THE UNIVERSITY of NEW ORLEANS
OFFICE OF RESEARCH

Radioactive Materials Management Guidelines

Table of Contents

Purpose

The University of New Orleans (UNO) Radioactive Materials Management Guidelines is written for the purpose of administering the rules and regulations by specifying the requirements that shall be adhered to by researchers and clinicians. Further, these guidelines define the level of compliance required of individuals who wish to utilize radioactive materials in their research, clinical practice, and teaching programs at UNO and associated institutions.

The requirements of these guidelines are authorized by the Radiation Safety Officer (RSO) and the Radiation Safety Committee at UNO.

All radioactive materials used at UNO are under the jurisdiction of the State of Louisiana, Department of Environmental Quality. The "Type A Specific License of Broad Scope" is a specific license authorizing receipt, acquisition, ownership, possession, use, and transfer of any chemical or physical form of the radioactive material specified in the license, but not exceeding quantities specified in the license, for any authorized purpose. The license may authorize any use of approved radioactive material by anyone in accordance with review and approval procedures established by the RSO and the Radiation Safety Committee. Therefore, individuals are not named on the license as users of radioactive material nor are radionuclides limited to narrow, specific uses.

1. Scope

These guidelines apply to all UNO employees, students, and volunteers who may work with radioactive materials.

2. ALARA Principle

The fundamental objective of radiation protection is to keep all radiation exposures "ALARA," or "as low as reasonably achievable," consistent with the purpose for which the activity is undertaken. Exposures are maintained ALARA by: following the basic principles of radiation protection; optimizing the amount of time of the exposure; maintaining distance from the source of the exposure; and using appropriate shielding and technology.

3. Acronyms & Terms

ALARA – As Low As Reasonably Achievable; a fundamental objective of working with RAM

AMP – Authorized Medical Physicist

ANP – Authorized Nuclear Pharmacist

AU – Authorized User

CPM – Counts Per Minute

DOT – Department of Transportation

DPM – Disintegrations Per Minute

EHSO – UNO Environmental Health and Safety Office

GM – Geiger Counters

HDR – high-dose-rate Afterloader

NMT – Nuclear Medicine Technologist

RAM – Radioactive Materials

RMP – Radiation Producing Machines

RPH – Radiation Permit Holders

RSO – Radiation Safety Officer (Samantha Pallas, labsafety@uno.edu)

T&R – Trustworthiness and Reliability

UNO – University of New Orleans

WB – Whole Body Dose

4. Responsibilities

University of New Orleans (UNO)

UNO provides sufficient authority and organizational freedom to the Radiation Safety Officer (RSO) and the Radiation Safety Committee to identify radiation safety problems, initiate recommendations or provide solutions, and verify implementation of corrective actions. The Radiation Safety Committee members are appointed by the Laboratory Safety Officer, who also serves as the RSO for UNO.

All employees, students, and volunteers are required to comply with the rules set forth by these guidelines.

All uses of radioactive material must be carried out in accordance with: the State of Louisiana Department of Environmental Quality Part XV. Radiation Protection; these guidelines; and any radiation safety procedures applicable to specific areas.

All uses of radiation producing machines (RPMs) must be carried out in accordance with: the State of Louisiana Department of Environmental Quality Part XV. Radiation Protection; these guidelines; and any radiation safety procedures applicable to specific areas.

All employees, students, and volunteers are required to report promptly to the RSO with any condition which may cause unnecessary exposure to radiation or radioactive material; or may constitute, lead to, or cause UNO to be in violation of the rules and regulations for radioactive materials or conditions of the license.

All employees, students, and volunteers are required to complete training from the PI/lab supervisor before working with radioactive materials or RPMs.

Radiation Safety Officer (RSO)

The RSO, in conjunction with the Radiation Safety Committee, serves as the general policy-making and internal regulating body for activities at UNO that involve the use of radiation and radioactive material. The RSO is responsible for enforcement of the policies

and procedures set forth by these guidelines. The RSO may ask members of the Radiation Safety Committee for assistance with and insight on the responsibilities listed below.

The duties and responsibilities of the RSO include, but are not limited to:

- Reviewing these guidelines for maintaining exposures doses ALARA and providing any additional recommendations needed to ensure that exposures are ALARA;
- Reviewing and discussing personnel dosimetry data at Radiation Safety Committee meetings for personnel exposures exceeding ALARA Level 1 and ALARA Level 2;
- Reviewing and approving or disapproving reports of new users and new uses of radioactive materials;
- Reviewing and discussing any significant incidents including spills, contamination, and mis-administrations with respect to enforce subsequent action taken;
- Reviewing and approving or disapprove policy and procedural changes prior to implementation;
- Auditing approved changes to determine implementation and compliance;
- Taking appropriate action when noncompliance is identified;
- Analyzing causes and recommending corrective actions to prevent recurrence;
- Documenting changes and maintaining documentation outlining the change and summarizing the radiation safety matters that were considered prior to approval of the change;
- Reviewing and approving or disapproving of the human use of radioactive material at UNO;
- Approving or disapproving of persons applying to function as Authorized Users, Authorized Medical Physicists, or Nuclear Medicine Technologists;
- Reviewing and approving or disapproving the procedures, types, and quantities of radioactive materials requested for human research, clinical use, or non-human use;
- Considering problems brought forward by medical or technical staff members and giving a prompt response;
- Reviewing research applications or amendments for the research use of machine-produced radiation on humans with respect to procedure, exposure to the subject, and risk information provided to the subject;
- Reviewing on the basis of safety and approving or disapproving each proposed method of machine-produced radiation on humans;
- Recommending or approving or disapproving policy for the safe use of X-rays in human research;

