas where radioactive material is used. The separate area within the laboratory must be clearly demarcated. The entrance to the area must be wide enough to accommodate wheel chairs (36") but narrow enough to indicate that this is a separate distinct area in which radioactive material is not allowed. This area must have solid barriers to at least 5 ½ feet above the floor on all sides except for the entrance. This area may not be used as a through passage between two parts of the room authorized for radioactive material.
6. Cubicle(s) at the end of laboratory benches that are used for research work may not be approved for the consumption or storage of food or drink.
7. Radiation Protection staff may approve food areas, within these guidelines, without consulting the UIC.
8. Food and drink areas, as described above, must be conspicuously posted:

No Radioactive Material Beyond This Point

This area has been designated as a food area.

 *room building*

Approved by EHS:  *EHS staff member’s signature*  Date

## Rules for the Care of Vertebrate Animals Containing Radioactive Material

Prior to beginning work with radioactive material in animals, laboratory supervisors must obtain approval from the IACUC and the UIC.

All animal housing and animal housing facilities must meet or surpass the standards set forth in "The Guide for the Care and Use of Laboratory Animals" published by the Institute for Laboratory Animal Research (ILAR). This Guide is a publication of the National Research Council's Division on Earth and Life Studies.

All animal husbandry carried out by the research personnel must be documented and approved by the IACUC. Training materials and training may be requested from the ORP.

All hands‑on care of animals containing radioactive material must be provided by the laboratory research personnel performing this research. These researchers must have training in the general use of radioactive material by EHS and specific training related to radioactive animal care by the laboratory's radioactive materials supervisor. This training must include specific instructions requiring that laboratory staff:

* Clearly identify the cages of animals that contain radioactive material with "Caution ‑ Radioactive Material" labels. Signs must be posted indicating whether or not animal‑care technicians are responsible for the care of the non‑radioactive animals
* Sharps used to deliver radioactive materials to animals must be disposed of in sharps containers that have also been labeled for radioactive waste
* Perform all feeding and cleaning of animals
* Clean and decontaminate cages and facilities
* Perform regular contamination surveys to prevent the spread of contamination, and to ensure that radiation levels are maintained as low as reasonably achievable
* Place radioactive animals, animal waste, and animal tissue into zip‑lock plastic bags. The bags must be indelibly labeled with "Caution ‑ Radioactive Material", radionuclide, activity, date, supervisor's name, and the mass of the contents. To facilitate storage, this radioactive waste must then be frozen in the smallest practical container
* Autoclave all paper and plastic animal‑contaminated waste prior to placing this material in EHS radioactive waste containers
* Add bleach, at a 10% final volume, to all liquid waste containers that will contain biological waste prior to placing biological waste in the container
* Contact EHS for waste collection after a few pounds of frozen waste is collected
* Package all animal and other wastes for transfer to EHS when research is complete
* Contact EHS to perform pre‑release surveys to allow reuse of room and equipment.

Penn State laboratory animal care technicians, who may not handle radioactive animals, are taught that radioactive animals, and the waste from such animals, must only be handled by approved laboratory researchers. Animal care technicians who work in the area where radioactive animals are used receive annual instruction in these requirements by EHS staff or by the animal care technician supervisor. Animal care technicians retain responsibility for general room cleaning such as the sanitizing of the sinks, floors, etc., but are not allowed to clean the cages of animals that contain radioactive material.

First approved by the IACUC on 4/12/1999 and by the UIC on 2/9/1999

Last revised by the IACUC on 11/12/2007 and by the UIC on 11/10/2009

Last approved by the IACUC on 12/14/2009 and by the UIC on 12/14/2009

## Special Rules for Radioiodinations

The following items are standard requirements for all authorizations to perform radioiodinations issued by the UIC.

 A written procedure for the iodination must be reviewed and approved by the UIC. Changes in the procedure are also to be submitted to EHS for review, prior to approval by the UIC.

 Persons performing radioiodinations must be listed on the authorization and must have completed specific radioiodination training. Such training must include:

 Observation of others performing an iodination or extensive experience performing iodinations prior to coming to Penn State.

 Performing a demonstration of the iodination procedure (without radioactive iodine) for a member of the EHS staff. Changes in this procedure may be required based on the results of this demonstration.

 Performing a demonstration of the iodination procedure, using radioactive iodine, for a member of the EHS staff. Changes in the procedure may be required based on the results of this demonstration.

 Within seven days after each iodination the person(s) performing the iodination must have a bioassay for radioiodine performed by EHS staff. This normally requires a 10-minute count of the photon emissions from the thyroid. Call EHS to arrange a time for the bioassay. If several iodinations are performed within a period of a few days, only one bioassay is required, as long as the time between the bioassay and any of the iodinations does not exceed seven days. In special circumstances the Radiation Protection staff may grant slight extensions.

 Stock vials of radioiodine and reaction vials must be kept sealed at all times. Transfers of solutions must be made through septums, using syringes and needles. This is to prevent the loss of volatile radioiodine from the air space in these containers, which occurs when the caps are removed, even momentarily.

 All reactions, including the initial purifications, must be conducted in a hood approved for radioiodinations.

 After each iodination, the hood and work areas must be thoroughly surveyed including the use of smears to detect any transferrable surface contamination, high radiation levels, or any contamination of skin or clothing. If any unusual contamination levels are found, or if there is any suspicion that there might have been some release of radioiodine during the iodination or purification, this must be reported immediately to EHS.

 A survey meter must be available at all times during the iodination and use of the labeled radioiodine compounds. Because of the low sensitivity of Geiger-Mueller detectors, a sodium iodide scintillation probe designed for the detection of 125I shall be used to check for contamination of the work area and the hands, clothing, and shoes of those using 125I.

Exceptions to these conditions may be approved by the UIC and made part of the supervisor’s authorization.

## Special Rules for Phosphorus-32.

The following items are standard requirements for all authorizations to **use** more than 5 mCi of phosphorus-32 at one time. These special rules are not applied to purchases of greater than 5mCi, but only when greater than 5 mCi are used at one time.

 A written procedure for the use must be reviewed and approved by the UIC. Significant changes in the procedure are also to be submitted to EHS for review, prior to approval by the UIC.

 Individuals using more than 5 mCi of P-32 must be listed on the authorization and must have completed specific training. Such training must include:

 Observation of others performing this work or experience performing this work prior to coming to Penn State.

 Performing a demonstration of the procedure (without radioactive material) for a member of the EHS staff. Changes in the procedure may be required based on the results of this demonstration. The purpose of this demonstration is to verify that the experimenter has been trained in the use of shielding and the care and handling of this large amount of radioactive material, and is aware of the materials needed to handle this material.

 An appropriate survey meter must be present at all times during the procedure.

1. After each use of radioactive material, the work areas must be thoroughly surveyed including the use of smears or wipes to detect any transferrable surface contamination, and the use of a radiation detection meter to detect any contamination of skin, clothing, and work area. If any unusual contamination levels are found, or if there is any suspicion that there might have been some release of P-32 during the procedure, this must be reported immediately to EHS.
2. Persons who perform this work must be assigned and wear whole body and extremity dosimeters.

Exceptions to these conditions may be approved by the UIC and made part of the supervisor’s authorization.

## Requirements for the Use of Sealed Sources

The following conditions apply to the use of all sealed radioactive sources, and will be added to all authorizations approved by the UIC.