- Developing, distributing, and implementing up-to-date protection procedures in the daily operation of these guidelines;
- Ensuring that the possession, use, and storage of radioactive materials are consistent with the limitations of the License;
- Ensuring that personnel training is conducted and is commensurate with the individual's duties regarding radioactive material;
- Maintaining documentation to demonstrate, by measurement or calculation, that individuals are not likely to receive, in one year, a radiation dose in excess of 10% of the allowable limits; or in the alternative, ensuring that personnel-monitoring devices are provided;
- Establishing and maintaining a personnel-monitoring program;
- Ensuring that dosimeters are appropriately provided, used, and exchanged and that records of monitoring are maintained;
- Ensuring that radioactive material is properly secured;
- Maintaining documentation to demonstrate, by measurement or calculation, that the highest total effective dose equivalent to the non-occupationally exposed individual likely to receive the highest dose from the licensed operation does not exceed the annual limit for members of the public;
- Notifying proper authorities of incidents, such as loss or theft of radioactive material, damage to or malfunction of sealed sources, and fire involving radioactive materials;
- Investigating precursor events and reporting on them to the State Medical Events, including the cause, appropriate corrective actions identified, and timely corrective actions taken;
- Participating in and documenting audit of the radioactive materials on campus at least annually for adherence to ALARA concepts, and seeking to remedy any deficiencies noted;
- Identifying violations of regulations, license conditions, or program weaknesses and developing, implementing, and documenting corrective actions;
- Ensuring that radioactive material is transported, or offered for transport, in accordance with all applicable Department of Transportation (DOT) requirements;
- Disposing of radioactive materials properly;
- Maintaining an up-to-date license, and submitting amendments and renewal requests in a timely manner;
- Reviewing quarterly radiation levels in restricted areas and adjacent non-restricted areas as indicated on staff surveys;
- Reviewing or developing shielding plans for new radiation areas;
- Conducting annual surveys on X-ray equipment and providing scatter and exposure charts to designated departments;

- Auditing all active radioactive material use and storage facilities quarterly and reporting any findings to the primary Radiation Permit Holder;
- Stopping unsafe operations that come to attention.

Radiation Permit Holders – Non-Human Research

Radiation Permit Holders (RPHs) who fail to comply with these regulations may cause the University to be subject to license revocation and/or other sanctions provided by law including monetary fines.

The RPH is the researcher who has been authorized by the RSO to use radiation or radioactive material in research *in vitro* or *in vivo*. See the Authorizations section for obtaining authorization.

The RPH's responsibilities include:

- Maintaining exposures ALARA for all laboratory personnel, both users of radioactive material and those who do not use radioactive material in their laboratory protocols;
- Ensuring that only those individuals trained and approved on their Authorization are permitted to use radiation or radioactive materials in their laboratories;
- Ensuring that laboratory personnel using radiation or radioactive material under their supervision are trained and educated in good radiation safety practices which contribute to maintaining exposures ALARA;
- Reviewing the supervised individual's use of radiation or radioactive material, providing reinstruction if needed, and reviewing records kept to reflect this use;
- Cooperating with the RSO during investigation and assessments;
- Reporting promptly to the RSO any condition which may cause unnecessary exposure to radiation or radioactive material; or may constitute, lead to, or cause UNO to be in violation of the rules and regulations for radioactive materials or the radioactive material license.

Authorized Users of Radioactive Material – Medical Treatment and Clinical Research

Authorized Users (AUs) who fail to comply with these regulations may cause the University to be subject to license revocation and/or other sanctions provided by law including monetary fines.

AUs are physicians who have been authorized by the RSO to prescribe and direct the use of radioactive material to humans for clinical or research use and to perform the final interpretation of the results of the tests or studies. If you are a physician wishing to be listed as an Authorized User, see Authorizations. AUs' responsibilities include:

- Protecting the health and safety of anyone using or affected by the use of radioactive materials under their direct supervision;
- Receiving initial training and ensuring that their staff members receive appropriate training;

- Ensuring that only those individuals trained and designated in writing by an AU are permitted to administer radioactive material to patients or human research subjects;
- Ensuring that their employees, staff, and visitors comply with relevant regulations, policies, and procedures;
- Reviewing the work of the supervised individual(s) and their radioactive material records;
- Prescribing the radiopharmaceutical dosage to be administered by issuing a written directive or reference to the diagnostic clinical procedures manual;
- Preparing and administering or supervising the preparation and administration of radioactive material for medical use in accordance with applicable policies and regulations;
- Being physically present for the administration of therapeutic doses;
- Being immediately available to communicate with the supervised user(s);
- Informing the RSO of any changes to the authorization;
- Reporting any medical events involving radioactive material such as mis-administrations, unintended administrations to pregnant women, etc. to the RSO;
- Reporting any medical events involving external beam radiation therapy; when the total dose delivered differs from the prescribed dose by 20 percent or more; when the fractionated dose delivered differs from the prescribed dose, for a single fraction, by 50 percent or more; when a dose is administered to the wrong individual or human research subject; when a dose or dosage is delivered by the wrong mode of treatment (photon vs. electron); when a dose is administered to the wrong site, etc.

Directors, Supervisors, and Managers

Directors, supervisors, and managers must have knowledge of the use of radioactive material or radiation producing machines in their areas.

They must understand that uses of ionizing radiation sources requires specific training for the worker, and they must provide that training for each worker prior to allowing any work with radioactive materials.

They must be aware that additions, removals, or alterations in the use of such radiation sources may require actions to be carried out by the RSO for safety or regulatory purposes, and they must therefore keep the RSO informed. Examples of actions that would require informing the RSO include:

- Hiring persons to serve as AUs, Authorized Medical Physicists (AMPs), or Nuclear Medicine Technologists (NMTs);
- Whenever an AU, AMP, or NMT leaves the UNO system;
- Whenever an RPH leaves;
- Procuring new or disposing of old radiation-producing equipment;
- Relocating or reconstructing radiation areas that alter or require radiation shielding.

Additionally, the RSO may turn to the director, supervisor, or manager for assistance in the enforcement of the radiation protection program.

Radiation Workers

The responsibilities of the Radiation Worker include:

- Following the instructions of the supervising RPH/AU;
- Following written radiation safety procedures or conditions established in the RPH/Clinical Authorization;
- Maintaining their radiation exposures ALARA;
- Properly wearing and returning in a timely manner any personnel monitoring badges issued;
- Wearing appropriate protective clothing and using proper shielding when indicated;
- Reporting promptly to the RSO any accidents, incidents, or conditions which may cause unnecessary exposure to radiation or radioactive material; or may constitute, lead to, or cause UNO to be in violation of the rules and regulations for radioactive materials or the radioactive material license.

Authorized Medical Physicists (AMPs)

In addition to the responsibilities of the Radiation Worker, AMPs' responsibilities include:

- Performing full calibration measurements on the high-dose-rate afterloader (HDR);
- Verifying biweekly that Spot-Checks were performed properly;
- Performing radiation surveys of the HDR after use;
- Performing output/activity measurements or calculations for any brachytherapy or HDR treatment plans;
- Meeting regulatory requirements for training and experience prior to performing any of the above responsibilities.

Nuclear Medicine Technologists (NMTs)

In addition to the responsibilities of the Radiation Worker, NMTs' responsibilities include:

- Following requirements for procedures involving written directive or the clinical procedures manual when preparing or administering radioactive materials to patients or human subjects (See Human Use of Radioactive Material);
- Performing and documenting measurements of radiopharmaceuticals for patients;
- Meeting regulatory requirements for training and experience prior to preparing radioactive material for human use.

Authorized Nuclear Pharmacists (ANPs)

ANPs must meet regulatory requirements for training and experience prior to preparing radioactive material for human use, as reviewed and approved by the RSO.

X-Ray Users and Operators of Radiation-Producing Equipment

Operators of radiation-producing equipment must meet regulatory training requirements. Responsibilities of staff working with or around radiation-producing equipment are detailed in Machine-Produced Radiation.

5. Access to Radiation Safety Program Documents

All licenses and documents are available for inspection at the following location:

University of New Orleans
Administration Annex, Suite 1005-U
2000 Lakeshore Drive
New Orleans, LA 70148

6. Radiation Exposure

Measuring Radiation Exposure

Exposure to ionizing radiation is measured using monitoring devices called dosimeters or radiation "badges." Badges measure external exposure to radiation. After the badges are worn for a specified period of time, they are sent for commercial processing. The amount of exposure to the badge is reported in units of millirem (mrem). Badges are worn on the part of the body most likely to receive radiation exposure. More information on badge placement is found in Rules for Wearing Badges.

Internal exposure to radiation, from inhalation, ingestion, or absorption, is unlikely to come from most forms of radioactive material used at UNO. However, some use of radioactive material requires monitoring of internal exposure to radiation. Tests used to determine internal exposure are called "bioassays." Please contact the RSO if you believe you require a bioassay.

Radiation Exposure Limits & Reports

If you are an adult radiation worker, then your radiation exposure limits are listed below. Occupational exposure for minors is limited to 10% of the corresponding limit for adults. If you exceed any annual limit, then you will not be allowed to work with or around radiation for the rest of the year.

Annual Occupational Exposure Limits (Radioactivity)		Quarterly Limits for X-Ray
Whole Body	5 rem (0.05 Sv)	1.25 rem/qtr (3 rem/qtr allowed if 5 rem/year not exceeded)
Lens of Eye	15 rem (0.15 Sv)	1.25 rem/qtr (3 rem/qtr allowed if 5 rem/year not exceeded)
Skin or Any Extremity	50 rem (0.50 Sv)	7.25 rem/qtr
Fetal Exposure	0.5 rem (5.0 mSv) during entire pregnancy after declaration	Not to exceed 0.05 rem/month, 0.5 rem (5.0 mSv) during entire pregnancy after declaration

All exposure reports are reviewed by members of the Radiation Safety Committee. As stated previously, if your exposure exceeds an ALARA level, you will be notified by the RSO. Otherwise, your Radiation Exposure Reports are sent to the radiation safety contact in your department. You should make sure that you know where those reports are kept. Once you receive a Radiation Exposure Report, you are required to initial your report to document that you are aware of your exposure.

Annual reports are also prepared by the RSO for each worker as required by regulation. Distribution is by mail directly to the individual, to the department contact, by electronic means, or a combination thereof.

If you ever have any problems finding your radiation exposure reports, please contact the RSO.

Notification of High Exposure/ALARA Levels

In order to identify those workers most at risk of exceeding radiation exposure limits, quarterly investigational levels have been established. These levels are called ALARA Levels, named after the basic radiation safety principle to always keep your exposure as low as reasonably achievable. There are two levels for each exposure limit: ALARA Level 1 and ALARA Level 2. The RSO will notify any worker who receives an exposure in excess of ALARA Level 1. If the exposure exceeds ALARA Level 2, then the RSO will also investigate in order to determine whether or not additional measures can or should be taken to reduce the exposure.