* Sources may not be opened or seals modified in any way. Sources may not be machined, ground, drilled, or tapped.
* Sources must be handled with tongs or other remote devices. Do not remove sources from gauges except under the direction of EHS or in accordance with a UIC approved procedure.
* Do not subject sources to potentially damaging conditions such as exposure to corrosive chemicals, dirt, abrasion, mechanical shock, temperature extremes, or high pressure unless such conditions have been reviewed and approved by the UIC.
* If anything unusual happens to the source, it must be reported immediately to EHS. This would include loss or theft of the source, mechanical shock or accidental exposure to any of the conditions listed above.
* Sources may be used and stored only in locations specified in the UIC authorizations.
* The source, or the device in which the source is used or stored, must have a radioactive materials tag stating the radionuclide, original activity, and date the source was received.

People using sources must wear personal monitoring devices, if the dose equivalent rate from the source or device exceeds 100 mrem/hr at one foot. The type of monitoring equipment will be specified by EHS. Monitoring equipment may be required for lower dose-equivalent rates depending upon type of use and exposure time.

The UIC must approve all locations used. Experimenters must have permission of property owners to use radioactive sources at remote locations. Shipment and transportation of sources must have the prior approval of EHS.

Persons transporting radioactive devices to remote sites and then returning them back to PSU must receive training in accordance with 49CFR172.700-.704, and be trained to package the material in accordance with 49CFR173. This training will be provided by the Radiation Protection staff. Permission for use of sources in other States must be obtained through the recipient state’s department of radiation protection. Any fees for this approval will be paid by the supervisor. A copy of the permission must be provided to EHS prior to transporting the source. EHS will retain records of training, transport, and permissions.

Since the cost of disposal frequently exceeds the cost of acquisition, EHS strongly recommends that supervisors only purchase devices that can be returned to the vendor for disposal. The experimenter may be responsible for the costs of disposal of radioactive material devices if they become damaged to the extent that the sources may not be returned to the vendor.

## Gas Chromatograph Sources

Electron capture detectors for gas chromatographs use radioactive sources that usually contain nickel-63. Under normal operating conditions, these sources present very little hazard. However the storage, cleaning, or exchange of these sources can cause contamination and radiation hazards.

The radioactive sources, which are usually metal foils, may **not** be removed from detector cells, except under the supervision of EHS staff.

Sources must be cleaned only according to manufacturers’ instructions. Do not use abrasives to clean foils. (Abrasives may scratch the source coating on foils, allowing leakage of the radioactive material.) Source foils should be handled with forceps and only by the edges to prevent scratching the foil surface.

Solutions used to clean and rinse detector cells may be contaminated and must be assayed and disposed of as radioactive waste. If foils are exchanged, the old foils must be returned to manufacturers. Contact EHS for assistance.

## Source Material (Uranium and Thorium metal or compounds)

“Source material” is uranium and/or thorium in any physical or chemical form, or ores containing 0.05% or more by weight of uranium and/or thorium. This category does not include plutonium or enriched uranium but it does include depleted uranium. The amount of source material referred to in this section is the amount of elemental uranium or thorium, not the amount of a compound or mixture containing these elements. Typical examples of source material are: uranium or thorium metals, oxides, acetates, and nitrates.

**Caution: Uranium and thorium metal are pyrophoric. Metal chips and metal powder can spontaneously ignite in air producing airborne contamination and creating a fire hazard.**

**Caution: Uranium and thorium nitrates are strong oxidizers, and as such are regulated as Hazardous Materials by the EPA.**

All authorizations, purchases, transfers, and disposals of source material at Penn State must follow the same procedures as applied to other radioactive materials. (Mineral specimens or unimportant quantities of source material such as those listed in 10CFR40.13 are not covered by these rules.)

Though small quantities of source material may be obtained without a Pa DEP license, there may be some hazard in using these materials or devices containing these materials. Use or storage of source material must be authorized by the UIC.

Source materials must not be stored in offices, desks, or other areas in close proximity to personnel for long periods of time. EHS staff will arrange for storage or disposal of source materials that are not being used.

Federal regulations require that the use of uranium or thorium be authorized by the UIC just as any other radioactive material. Users of this material must complete the standard application form and submit it to UIC for review.

The irradiation of source materials in the Penn State Breazeale Reactor will produce fission products and transuranic elements. These materials can be very dangerous and may not be covered by NRC or PA DEP licenses. Therefore, experimenters proposing to irradiate source material must discuss their plans well in advance with the Radiation Protection and the Breazeale Nuclear Reactor staffs. Samples of soil, rock, sediments, etc. may contain enough uranium or thorium to cause problems if irradiated, even though sample materials are not classified as source material.

## Special Nuclear Material

Because they are fissile, plutonium, uranium-233, and uranium-235 are defined as "special nuclear material". Such materials have special handling and control requirements. In particular, except for small plated alpha sources, Special Nuclear Material may only be used within the Radiation Science and Engineering Center and the Academic Projects Building at University Park.

Nearly all proposals to use these radioactive materials will require an amendment to Penn State’s NRC license and considerable prior planning. The license that permits Penn State to use this material has the following conditions beyond those for the use of other radioactive materials.

* For continuing work, a new request is to be approved by the UIC prior to the expiration of an existing authorization.
* Suitable clothing (lab coats, gloves, etc., specific to the job) shall be required for work with unencapsulated SNM. Hands, shoes, and clothing shall be monitored when leaving an area where the material is used. Except by approval of EHS staff, persons shall not exit an area if personal clothing and /or skin are contaminated above background levels.
* Surface contamination surveys in laboratories shall be conducted daily when unencapsulated SNM is used. Routine radiation surveys shall be conducted monthly in areas where radioactive materials are used or stored.

Contact EHS well in advance of planning new uses for this material.

## Use of Radioactive Material at non-University Park locations.

Researchers wishing to use radioactive materials at non-University Park locations must submit requests for authorization to the UIC in accordance with section 5 and 6 of these procedures.

EHS staff will periodically monitor radioactive material laboratories at the Commonwealth Campuses (not including the College of Medicine) and will provide waste disposal, personal monitoring, and other services, as it does at University Park. Because of the distances from University Park to other campuses, contamination surveys may be less frequent than at University Park. Therefore, laboratory supervisors may be required to perform periodic written laboratory surveys and mail the reports to EHS.

The UIC will restrict researchers at the Commonwealth Campuses to those procedures for which they have proper facilities and equipment. Researchers should contact EHS to arrange the loan of equipment or facilities at the University Park Campus if necessary.

# Public and Occupational Radiation Exposure Limits

## ALARA

It is the policy of Penn State University, as established by the UIC, that the release of radioactive material and the exposure of people to ionizing radiation be kept **A**s **L**ow **A**s **R**easonably **A**chievable. In particular, occupational exposures of personnel to radiation may not exceed the limits in the federal and state regulations. In addition, occupational exposure of individual that exceed 10% of permissible limits will be investigated by EHS to determine whether the exposures or releases were ALARA and whether action is required to limit future exposures or releases.

## Occupational Exposure Limits

Occupational exposure means the exposure to ionizing radiation that occurs while working with radioactive material or radiation producing equipment. It does not apply to Penn State individuals who have not been trained to work with radioactive material but only work in the vicinity. Occupational exposure includes internal exposure to radioactive material as well as external exposure to radiation.