Quarterly ALARA Investigational Levels		
	Level 1	Level 2
Whole Body	> 125 millirems	> 375 millirems
Lens of Eye	> 375 millirems	> 1125 millirems
Skin/Extremities	> 1250 millirems	> 3750 millirems
Fetal	None	> 50 millirems/month

Non-Radiation Worker Radiation Exposure

If you are not a radiation worker, then, by definition, your annual exposure from the use of radiation at UNO cannot exceed 100 mrem—exclusive of background, medical procedures, or exposures from patients authorized for release or sewer disposal. There are many controls in place to keep radiation exposure within this limit for those who do not work with radiation. These include shielding X-ray rooms; documented daily and weekly surveys for contamination and measurements of radiation levels, establishing restricted areas; establishing safety procedures for receiving and disposing of radioactive material, establishing safety procedures for using X-ray equipment, etc.

Dosimetry Badge Requirements

Regulations for both radioactive material and X-ray machines require that any person who is occupationally exposed to radiation at a level which is likely to exceed 10% of any regulatory limit must be issued a radiation badge. ALARA Level 1 exposures, as seen in Notification of High Exposure/ALARA Levels section, are set at ten percent of the regulatory limits.

The below table lists job functions that are at the greatest risk for exceeding an ALARA Level 1 dose and the type of badge(s) that individuals holding these positions will be assigned:

Job Functions at Risk of Exceeding ALARA 1 Level Doses	
If your job function involves…	**Then you must wear* a…**
Working with large quantities of beta emitters	Ring Badge
Operating any type of X-ray equipment	Body Badge
Performing or assisting fluoroscopy procedures infrequently	Collar Badge
Performing or assisting fluoroscopy procedures on a daily basis	Body Badge & Collar Badge**
Handling radiopharmaceuticals or brachytherapy sources for patients	Body Badge & Ring Badge
Performing HDR procedures	Body Badge
Caring for patients containing radioactive material for therapy	Body Badge
**see Rules for Wearing Badges* ***also see Rules for Wearing Badges for how radiation exposure from two badges is calculated*	

Information for Voluntary Use of Badges

Any worker concerned about his or her exposure to radiation from radioactive materials, X-ray machines, or radioactive patients should consult with the RSO. The RSO can determine, by your job responsibilities, if a radiation badge is necessary. If one is not necessary, the RSO can explain why you are not likely to receive enough exposure to radiation to require monitoring. For example, if someone at your job was monitored previously, the RSO can evaluate your potential exposure based on those exposure records. If you are still concerned about your exposure, then the RSO can issue you a badge for an evaluation period (typically six months) or until you don't wish to be monitored anymore.

Requesting Badges

Contact the RSO. You will be asked to complete the Dosimetry Monitoring Request Form and receive documented training (see Training) in the proper use of a badge and basic radiation protection principles.

Once you've completed the form and received training, a badge will be issued to you. All workers issued radiation badges are required to follow those rules and responsibilities stated in these guidelines and to cooperate with the RSO in their efforts to maintain exposures ALARA.

Rules for Wearing Badges

Control badges assigned to a shipment must be kept in a low radiation background area. These control badges must be returned when the badges are collected for processing.

If you are issued a badge, you must wear it whenever you are working with or near sources of radiation exposure.

Badges must only be worn at work.

Wear the badge on the part of the body closest to the source of radiation.

For X-ray machine operators or staff issued a single badge, it must be worn unshielded on the collar or waist area. If a lead apron is worn, it must be worn on the outside of the apron at the collar. Assigned dose to Whole Body (WB) is 0.3 times the collar badge reading.

For X-ray machine operators or staff issued two badges, a designated chest badge must be worn on the torso, shielded underneath the lead vest. The designated collar badge must be worn unshielded at the collar. The collar badge will be used to evaluate the eye and skin exposure. The worker's WB dose will be calculated from the results of the two badges according to the following formula:

WB = (1.5 x Body Badge) + (0.04 x Collar Badge)

Ring monitors must be worn so that the label is facing the palm of your hand and underneath your glove.

Wear a ring badge, if required, during the elution of generators; during the preparation, assay, and injection of radiopharmaceuticals; when performing camera quality control; when holding patients during procedures; and when handling radioactive material.

Fetal monitors must be worn at the abdomen, under any protective lead.

Badges, when not being worn, must not be stored near any radiation sources.

A badge assigned to one individual must never be worn by another individual.

Returning Badges

All departments shall establish a Radiation Safety contact that is responsible for exchanging the old and new badges. Laboratories on campus can use Interoffice Mail to send their badges to the RSO:

Samantha Pallas, Lab Safety Officer/RSO
2000 Lakeshore Drive

Administration Annex, Suite 1005-U
New Orleans, LA 70148

Please make every effort to return your badges for processing by the 8th of the month following the wear period. Late badges generate unnecessary work and expense. The RSO may request disciplinary advice from the supervisors of workers who chronically return their badges late.

Lost Badges

Report all lost badges to the RSO. If you need a replacement, one can be assigned. The RSO may ask if you performed more, less, or any usual work with radiation during the wear period of the lost badge so that an exposure amount can be estimated and assigned to your history.

Pregnancy

Employees, students, and volunteers at UNO who work with radiation have the option of notifying and are encouraged to notify the RSO of suspected or confirmed pregnancies as soon as possible, so that the RSO can work with the individual and their supervisor to monitor the radiation exposure levels during the pregnancy and take measures, as appropriate, to maintain exposures ALARA and within regulatory limits.