NRC regulations (10 CFR 20.1201) limit the annual occupational dose to individual adults to the most limiting of:

 5,000 mrem total effective dose equivalent (whole body exposure)

15,000 mrem eye dose equivalent

50,000 mrem shallow dose equivalent to the skin or to any extremity (hands)

50,000 mrem to any individual organ or tissue other than the eye

For minors -- personnel under 18 years of age-- the limits are 10% of these listed.

Note that everyone who has been trained by EHS and is working under a supervisor's authorization to use radioactive material or radiation producing equipment is considered "occupationally exposed" to radiation. Everyone not trained to work with radioactive material or radiation producing equipment, is considered a member of the public.

Also note that occupational exposures at Penn State are mostly less than 100 mrem a year for whole body exposures and less than 200 mrem for extremity exposures.

If you are exposed to radioactive materials or radiation producing equipment at locations other than at Penn State, contact EHS for dosimetry instructions.

## Public Exposure Limits

NRC regulations require that the total effective dose equivalent to individuals not working with radioactive material may not exceed 100 mrem per year or 2 mrem in any one hour. These public exposure limits apply to anyone not explicitly trained to work with radioactive material or radiation producing equipment.

This public exposure limit applies inside and outside of University laboratories and buildings.

## Exposure Limits during Pregnancy

A "declared pregnant woman" is a radiation worker who is pregnant and has officially notified the RSO, in writing, if she chooses, that she is pregnant. The exposure to the fetus of a declared pregnant woman may not exceed 500 mrem during the duration of the pregnancy.

In order for a woman to officially declare herself pregnant, she must write a letter to Radiation Protection stating

“I, *your name* am a radiation worker at Penn State working in professor *name*  laboratory in *room, building* . I am pregnant and my child was conceived on about *date*  and is expected on about *date* . I normally work with the following types and amounts of radioactive material: .”

 *Your signature date of letter e-mail address phone number*

After the letter is received, a member of the EHS staff will visit and determine if extra precautions or monitoring is required to ensure that the exposure to the fetus does not exceed 500 mrem.

# Personal Monitoring and Bioassay Requirements

## Dosimeters

The University supplies personal monitoring devices to individuals who receive or might receive an effective dose equivalent in excess of 10% of the applicable limits. Personal monitoring devices is also required for anyone who enters a high radiation area (in excess of 100 mrem in one hour at 30 cm from the surface of the sources). Even though it is unlikely that any University personnel would receive more than 10% of the limits, personal monitoring is required in many instances in order to record and evaluate the dose received. EHS staff will determine the type of personal monitoring devices required in each case and will supply it to the user. Individuals who have been provided with such equipment, for any reason, are **required** to use it as specified.

Personal monitoring consists of small radiation detection devices or dosimeters that are worn on the chest and sometimes the hand. These devices are rented from an off-campus vendor. Fresh dosimeters are supplied quarterly. Dosimeters must be stored in an area away from radiation sources when not in use. Dosimeter records are maintained by EHS and are available to each individual upon written request. Researchers will be notified by EHS if their dosimeter has a reading in excess of 10% of the average quarterly limit, *i.e*. greater than 125 mrem whole body in one quarter for adults. Dosimeters must be returned to EHS as soon as replacements are received, even though an individual may not have worked with radiation during the issue period. This is to ensure that the University has a continuous record for the time periods during which an individual might have been exposed to radiation. Supervisors must notify EHS to terminate dosimeter service when an individual leaves the University or discontinues activities that require personal monitoring. There will be a fee charged for lost or late dosimeters that must be paid by the individual or the individual’s supervisor. There may also be a fee charged to supervisors for not notifying EHS that persons who had been issued dosimeters have left campus.

Personal monitoring devices are insensitive to low energy radiation, such as that emitted by 3H, 14C, 35S, 55Fe, or 45Ca, and dosimeters will not be issued to people working only with 3H, and 14C isotopes. For 35S, 55Fe, or 45Ca users, dosimeters will be issued for one year period to establish an exposure history for record purpose. Dosimeters will not be issued to people working only with 125I radioimmunoassay kits, since the exposure from this amount of radioactive material is insignificant.

Under no circumstances are personal monitoring devices to be tampered with or deliberately exposed to radiation in order to give a false or inaccurate measurement of the exposure. Under no circumstances may personal monitoring devices be shared. All issued dosimeters must be worn at all times when working with radioactive material or radiation producing equipment at Penn State. Dosimeters may NOT be worn at non-University locations. These are very serious violations of University rules and could result in the UIC prohibiting the individual(s) involved from further work with radioactive material.

## Bioassays

In some cases it may be necessary to perform bioassays to determine whether internal exposure to radioactive materials has occurred. Bioassay requirements are established by EHS to insure compliance with regulations and license conditions. Persons using radioiodine in amounts greater than 1 millicurie at a time must have bioassays performed within seven days of such use. The assay will normally be performed by measuring the radiation emitted by radioiodine in the thyroid gland. EHS staff may extend this time limit under certain circumstances.

Persons using more than 100 mCi of tritium in unsealed form at one time must collect a urine sample within 72 hours of the exposure and deliver it to EHS for evaluation. EHS staff may extend the time limit under certain circumstances.

EHS may require bioassays for users of other radionuclides, or smaller amounts, based on the type of experiment being performed, the amount of radioactive material being used, and the results of surveys for contamination and airborne radioactivity.

# Contamination Limits and Survey Procedures

## Contamination Limits

Users of radioactive material are required to perform surveys of their work area after each use of the dispersible radioactive material using methods and detection equipment appropriate to the types and amounts of radionuclides present. Prior to using any portable survey meter, personnel must validate its proper response to radiation with a radioactive check-source. **Whenever removable contamination is detected, the object must be decontaminated, disposed, or contained to prevent the spread of contamination.** Decontamination of areas that are not readily accessible is not required. In these areas (e.g., inside glove boxes, interior of centrifuges, insides of pumps), the amount of contamination allowed is limited by the radiation level on the outside of the containers. Whenever laboratory personnel detect radiation on the outside of inaccessible areas they must 1) decontaminate or 2) contact EHS for a survey with a calibrated meter. Although ALARA considerations apply, radiation levels may not exceed 5 mrem per hour at 30 centimeters from the surface of equipment without obtaining special permission from the UIC. The UIC will ensure that ALARA aspects are considered prior to granting such permission.

Note: Radiation levels inside the Radiation Science and Engineering Center may exceed the above limits when properly posted.

Equipment that has been used with radioactive materials (*e.g.* refrigerators and centrifuges) must be surveyed by EHS staff prior to its release for unrestricted use. This also applies to equipment that is being repaired, either on or off campus, by people who are not familiar with radioactive material. Such equipment will be surveyed and, if it meets the NRC's contamination requirements, will then be tagged for unconditional release by EHS staff.

## Survey Instrumentation

### Portable Hand-Held Instruments

Portable hand-hold instruments that are used on campus primarily consist of Geiger-Mueller (GM) detectors with either a pancake or end-window probe, sodium iodide (NaI) detectors, and ion chamber detectors for radiation level measurements. For the majority of radioactive material used on campus, a hand-held survey meter will be the instrument of choice. The GM probe is a gas-filled detector that is capable of detecting alpha, beta, and gamma radiation. It is commonly used to survey for medium and high energy beta emitting isotopes such as C-14, S-35, and P-32. The NaI detector is designed to be more efficient at detecting low energy gamma and X-ray sources such as I-125. It cannot detect medium energy beta emitting sources like C-14 or S-35.

Portable survey meters, including the GM detector and NaI(Tl) detector, cannot be used to detect low energy beta emitters, such as H-3. Although Fe-55 can be detected with a pancake GM probe, the detection efficiency is so low that Fe-55 contamination might be easily missed by GM probe detection. Thus both H-3 and Fe-55 will require that smears be taken in the work area and counted in a liquid scintillation counter, which has a much higher detection efficiency than GM and NaI(Tl) detectors for low energy beta and gamma radiation.

### Liquid Scintillation Counter

A liquid scintillation counter (LSC) is a stationary counter in which radioactive material is placed directly into a scintillation fluid for radioactivity measurement. The LSC is able to detect most radionuclides with good efficiency. The ability for an instrument to detect beta and gamma radiation depends mostly on their energy. For example, hydrogen-3 (tritium) emits a beta particle with a maximum energy of 18.6 keV (0.0186 MeV). It does not have enough energy to travel more than an inch in air, or even enough energy to pass through the thin window of a Geiger-Mueller (GM) pancake detector. It will lose all of its energy before it can interact with the detector and be counted. Therefore, when surveying for H-3 contamination, smears of the working area must always be taken and counted in a liquid scintillation counter (LSC).

Each radiological instrument and detector combination has its specific uses and limitations. It is important to understand these differences in order to choose the correct instrument for the right application. The table below summarizes the best techniques to use when surveying for specific radionuclides.

|  |  |
| --- | --- |
| **Radioisotope** | **Recommended Contamination Survey Methods** |
| H-3 | Smears / Liquid Scintillation Counting |
| C-14 | Pancake GM & Smears / Liquid Scintillation Counting |
| P-32 | Pancake GM |
| P-33 | Pancake GM & Smears / Liquid Scintillation Counting |
| S-35 | Pancake GM & Smears / Liquid Scintillation Counting |
| Ca-45 | Pancake GM & Smears / Liquid Scintillation Counting |
| Fe-55 | Pancake GM & Smears / Liquid Scintillation Counting |
| Co-60 | Pancake GM |
| Zn-65 | Pancake GM |
| I-125 | Sodium Iodide (NaI) |

## Contamination Survey Procedures

Surveys are performed to determine the radiation and contamination levels in a laboratory or on a piece of equipment. Radiation surveys are made to measure the radiation levels in an area due to the presence of ionizing radiation, even though contamination is not necessarily present. Contamination surveys are performed to detect the presence of loose radioactive material, fixed to a surface or transferable, in areas where it is not desired.

Users of radioactive material are required to perform surveys of their work area before and after each use of the dispersible radioactive material using methods and detection equipment appropriate to the types and amounts of radionuclides present. Whenever working with dispersible radioactive material, be sure to keep the survey meter on and near the work station. Also be sure to check hands and gloves frequently. After the experiment is completed, a thorough contamination survey must be performed to ensure no contamination occurred, or that any contamination is found and controlled to prevent the spread of the contamination.

Contamination surveys are performed by any one, or more, of the following three basic techniques:

### Portable meter scanning

Portable meter scanning is performed by moving a hand-held radiation detector slowly over an area to look for small amounts of loose or fixed radioactive material. It is the quickest and easiest (through not the most sensitive) method to assess surface contamination on objects such as lab coats, hands, floors, benches, etc. This method can also provide a direct measurement of external radiation dose rates, which is useful for the evaluation of potential exposure dose, and shielding needs and effectiveness.

When using a portable survey meter to scan for external contamination, follow these steps:

* Verify that the instrument is in good working order.
* Turn the monitor on, check the battery response, and replace batteries if needed.
* Check the calibration sticker for expected check source response.
* Verify the instrument responds correctly to the expected check source level, ± 20%.
* Establish the background for the instrument.
* If the meter is so equipped, the audio output should be turned on so that the audio can be heard during the survey.
* Hold the probe approximately 1/2 inch from the surface being surveyed for beta and gamma contamination, and approximately 1/4 inch for alpha contamination.
* Do not allow the probe to touch the area being surveyed to avoid contaminating the probe.
* Move the probe slowly over the surface, approximately 1 – 2 inches per second.
* If the count rate increases during the survey, pause for 5 to 10 seconds over the area to provide adequate time for instrument response.
* If the instrument gives a consistent and positive increase above the expected background level, contamination is probably present and needs to be addressed.

### Wiping

Wiping an area means using a moistened paper towel, or equivalent, to dust an area to collect and concentrate radioactive material onto the towel. The towel is then scanned with a hand-held radiation detector to determine if the wipe collected any radioactive material. Any area from which the towel collected radioactive material must be decontaminated. This method is useful for routine monitoring of work areas.

When using wiping method to scan for external contamination, follow these steps:

* Use paper towels, disposable wipes, disc smears or equivalent as the collection medium. Floor may also be surveyed by the use of dust mops that utilize treated cloths.
* Wipe the collection medium over the surface using moderate pressure. A minimum area of 500 cm2 should be wiped; however too large wiping area might cause degradation of the collection medium.
* Scan the surface of the collection medium using a portable radiation survey detector
* Take appropriate measure to control the potential spread of the contamination if contamination is detected.

### Smearing

Smearing means using small bits of paper or other material to dust about 100 cm2 of surface. The paper bits are then placed into a shielded radiation detector such as an automatic gamma counter or a liquid scintillation counter to determine the amount of radioactive material collected. The smear survey is the most sensitive technique for detecting transferable contamination. Smears for tritium, sulfur-35, carbon-14, iron-55, and calcium-45, must be counted in a liquid scintillation counter. Smears for iodine-125 may be counted in an automatic gamma counter or a liquid scintillation counter. For greatest collection efficiency, smears should be slightly dampened prior to use.

When using wiping method to scan for external contamination, follow these steps:

* Use an inch size square or round filter or smear paper for smearing. The paper may be moistened with distilled water, ethanol or other solvents that will help dusting. A dry paper is acceptable, but less sensitive.
* Wipe areas designated for radioactive material use in the lab, and some additional non-use areas, including areas of frequent contact, such as doorknobs, light switches, telephones, and so on.
* Cover an area of approximately 100 cm2 for each wipe.
* Number each wipe and document the numbers on the survey map.
* Use either LSC or gamma counter, depending on the radiation type emitted from the potential contaminant, to count the smear samples.
* Determine if contamination is detected by comparing the counting readings from samples with that from background.
* Decontaminate the areas with contamination, then repeat the searing procedure until no contamination is detected.

Fixed contamination is present when radiation is detected with a survey instrument but wipe or smear tests show no transferable contamination. The immediate hazard of fixed contamination is the radiation level adjacent to the contaminated surface, but there is also the possibility that the contamination will become loose at a later time. Thus, even fixed contamination should be reduced to the lowest possible level. In some cases it may be necessary to fix the contamination to the surface with paint, tape, or other coatings to prevent the spread of contamination while the radioactive material decays. Disposal may be required for objects with fixed contamination from radionuclides with a long half-life.

Surveys to determine the concentration of airborne radioactive material usually require air sampling equipment and are performed only by EHS staff. The assistance of the users of the radioactive material may be necessary during such surveys. Users may be required to wear sampling equipment or to turn the samplers on and off at set times. Concentration of radioactive materials in the air is determined and compared with permissible concentration levels to determine which control procedures and bioassay requirements are needed. This primarily applies to the heavy radionuclides such as uranium and thorium.