All employees, students, and volunteers at UNO who work with radiation will be informed of applicable state and federal regulations regarding occupational exposure to the fetus from ionizing radiation during their initial radiation safety training.

As soon as any employee, student, or volunteer at UNO who works with radiation determines that they are pregnant, they should (unless privacy is desired) advise their supervisor and declare the pregnancy in writing to the RSO giving the approximate date of conception. The RSO will review the past radiation exposure history and job function of the declared pregnant radiation worker and determine if radiation restrictions should be applied. If so, these restrictions will be discussed with the individual and their supervisor and will be provided to both in writing.

Any employee, student, or volunteer at UNO who works with radiation may, without declaring pregnancy, consult with the RSO concerning issues relating to exposure of an embryo/fetus to radiation in the course of the employee's job.

The RSO will issue a monthly fetal badge for the declared pregnancy radiation worker to wear at the waist in addition to the regular badge.

All lead barriers in the university are designed so an individual, if behind the barrier for the full 40 hours of a week, would receive less than 10 mrem to the surface of their body and much less to the fetus. NCRP, NRC and the State of Louisiana allow the fetus of a declared pregnancy radiation worker to receive 500 mrem, sum of internal and external exposure, during the nine months of pregnancy.

It is recommended that pregnant nurses not care for patients containing therapeutic quantities of a radionuclide or brachytherapy sources.

For more information about working at UNO during pregnancy, please consult the UNO Laboratory Pregnancy Protection Fact Sheet.

7. Training

Each PI or lab manager who oversees research or areas that use radioactive materials is responsible for ensuring that all students, staff, faculty, and volunteers are trained on radiation safety at UNO. Training must be completed before any work with radioactive materials or equipment that produces radiation occurs. The training is dependent on the job functions performed and falls into four categories:

- Ancillary
- Laboratories
- Machine-producing radiation

It is possible that someone may need to be trained in more than one category. Training will include regulatory-required content based on the job function, as well as education topics identified by the department in which you work and the RSO.

Training materials and documentation of training must be sent to the RSO before anyone works with radioactive materials or radiation producing equipment.

Training Requirements for Ancillary Workers

Workers who enter radiation use areas to perform their duties with no direct use of radioactive material will receive instruction that includes the following topics:

- Potential radiation hazards in each area where the employee will work;
- Posting requirements of areas where radioactive material/radiation is used and/or stored;
- Basic radiation protection to include concepts of time, distance, and shielding.

Training must be provided by the PI, lab manager, or whoever manages the space with radioactive material/radiation. All training materials and documentation of training must be sent to the RSO before anyone works with radioactive materials or radiation producing equipment.

Retraining must be conducted whenever there is a significant change in duties or regulations.

Training Requirements for Laboratory Workers Using Radioactive Material

Training for laboratory workers must include the following topics:

- Atomic structure
- Alpha, beta, and gamma radiation
- Radioactive units
- Radioactive decay
- Biological effects
- Background radiation
- ALARA
- Radiation protection principles
- Radiation surveys
- Radiation inventory
- Recordkeeping
- Personal protective equipment (PPE)

- Waste disposal
- Occupational dose limits and dosimetry
- Policy on radiation pregnancy
- Purchase, receipt, and storage of radioactive material
- Radiation instrumentation
- Spill and contamination procedure (non-emergency)
- Emergency response

Training must be provided by the PI, lab manager, or whoever manages the space with radioactive material/radiation. All training materials and documentation of training must be sent to the RSO before anyone works with radioactive materials or radiation producing equipment.

Retraining must be conducted at least every three years or whenever there is a significant change in duties or regulations.

Training Requirements for X-Ray Machine Operators

State of Louisiana regulations require operators of radiation-producing machinery to take a minimum amount of training. For patients and veterinary use, the requirement is 6 hours of radiation safety training prior to use of X-ray machines on patients. Similar requirements exist for other uses of X-ray-producing machines such as X-ray crystallography machines and DEXA units.

Physicians, veterinarians, radiologic technologists, and nuclear medicine technologists are considered to have satisfied the Louisiana certification requirement for machine-produced radiation safety training as part of their state licensing and will not need to complete training through UNO.

Training for operators and support staff will include the following topics pertinent to their specific job function:

- Applicable regulations
- Operator responsibilities
- Potential radiation hazards in work areas
- Risk estimates, including comparison with other health risks
- Basic radiation biology
- Steps to minimize exposure to patients and staff
- Patient safety
- Radiation effects on skin
- Pregnant patient precautions
- Recordkeeping exposure information
- Reporting high or accidental exposures
- Proper use of personnel dosimetry
- Department-specific work rules
- Procedure risks

Training must be provided by the PI, lab manager, or whoever manages the space with radioactive material/radiation. All training materials and documentation of the training must be sent to the RSO before anyone works with radioactive materials or radiation producing equipment.

Retraining must be conducted whenever there is a significant change in duties or regulations.

8. Authorization to Use Radiation for Non-Human Use of Radioactive Material

Application

The applicant must be a faculty member of a division of UNO with training and experience commensurate with the intended use.

The applicant must complete an Application Form and send it to the RSO. Within this application, you must sign a statement indicating familiarity with these guidelines and acknowledging your commitment to keeping exposures ALARA.