## Radiation survey

Radiation surveys are performed to measure the dose rates produced by radioactive sources, or to confirm the absence of these dose rates. Radiation surveys must be made with instruments calibrated for the intensity, energy, and type of radiation being measured. A Geiger-Mueller (GM) survey meter is usually not adequate, but is acceptable for making approximate measurements of most low-level gamma and beta radiation. If low-energy radiations are present, such as those from 14C, 35S, and 45Ca, a thin-window detector must be used. A low-energy gamma probe, NaI(Tl), should be used whenever 125I is present. Radiation surveys should be performed when using more than 0.1 millicurie of unshielded, high-energy, beta and gamma ray emitters. However, even a few microcuries of such material in the form of thin films on planchets or petri dishes can produce significant radiation levels in work areas. If significant radiation levels are found by laboratory personnel, EHS must be contacted to perform radiation surveys with calibrated instruments. Radiation levels in unrestricted areas outside of laboratories, must be kept below 2 mrem in one hour AND below 100 mrem per year. When storing large amounts of radioactive material against a wall in your laboratory, remember to survey on the other side of the wall.

A calibrated ion chamber will be the appropriate instrument for radiation survey. When a radiation survey is performing, follow these steps:

* Survey the entire area with radiation concern, noting fluctuations in the meter or audible response. Investigate any increase to determine the magnitude and location of the highest reading.
* Obtain 30 cm dose rate reading by measuring the radiation level at 30 cm from the radiation source or from any surface from which the radiation penetrates.
* Unrestricted area dose rates should be measured at an approximate distance of 1 meter from the radiation source, or from any surface from which the radiation penetrates.
* Contact dose rates shall be taken with the detector of the instrument at or near contact with the surface from which the radiation penetrates.

## Survey documentation

Contamination surveys before and after each radioactive work in a lab shall be documented on the EHS contamination survey log sheets. EHS will conduct quarterly or monthly surveys of each authorized radiation lab. The survey results and forms will be stored over three years in EHS for compliance.

## Survey meter calibration

All survey meters, including contamination and radiation monitoring meters will be calibrated by radiation protection office. Contamination survey meters will be calibrated every three years, and radiation monitoring meters will be calibrated annually. Some radiation survey meters for industry X-ray machine will be calibrated every six months for state regulatory compliance.

## Radiation lab decommission

When a PI decides to stop using radioactive materials in one or more radiation labs, the PI or radiation workers in the lab should ensure no radioactive materials are left in the lab by checking radioactive material inventory sheets, disposing not used materials, and submitting radioactive material pick-up request. After all radioactive materials are removed from the lab, a thorough contamination survey should be conducted to ensure all contaminated instruments or equipment that have been used for radioactive material experiments and storage are decontaminated. All “CAUTION, RADIOACTIVE MATERIAL” signs should be removed from instruments and equipment after no contamination is confirmed. EHS staff will come to conduct decommission survey for the lab to ensure no contamination in the lab is found before it is released for non-restricted use.

# Emergency Response Procedures

If you have a chemical, biological, or radiological accident — Call: **(814) 865‑6391** (EHS)

For life threatening emergencies (Police, Fire, Accident, or Ambulance) — dial **911**

## Radiological Incidents:

 If an incident involves a spill of a small quantity of radioactive material in a small well-defined area and it is a kind with which you are familiar, **and** you have been trained in proper clean‑up procedures, follow those procedures. Notification of EHS is not required but is advisable. EHS staff will be happy to survey the area after the cleanup to verify that all areas are clean.

 If an incident involves a spill of a small quantity of radioactive material, and you are **NOT** trained in how to clean up the spill, don't have proper clean‑up materials or have received no training in proper procedures, call your supervisor for assistance and EHS for assistance.

 If a spill is of a large or unknown quantity, is widespread or the extent of the contamination is unknown, immediately call EHS and your supervisor. Follow general cleanup procedures on the last page of this section.

 If an incident involves a wound **and** personal contamination (external or internal), contact EHS immediately.

**If the wound causes serious medical concern, priority must be given to life saving measures. Call 911 immediately for assistance.**

Make sure that medical personnel are aware that their patient is contaminated, and that they themselves must, after delivering their patient to the hospital, be checked for possible contamination.

 If an incident involves gross personal contamination, notify EHS and follow this general procedure:

 Remove contaminated clothing.

 With small wounds, encourage slight bleeding to flush wounds, then cover with tape to prevent internal contamination.

 Flush contaminated skin with an abundance of warm (not hot) water. After this initial rinse, clean contaminated skin with mild soap.

 When body contamination is no longer transferable, decontaminate any wounds.

## Injuries:

1. If the victim does not need immediate attention requiring an ambulance, the victim should go to University Health Services Center (UHS). If the victim is contaminated, call UHS for advice. Staff there may wish to provide on-site care while decontamination is performed, or they may direct the victim to Mt. Nittany Medical Center.
2. If the person needs immediate attention, call 911 for an ambulance. It is then up to medical personnel to decide where the victim should be taken. If the victim is contaminated, make certain that medical personnel are aware that he or she is contaminated. EHS staff will ensure that the ambulance is properly decontaminated.

## Fires

In campus laboratories, normal life and property saving concerns must **always** take precedence over limiting the spread of radioactive material. All normal fire-fighting precautions must be observed. In addition, all those involved should be checked for contamination by EHS before leaving the scene.

## Laboratory Spill Procedures

In the event of a minor spill, notify the laboratory’s authorized Supervisor, clean up the spill, and then contact EHS. EHS **must** be immediately notified whenever any of the following conditions apply:

1. The spill involves greater than 10 μCi of any radionuclide,
2. The spill involves any quantity of iodine-125 or iodine-131 in the form of NaI,
3. The spill involves any quantity of uranium, thorium, or other alpha emitting radionuclide,
4. The spill has the potential to contaminate areas outside your laboratory such as offices, hallways, or elevators, or
5. The laboratory is shared by two or more research groups,
6. Contamination is found on anyone’s shoes, skin, or clothing (excluding laboratory coats and gloves),
7. You are not confident that you have the ability to survey and decontaminate the area on your own.

The General procedures for handling a radioactive spill are:

1. **Stop** the spill.
2. **Warn** others in the laboratory. This will help minimize the spread of the contamination.
3. **Isolate the area.** Prevent anyone from walking through the spill area. If there is any sign of hallway contamination, fix ropes across the hall at least 10 feet from the laboratory door on both sides of the lab. Enforce the no-pass rule and station someone in the hall to stop traffic.
4. **Minimize** **exposure to radioactive materials.** Laboratory coats and gloves are required. Shoe covers may be required.
5. **Call** **for Help.** The laboratory supervisor should be present to organize the cleanup. The supervisor should call in all staff and students. Request help from EHS by calling 814-865-6391.
6. **Establish a 'Clean' area.** This area should be inside the room if possible, in the hall if not. Issue plastic bags as shoe covers. Bench paper is handy for covering floors to make a clean area.
7. **Survey** **all lab personnel**. Record the results (*e.g.* Joe, left shoe: 10,000 cpm-GM at 1 cm, Betty, palm of right hand: 950 cpm-GM at 1 cm). Pay special attention to skin contamination. Measure the contamination levels prior to a quick clean, clean then recheck to see if the contamination levels are decreasing. Clean the skin with lots of room temperature water.
8. **Survey** people in neighboring labs if widespread problems seem possible. Ask your neighbors to survey their own labs.
9. **Determine** if the chemical composition of the spill could cause airborne particulate contamination if the spill were allowed to dry. If possible, mop the spill immediately.
10. **Survey public areas.** Have someone without contaminated shoes survey the hall, elevator, stairs, etc. If contamination is found outside the laboratory, expand the roped-off potentially contaminated area. Laboratory personnel should clean the halls while others continue to survey the other public areas. Extend the roped off area as necessary. Do not decontaminate inside laboratories until all public areas are clean.
11. **Survey** **the room.** Keep people out of the laboratory until a survey of the room is completed. Smears are not necessary unless it is a tritium spill, but documentation is necessary. This is to find the extent of the contamination so that it is not spread further during the decontamination phase.
12. **Clean** **and** **decontaminate** **all areas.** Work from cleaner areas towards areas with more contamination. Clean floors and other public areas before benches and private areas. Survey shoes regularly. Change gloves whenever they are contaminated. Borrow extra meters, gloves, bench paper, paper towels, and other cleaning tools from neighboring laboratories. Do not remove contaminated shoes. Place plastic bags over shoes and walk carefully or stand on paper towels and shuffle carefully.
13. **Resurvey** the room to verify that all areas have been properly decontaminated. Document your results.

EHS staff will not decontaminate your laboratory. They will help train, supervise, and monitor your activities. Remember, there is **no** penalty imposed by the UIC on laboratory groups who detect a spill of radioactive material and promptly notify EHS.

# Radioactive Waste Disposal

## General Rules

This section is designed to ensure that all radioactive wastes generated under the University’s radioactive materials licenses are properly accounted for and safely handled. It is the authorized PI’s responsibility to assure that each individual user under his/her supervision is informed in the proper practices and procedures for the handling of radioactive wastes. To ensure all radioactive wastes are properly and safely handled. General rules below shall be followed:

1. All radioactive wastes shall be collected by EHS for disposal. The University provides for the disposal of radioactive waste in a number of ways, including storage for decay, release to the sewer system, and shipment to commercial burial sites after radioactive wastes are collected from radioactive research labs.
2. It is imperative that experimenters purchase and use only as much radioactive material as is required for their experiments and minimize the amount of waste they produce. Care must be exercised to separate radioactive waste from non-radioactive waste as it is generated. Below are some examples of good waste minimization practices:
* Use short lived radioisotopes (half-lives less than 120 days) whenever possible. Waste with half-lives less than 120 days is processed at a greatly reduced cost.
* Use separate waste containers for each different isotope regardless of its half-life.
* When working with readily detectable radionuclides, monitor potentially contaminated items and dispose of non-contaminated materials as appropriate (chemical, bio waste, etc.).
* Use only biodegradable non-flammable liquid scintillation cocktails. Use of solvent based cocktails require prior approval by EHS.
1. No radioactive material may be released to hood exhausts or sink drains expressly for disposal purposes without prior written approval from EHS. The University is committed to minimizing the release of radioactive material to the environment. An authorization to use radioactive material issued by the UIC may list the maximum quantities of material that may be released to the sanitary sewer. These limits cover only occasional and inadvertent releases of very low-activity material as a result of glassware washing, aspirator operation, etc.
2. All radioactive materials, including radioactive wastes, must be stored in secure areas.

## Radioactive Waste Categories / Classifications

Based on the half-life of the radioisotopes in the wastes, radioactive wastes can be classified as two primary categories: one is short lived waste which contains isotope with a radiological half-life of less than or equal to 120 days; the other is long lived waste which contains isotope with a half-life of greater than 120 days. These two categories can be further divided into classifications below based on the physical/chemical properties:

* **Solid Dry Active Waste (DAW)**: Radioactively contaminated lab trash such as glassware, paper, plastic, gloves, culture dishes, syringes, etc.
* **Liquid Waste**: Aqueous or organic waste solutions containing radioactive materials.
* **Liquid Scintillation Vials**: Liquid scintillation cocktail fluid that has been used for the analysis of radioactive samples.
* **Carcasses / Animal Material**: Animal carcasses, bedding material, and lab waste contaminated with animal material that also contain radioactive material.
* **Mixed Waste**: Radioactive waste, which also contains other hazardous materials / chemicals.
* **Sealed Sources**: Encapsulated radioactive sources used for instrument response or research.

## Collection Processes for Different Radioactive Waste Classifications

### Solid Waste (DAW)

Solid dry radioactive waste is to be placed in the pre labeled radioactive waste containers provided by EHS. The use of other collection containers must be approved by EHS prior to being used. A separate container should be used for each isotope you are working with. If wastes with different isotopes must be mixed, a pre-approval shall be obtained from EHS and the waste container needs to be labeled with each isotope. The waste with multiple isotopes will be processed based on the longest lived isotope in the container, which might cause extra cost for waste disposal. Below are some basic rules for collecting and packaging solid radioactive wastes at the University.

1. Solid waste containers must be kept covered at all times. Each container is tagged with a yellow card on which the description and activity of the waste must be recorded each time radioactive material is placed in the container.
2. No liquids or containers with any liquid in them may be placed in solid waste containers.
3. Do not place non-radioactive waste into radioactive waste containers.
4. Sharps (syringes, hypodermic needles, razor blades, etc.) must be placed in a radioactivity-labeled sharps container. The radioactivity-labeled sharps container must be closed prior to being placed inside the solid dry radioactive waste container provided by EHS. This is necessary to ensure the safety of anyone processing the waste.
5. No lead may be placed into any radioactive waste container. Lead contaminated with radioactive material must be placed into a small separate container for transfer to EHS.
6. Other metal must also be avoided in the solid waste stream. Metal contaminated with radioactive material should be cleaned after each use, or be disposed of in a separate container, which can be requested from EHS.
7. Materials that are explosive, pyrophoric, EPA hazardous or biologically hazardous may not be accepted at commercial radioactive waste burial sites. EHS must be consulted well in advance of any experiment that will produce any such hazardous wastes contaminated with radioactive material, which is defined as **Mixed Waste**, and will be discussed in 11.5.
8. Radioactive waste that is also biologically hazardous *must* be inactivated (*e.g.* autoclaved) before it is placed in waste containers. See PSU Policy SY29 “Infectious Waste Disposal” for further details.
9. Glassware should always be decontaminated after used for radioactive material, and must be kept an absolute minimum in solid waste. If any glassware cannot be decontaminated and has to be disposed of as solid waste, the thickness of the glass must be carefully checked to ensure it is not greater than the thickness of a liquid scintillation vial. Otherwise, the glassware must be disposed of separately. Contact EHS for a separate disposal container for thick glassware.
10. To calculate the activity of radioactive material in your solid radioactive waste, remember that:

(Activity at start) – (Activity in liquid) – (Activity in samples) = Activity in solid waste

1. Prior to requesting a waste pick up, the outside surface of the container must be checked for contamination. If any contamination is found it must be cleaned to background levels.

When a waste container is full, request a pickup (see EHS web page). Full containers will be collected and replaced with an empty one if requested. A waste container will **not** be collected if the contents on the yellow card are not properly listed. Read the instructions on the waste container tag before signing; legible signatures are required.

### Liquid Waste

Liquid radioactive waste is to be placed in the pre labeled radioactive waste containers provided by EHS. The use of other collection containers must be approved by EHS prior to being used. A separate container should be used for each isotope you are working with. If wastes with different isotopes must be mixed, a pre-approval shall be obtained from EHS and the waste container needs to be labeled with each isotope. The waste with multiple isotopes will be processed based on the longest lived isotope in the container. Below are some basic rules for collecting and storing liquid radioactive wastes at the University.