After the RSO checks the application for completeness, it is sent to the Radiation Safety Committee, where it is reviewed with respect to:

- Training and experience presented by the Radiation Permit Holder in reference to proposed use;
- Facilities and instrumentation available;
- Proposed techniques of safely using and disposing of radioactive material.

Approval is granted by unanimous vote by a convened quorum after resolution of any comments or questions.

Upon approval, the RSO will deliver the authorization to the laboratory.

Laboratory personnel named on the authorization to use radioactive material must receive training prior to their first use of radioactive material. See the Training section.

The Radiation Permit Holder (RPH) will evaluate all approved procedures before using radioactive materials to ensure that exposures will be kept ALARA. This may be enhanced through the applications of trial runs.

Amendments to Authorizations

Submit any amendments to authorizations to the RSO before purchasing or otherwise using radioactive materials or radiation-producing equipment.

Amendments may include:

- Adding, removing, or changing protocols
- Adding or removing personnel
- Adding or removing labs

An approval of changes to personnel to use isotopes, and addition and deletion of laboratory locations may be made at the discretion of the RSO and the Radiation Safety Committee. Committee members receive a report of these administrative changes at each meeting.

Protocol amendments must include, at a minimum:

- The project title
- The radionuclide and chemical form involved

- An indication of any need to increase total possession limit or to add a chemical form
- A detailed description of the portion(s) of the protocol dealing with the use of the radioactive material
- The names and experience of any additional staff members who may be added due to the project
- IACUC committee approvals, where needed

When additional isotopes or procedures are involved, the applicant must demonstrate appropriate knowledge and experience to ensure safety in carrying out the protocol.

The Radiation Safety Committee will grant approval by unanimous vote by a convened quorum after resolution of any comments or questions.

When adding new personnel, all new personnel must receive training in accordance with the Training section of these guidelines.

When adding labs, laboratories must undergo a pre-occupancy contamination survey by the RSO. The RSO will add the room number(s) to the Authorization and provide signage for the lab accordingly.

When removing labs, labs must follow the Laboratory Moves, Relocations, and Decommissioning Guidelines (found at https://www.uno.edu/research/funding/compliance under Lab Moves, Relocations, and Decommissioning), including a post-occupancy contamination survey by the RSO. The researcher is responsible for any radioactive material and radiation-producing equipment abandoned in a lab.

Renewals

The RPH must apply for renewal every three (3) years by completing the Application Form again.

Active and Inactive Labs

When the RPH has not used radioactive material and has had no radioactive material inventory or waste for a period of one year, then Inactive Status can be requested by amendment. The RSO will review the current standing of the authorization prior to approval. Authorizations approved for Inactive Status will not be inspected, personnel will not require refresher training, and survey instruments will be stored and will not require annual calibration.

Reactivation of inactive labs will require the lab to submit correspondence to the RSO. Radiation survey instruments must be calibrated. Radiation safety training must be completed by laboratory radiation workers prior to ordering or working with radioactive material in accordance with the Training section of these guidelines. Reactivation may take several weeks to allow for retraining of personnel and calibration of survey instrument(s).

Laboratories that are place on Inactive Status will turn in all radiation badges during this period. In the event Active status is requested, badges will be provided after the training requirements and risk assessment have been completed.

When the RSO receives an order or request for transfer of radioactive material to a laboratory on Inactive Status, then the RPH will be returned to active status once training and survey instrument calibration requirements are satisfied.

When the RPH has not used radioactive material and has had no radioactive materials inventory or waste for a period of two years or longer, the authorization will be terminated and the laboratory decommissioned for radioactive material use.

Authorizations must be kept in good standing. RPHs will be notified when renewals are due. Any changes made during the review will be included in the renewal application. Renewal applications received by the expiration date of the authorization will be considered active until the RSO issues a new authorization.

If the RPH does not submit renewal materials by the expiration date, the authorization will be terminated.

Suspension

The RSO has the right to suspend an authorization, in full or in part, following the discovery of violations or infractions of the authorization. The RSO may reinstate the authorization once the violations have been corrected and an increased surveillance program is put into place.

9. Authorization to Use Radiation for Human Use of Radioactive Material

Application

Applicants must have faculty status (assistant professor or greater), must be experienced in the use of radioactive materials, and must be trained in accordance with the Training section of these guidelines.

Researchers must complete an Application Form and send it to the RSO. Within this application, you must sign a statement indicating familiarity with these guidelines and acknowledging your commitment to keeping exposures ALARA.

Applications will require the description of personnel monitoring, protective clothing, shielding, and surveying procedures designed to properly evaluate exposures and maintain them ALARA.

After the RSO checks the application for completeness, it is sent to the Radiation Safety Committee members where it is reviewed with respect to:

- Training and experience presented by the RPH in reference to proposed use
- Facilities and instrumentation available
- Proposed techniques of safely using and disposing of radioactive material

Approval is granted by unanimous vote by a convened quorum after resolution of any comments or questions.

Upon approval, the RSO will deliver the authorization to the laboratory. After this, the AU may then order, receive, and use the requested materials, but must do so according to the statements and representations made in the application, and any conditions set forth

by the RSO and all applicable local, state, and federal laws, regulations, and license conditions. Violations or infractions of these conditions may be cause for suspension or termination of the approval to receive and use radioisoptopes.

Approval will be given for a period of three (3) years.

Amendment

Any changes to the authorization, such as additional personnel, new radionuclide(s), increased or decreased possession limits, changes in experimental procedures which have an impact on safety, addition or removal of areas of radioactive material use, changes to the number of subjects of controls, or changes in the chemical or physical form of a material previously approved must be submitted as a request for amendment. See the Amendment to Authorizations section.