1. The lids of liquid waste containers must securely tightened at all times. Containers are supplied with tags, on which the chemical description and activity of the waste must be recorded each time when liquid waste is added.
2. The liquid waste containers must be kept in secondary containment. Contact EHS if you need a container for this purpose.
3. No solids (pipette tips, gloves, paper towels, etc.) may be placed into liquid waste containers.
4. Do not put non-radioactive waste in radioactive waste containers.
5. Store wastes containing radioiodine in the special containers provided by EHS; they are supplied with chemicals to inhibit the formation of iodine vapors.
6. Liquid wastes containing hazardous chemicals such as benzene, chloroform, pesticides, or heavy metals must be segregated from non-hazardous liquid wastes. Radioactive waste containing hazardous materials will be disposed through vendors licensed to handle mixed radioactive and hazardous waste. This waste must also be labeled and handled as hazardous waste per current EHS chemical waste requirements.
7. EHS policies require all waste be made biologically inactive before disposal. Before placing biologically active waste into a radioactive waste container, first add one liter of household-strength bleach into the container. This 10% solution will inhibit the growth of cells.
8. Most liquid waste is held for decay then discharged into the sanitary sewers. Please be careful to list all chemicals in the waste so EHS can verify that such discharges will cause no chemical pollution.
9. To determine the activity of radioactive materials in each jug, count a sub-sample of waste in a liquid scintillation counter and calculate the total activity of all of the waste. See the EHS web site for more information on a simpler method that may be applied to 32P and 125I.
10. The jug should not be filled past the 8 liter mark on the side of the jug.
11. Prior to requesting a waste pick up, the pH must be adjusted to between 5 and 9, and the outside surface of the container must be wipe checked for contamination. If any contamination is found, it must be cleaned to background levels.

When waste containers are full and after completing the tag, request collection on the EHS web page. Full containers will be collected and replaced with empty ones if requested. Waste containers will **not** be collected if either the chemical OR the radioactive contents are not properly listed. Read the instructions on tags before signing; legible signatures are required. In order to properly process the waste, the waste card must be completely filled out including:

* List of all chemicals (by name) in the waste.
* CAS number for each chemical
* Amount of each chemical
* Isotope and total activity in container
* Total volume in container
* The pH (which must be between 5 and 9)
* Sign and date the bottom of the waste card

### Liquid Scintillation Vial Waste

Whenever possible, use only biodegradable nonflammable (flashpoint > 140 degrees Fahrenheit) liquid scintillation fluid. High flashpoint cocktails include, but are not limited to: Cytoscint, Ecolume, Fisher's Scintiverse BD, Scintisafe Econo 2, Scintisafe Econo F, National Diagnostics Ecoscint A, C, H, and O, and OptiScint Hisafe and Hisafe 3. More acceptable fluids can be found in the radioactive waste management section of the EHS website.

Liquid scintillation counting (LSC) vials is to be placed in the pre labeled radioactive waste containers provided by EHS. The use of other collection containers must be approved by EHS prior to being used. A separate container should be used for each isotope you are working with. If wastes with different isotopes must be mixed, a pre-approval shall be obtained from EHS and the waste container needs to be labeled with each isotope. The waste with multiple isotopes will be processed based on the longest lived isotope in the container. Below are basic rules for collecting and storing liquid scintillation vial waste at the University.

1. **Do not empty the vials. And ensure that lids are tightly secured.**
2. The vials should be stored in their original cardboard shipping tray, which can then be placed inside the EHS supplied container
3. LSC vial waste must be separated by nuclide. Tritium and carbon-14 may be co-mingled.
4. LSC vial waste containers must not contain solid laboratory waste or any other non-vial waste.

EHS staff will collect vials for disposal when requested. Record the radionuclide, the total activity in all of the vials, and the brand of LSC fluid used.

## Animal Waste

Animal carcasses, bedding, excreta, blood, milk and any other biological materials contaminated with radioactive material require special handling for disposal. In general, biological waste containing short-lived radionuclides such as 32P, 35S, 45Ca, 125I and will be stored for decay, then incinerated. Long-lived waste such as 14C or 3H will be transported off-site for disposal in approved commercial burial sites via an incinerator. It is essential that arrangements for ultimate disposal be made with EHS before starting experiments that will produce biological waste. Production of all animal waste, including bedding, should be kept to a minimum. Below are some basic requirements for collecting and packaging radioactive animal waste at the University.

1. All carcasses / animal material must be double bagged and kept frozen prior to being disposed of. When requesting a waste pickup for carcasses / animal material, include a description of the type of animal (mouse, rat), total number, isotope, and total activity for the waste.
2. Animal bedding should be autoclaved and kept separate from other waste for pick up. Even after being autoclaved, the animal bedding is handled as biological waste and needs to be incinerated as such.
3. Sharps used with animal experiments must be placed in sharp containers and kept separate from other waste.
4. General lab waste used with animal experiments should not contain any metal. The amount of thin glass should be kept to an absolute minimum. Any glass thicker than a liquid scintillation vial must be disposed of in a separate container.

## Mixed Wastes

Mixed waste is defined as radioactive waste that also contains another hazardous constituent. Due to the extra disposal cost, extra cautions should be taken to minimize the production of this type of waste.

* Always keep mixed waste separated from regular radioactive waste. Use separate containers for collecting mixed waste.
* Usually the regular EHS issued radioactive waste containers will be too large for the amount of mixed waste being produced. Mixed waste can be collected in smaller containers that are compatible with the hazardous constituent in the waste.
* Contact EHS and request radioactive waste tags for each container containing mixed waste. When completing the waste tags, pay extra attention to ensure the correct amount of the hazardous constituent is recorded.
* All liquid mixed waste must be kept closed when not in use and stored inside secondary containment compatible with the waste.
* Mixed waste must be labeled and handled as hazardous waste per current EHS chemical waste requirements.

## Sealed Sources:

Sealed sources, such as those contained in liquid scintillation counters and gas chromatographs, should never be removed from the equipment or altered in any way. Also, sealed sources must never be mixed with any other waste stream.

If you have a sealed source or a piece of equipment that contains a sealed source that you no longer need, contact EHS for disposal.

## Stock Vials

Do not place vials containing greater than one millicurie of long lived radioactive material into the normal solid waste containers. Contact EHS for a special waste collection. However, lower activity stock vials should be placed into solid waste containers even when they contain a few milliliters of liquid. Stock vials of short-lived radionuclides (half-life < 100 days), with less than a few milliliters of liquid, should be placed directly into the normal solid radioactive waste container.

## Sharps

Hypodermic needles and other sharps must be placed in sharps containers before disposal into the normal radioactive waste container. See PSU Policy SY29 “Infectious Waste Disposal” for further details.

Note: Cardboard containers (such as milk or orange juice containers) are not suitable for use as primary containers for such items as hypodermic syringes and needles, pasteur pipettes, razor or scalpel blades. They may be used for collection of “non-sharp” items such as serological transfer pipettes and plastic pipette tips

## Biohazardous Radioactive Waste

EHS policies require that all waste be made biologically inactive before it is collected.

For liquid waste which will be placed in normal EHS radioactive liquid waste containers, place one liter of household-strength bleach into each waste container in which your laboratory will place biologically active cells. This will provide a 10% final‑volume of bleach in the container.