Approval is granted by unanimous vote by the Radiation Safety Committee after resolution of any comments or questions. An administrative approval of changes of personnel to use isotopes, and addition or deletion of laboratory locations, can be made at the discretion of the RSO. The RSO may require additional conditions under which the use of radioactive material must be conducted.

Prior to using radioactive material in a clinical area, the RSO will review the facility layout and proposed uses to determine if shielding is adequate to comply with exposure limits for the general public in adjacent areas.

An amendment must be submitted and approved prior to allowing any person to assume the responsibilities of an AU, AMP, or NMT.

Renewal

The RSO will contact the AU to review the authorization prior to renewal. Any changes made during the review will be included in the renewal application. Renewal applications received by the expiration date of the authorization will allow the work to continue in the interim until the RSO issues a new authorization.

Suspension

The RSO has the right to suspend an authorization, in full or in part, following the discovery of violations or infractions of the authorization. The RSO may reinstate the authorization once the violations have been corrected and an increased surveillance program put into place.

10. Closing/Terminating a Lab

The RPH or AU may request assistance from the RSO when leaving a lab. However, it is the responsibility of the RPH when leaving a laboratory to properly dispose of or safely remove all hazardous materials, waste, and contaminated equipment in their lab. Work on all study protocols must cease. All laboratory spaces and equipment will be surveyed for radioactive contamination by the RSO. The Laboratory Moves, Relocations, and Decommissioning Guidelines can be found at https://www.uno.edu/research/funding/compliance under Lab Moves, Relocations, and Decommissioning.

The authorization may be terminated upon the following conditions:

- Written request of RPH
- Failure to renew authorization in a timely fashion
- Violations or infractions of the authorization that are not corrected

11. Machine-Produced Radiation in Research

Human Use and Clinical Trials

The RSO reviews applications for research that involve the use of ionizing radiation on the research subjects.

The applicant should submit a summary of radiological procedures that will be used in the research study. The RPH will indicate which procedures are research-driven and which are standard of care. The applicant's submission will also help the RPH in estimating the total radiation dose likely to be given to the patient. This total dose is then categorized as a Low Dose, Moderate Dose, or Significant Dose.

Standard of care includes imaging that is normally performed as indicated by the subject's medical provider for diagnosis or treatment of a disease. The benefit of the patient is the sole criteria when deciding whether or not to perform these scans. These scans may have research benefits, but research benefit must not be a factor when considering performing the scan. Any other scans are considered beyond standard of care.

The RSO will also review the submission to determine whether the research subject is appropriately notified of the risks from the radiation. The applicant should include radiation risk information in the consent that provides the subject the following three pieces of information:

- Which procedures involve ionizing radiation;
- If the radiation is necessary for their care or if it is being done only for the research purposes; and
- A comparative estimate of the risk of cancer from these procedures.

Approval is granted by unanimous vote by the Radiation Safety Committee and the RSO after resolution of any comments or questions.

Studies that involve only standard of care or low-dose procedures on adults are reviewed by the RSO and registered as compliant with the requirements for informed consent rather than approved by committee.

Studies that also involve only standard of care or low-dose nuclear medicine procedures on adults will be reviewed by the Radiation Safety Committee and RSO and registered as compliant with the requirements for informed consent.

Non-Human Use

Any research use of machine-produced radiation on animals or samples requires an application to the RSO.

12. For Unescorted Access to Irradiators

Irradiator Access

Any person requesting to have unescorted access privileges to an irradiator must contact the RSO for further instructions. Trustworthiness and reliability (T&R) must be verified before unescorted access privileges will be grated. The UNO T&R designee will provide the forms and advise applicants via email of next steps.

The approval process consists of the following steps:

- Certification by the RPH – the RPH certifies that the applicant requires unescorted access to the irradiator.
- Payment for approval for fingerprinting charges – the RPH provides an active SmartKey code for charges.
- T&R Verification – the RPH may review past work history for employees who have been at UNO longer than three (3) years. Work and education history will be reviewed by the T&R designee for employees who have been at UNO less than three (3) years. This may include review of graduate school applications, Human Resources documentation, and other resources as requested. Past employers may be contacted.
- Fingerprinting – digital fingerprints are taken by the UNO Police Department and transmitted to the Nuclear Regulatory Commission for a criminal background check.

The UNO T&R designee will provide specific approval and instructions for access once all steps are complete. Other users with unescorted access privileges may provide instruction on the operation of the irradiator only.

Access privileges can be revoked at any time for security violations and may only be reinstated following review and agreement by the T&R designee.

13. General Rules for Handling Radioactive Material

Do not allow children under 18 years of age in laboratories where radioactive materials are used or stored unless they are students or employees of UNO who have been approved by the RSO.

Personal Protective Equipment (PPE)

Wear a laboratory coat or other protective clothing, disposable gloves, close-toed shoes and eye protection at all times when using radioactive materials. Ensure you are also wearing the additional PPE required for your laboratory based on your lab's PPE Assessment found in the Lab Safety Binder.

PPE such as lab coats and gloves should not be worn outside of the laboratory.

Contamination Control

All work bench areas must be covered with absorbent paper. Absorbent paper must be checked for contamination after each use. Work with large volumes of radioactive material must be done on a tray.