Solid biohazardous radioactive waste must be autoclaved prior to placing it into the radioactive waste container. This is required to protect EHS staff to exposure to biohazardous materials.

# Purchasing or Receiving Radioactive Material

Persons acquiring radioactive material must receive prior authorization to possess the material from the UIC. This requirement applies to transfer from sources within or outside of the University. EHS must be notified of all transfers between authorized supervisors to ensure that possession limits are not exceeded.

Each request for acquiring radioactive material must be approved by EHS. For purchases of radioactive material, procedures below shall be followed to ensure the order has been reviewed and approved by EHS before it is placed.

Radioactive material ordering procedures

1. Request a quote from vendor or prepare a quote through on-line purchase.
2. Submit the quote to your department accounting office to prepare a purchase order. There are two types of purchase order: one is one-time non-catalogue or E-buy purchase order, which will be sent to vendor for immediate shipping after it is approved; the other is standing order with multiple items that might be shipped at different time.
3. During the preparation of a purchase order, the preparer (someone in the accounting office) should check the RADIOACTIVE MATERIAL check box for radioactive material purchase order, and use Radiation Protection Office’s address below as shipping address.

Radiation Protection Office

Attention to the PI

228 Academic Projects Building

University Park, PA 16802

In the meantime, a requisition number will be created. The established requisition will be submitted for approval by Financial, EHS and Purchase departments in sequence.

1. EHS will check to ensure the shipping address is correct, the listed isotope (s) is authorized for the research lab, and the total activity for each isotope is not over the possession limit. If any of these information needs to be corrected, EHS will reject the requisition, and the preparer will be notified. If this happens, a new purchase order will need to be prepared with correct information, and re-submitted for approval.
2. Once the purchase order is approved by Financial, EHS and Purchase departments, a PO number will be assigned and sent to the vendor and the preparer. The preparer then forwards the PO number to the research group.
3. For non-catalogue or E-buy purchase order, the vendor will ship the product (s) to the Radiation Protection Office with attention to PI right after the PO is received.
4. For Standing purchase order, the research lab will need to call the vender to ship specific item (s) listed on the PO when the lab is ready to use the radioactive materials. The order will be also shipped to the Radiation protection Office with attention to PI.
5. The Radiation protection Office will assign an inventory number to each isotope received, and survey the package to ensure no contamination, and finally deliver the package to the research lab.

EHS staff may allow physically large shipments to be delivered to other locations. Purchases of radioactive material are prohibited on Purchasing Cards.

Suppliers of radioactive material are required to have written assurance that the recipient is licensed to receive the material. EHS will provide this information to suppliers and maintain a file of such assurances from licensees who receive material from the University. Individual users may not provide suppliers with the University license numbers or copies of the license.

If a radioactive material shipment is delivered directly to your laboratory, call EHS so the required paperwork can be completed. Do not open the material.

# Transporting Radioactive Material

Transporting radioactive materials is strictly regulated by federal and state departments of transportation (DOT) and by the NRC. Requirements for containers, labeling, marking, and shipping papers are detailed and complex. Therefore, all motor-vehicle shipments of radioactive material, on or off campus, must be approved in advance by EHS staff. This includes shipments by U.S. Postal Service, common carriers, and University vehicles. Contact EHS at least one week in advance of any required off-campus or across-campus transfer of radioactive material.

EHS will provide instruction as required by DOT and NRC regulations to laboratory groups that will be transporting radioactive material by motor vehicle.

Small amounts (< 50 μCi) of radioactive material may be walked between authorized laboratories in different buildings without notifying EHS. Whenever radioactive material is walked between buildings, it must be double-sealed to prevent leakage, and the outside of the package must be labeled with your laboratory address and phone number. The inner package must be labeled with the words: RADIOACTIVE MATERIAL. EHS staff may increase the activity that may be walked between buildings in special circumstances.

If you are loaning or giving radioactive material to another laboratory, contact EHS to have your and the recipient’s inventory balance brought up to date.

# Procedures to Identify and Report Safety Component Defects

NRC regulations (in 10CFR21) and Pa DEP require that any individual who notices a defect in equipment that could bring about a substantial radiological safety hazard immediately notify the NRC or Pa DEP through EHS. If you notice any design defect in equipment notify EHS as soon as possible. EHS will investigate and determine if NRC or Pa DEP notification is required.

Note: This reporting requirement does not normally apply to broken radiation detection equipment.

# Sources of More Information

Penn State’s EHS web site is at http://www.ehs.psu.edu/ for Penn State information and links to other universities’ EHS web sites.

To read a copy of any of Penn State’s licenses to use radioactive material or to obtain a paper copy of any regulations, contact EHS at 865-6391

Other web sites for information on regulations are:

NRC http://www.nrc.gov/

Pa DEP <https://www.pacode.com/secure/data/025/025toc.html>

# Definitions

**Acronyms used in these rules.**

ALARA As Low As Reasonably Achievable

DOT United States Department of Transportation

EHS Penn State Environmental Health and Safety

EPA United States Environmental Protection Agency

NRC United States Nuclear Regulatory Commission

RPO Radiation Protection Office

RSO Radiation Safety Officer

UIC University Isotopes Committee

DEP Pennsylvania Department of Environmental Protection

*Authorization:* Approval by the University Isotopes Committee to use radioactive material.

*Supervisor* The person authorized by the University Isotopes Committee to be the person in charge of a radioactive materials laboratory.

*Carrier-free*  Radioactive material that contains no non-radioactive atoms of the same element.

*Contamination:* Un-contained radioactive material in a place where it is not wanted.

*Fixed contamination:* Contamination that is permanently attached to a surface. Repeated cleaning does not reduce the amount of radioactive material present.

*Transferable contamination:* Radioactive material that can be cleaned from a surface.

*Decay product* The radioactive or stable atoms resulting from the nuclear transformation of radioactive atoms.

*Radiation* The energy that an atom emits to lower itself to a reduced energy state. The energy can be electromagnetic (x-ray or gamma radiation) or corpuscular (alpha or beta radiation). There is no such thing as a radiation spill.

*Radioactivity* Is a property of materials that are radioactive.

*Radioactive material* Radioactive atoms, often contained within other non-radioactive materials.

*Rem* Unit of radiation exposure. Also frequently given in millirem (mrem).

*Source Material* Means: (1) Uranium or thorium, or any combination thereof, in any physical or chemical form or (2) ores which contain by weight one‑twentieth of one percent (0.05%) or more of: (i) Uranium, (ii) thorium or (iii) any combination thereof. Source material does not include special nuclear material. The sub-critical pile is source material.

*Special Nuclear Material* (SNM) means (1) plutonium, uranium 233, uranium enriched in the isotope 233 or in the isotope 235, or (2) any material artificially enriched by any of the foregoing but does not include source material. SNM includes the Pathfinder fuel, Pu-Be neutron sources, and small Pu and U-233 calibration sources.

*NORM* Naturally Occurring Radioactive Material – means a nuclide which is radioactive in its natural physical state--that is, not man‑made--but does not include source or special nuclear material. It does include 40K, 226Ra, 220Rn, and all radon daughters.

*ALARA*: (Acronym for "As Low As Reasonably Achievable") means making every reasonable effort to maintain exposures to radiation as far below the dose limits as is practical consistent with the purpose for which the licensed activity is undertaken. The following items should be taken into account: the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to public health and safety, and other societal and socioeconomic considerations in relation to utilization of nuclear energy and licensed materials in the public interest.