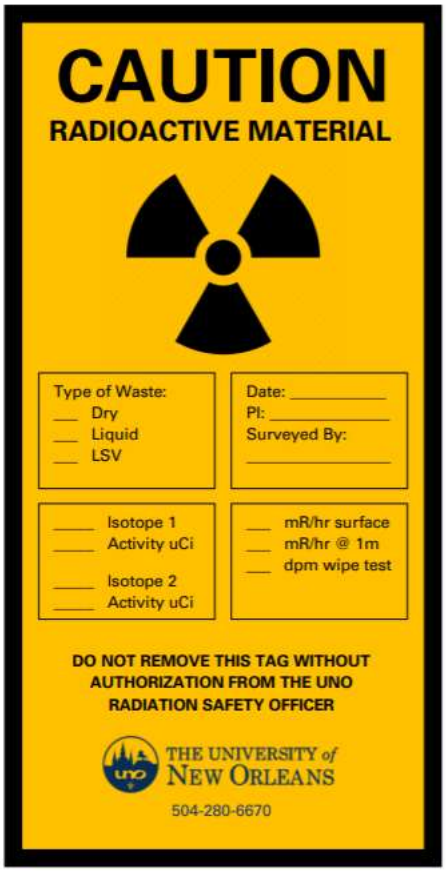
Monitor hands, shoes, and clothing for contamination after each procedure or before leaving the area.

Do not eat, drink, smoke, apply cosmetics, or change contact lenses in any area where radioactive material is stored or used.

Do not store food, drink, cosmetics, toothbrushes, etc. in areas where radioactive material is stored or used.

Never pipette by mouth.

Dispose of radioactive waste only in designated radioactive waste containers. Ensure containers are managed (stored, labeled, shielded, etc.) in accordance with the UNO Regulated Waste Guidelines, which includes the Radioactive Waste Label (below).



Exposure Control

Shielding materials must be available for specific isotopes used in the lab. Use lead shielding for gamma emitters and Plexiglas for high energy beta emitters.

Wear personnel monitoring devices, if required, at all times while in areas where radioactive materials are used or stored.

Additional Precautions in Shared or Multi-User Labs

In large community laboratories shared by radiation users and non-radiation users, care must be exercised to limit both contamination events and exposure concerns. Quantities

of and procedures with radioactive materials used in the open laboratory will be limited according to possible hazards connected with its use.

Recommended possession limits for RPH permits in shared labs are:

- 10 mCi limit for H-3, C-14, P33, S-35, Cr-51 and Tc-99m
- 1 mCi limit for Na-22, Na-24, P-32, Cl-36, and Ca-45
- 100 µCi limit for I-125 and I-131

Approval may be granted for possession limits above those recommended on a case-by-case basis.

Radioactive materials must be adequately shielded on all sides to maintain exposures at less than 2 mR/hr at one foot from the source.

Use enclosed labs with the doors closed or a chemical fume hood for:

- Amounts of stable, non-volatile radioactive materials which exceed the above recommended possession limits for RPH permits in shared labs.
- Procedures which may result in the production of small amounts of radioactive aerosols such as micro centrifuges and speed-vacs. Request specific approval if your equipment must be used in shared spaces.
- All unstable and/or volatile radioactive materials must be used in chemical fume hoods; preferably within an enclosed lab to restrict traffic.

Labeling

All countertops where radioactive materials are used must be clearly defined and labeled with the radiation symbol.

All hoods in which radioactive materials are used must be clearly labeled with the radiation symbol.

All sinks in which radioactive material is introduced by cleaning of contaminated labware must be clearly labeled with the radiation symbol.

Centrifuges, incubators, speed-vacs, and other multi-user equipment in which radioactive material is used must be clearly labeled with the radiation symbol.

14. Laboratory Requirements

Required Lab Features

Basic construction of UNO laboratories is suitable for most combinations of radiotoxicity and possession limits requested. Laboratory use generally requires handling only low levels of non-volatile radioactive material. Laboratories where radioactive material is used or stored must possess the following features:

- Smooth and nonabsorbent floors;
- Countertops impervious to forms of radioisotope being used;
- Handwashing sink with impermeable surface and drain set level with or below sink-level to allow for complete draining;
- Negative air pressure in laboratories with one-time pass-through ventilation;
- Access to a GM Survey meter, unless only H-3 is used;

- Access to a liquid scintillation counter and/or gamma counter.

Additional Features Dependent on Usage

Lab requirements may increase with higher possession limits or radiotoxicity of the material.

Additional facilities, such as chemical fume hoods, portable shielding, or built-in shielding may be necessary for isotopes with higher radiotoxicity, such as Ca-45, I-125, or I-131.

15. General Rules for Storage and Security of Radioactive Material

Secure all radioactive materials when it is not under the constant surveillance and immediate control of the user(s). Store all radioactive solutions in clearly labeled containers. Areas where radioactive materials are stored need specific safeguards to prevent unauthorized removal or access.

Self-Contained Laboratory

RPHs who are in a self-contained laboratory area must choose a method of securing their stock solutions from the following options:

- Secure in a locked refrigerator or freezer.
- Keep lab locked when vacant, even for short periods of time.
- Keep material in a lock box inside the refrigerator or freezer.

The RPH's choice will become an audit item. If material is found unsecured, use of a lock box will become mandatory.

Shared or Multi-User Labs

All stock material must be kept in a lock box inside a refrigerator, freezer, or cabinet. The box must be secured to prevent easy removal. Refrigerators and freezers must be locked at the end of the day.

Radioactive samples may be stored in a locked refrigerator or freezer located in a hallway or alcove. Refrigerators and freezers must be locked at the end of the day.

16. Clinical Areas

Since clinical areas typically see much more frequent activities using radioactive material, additional safeguards should be in place. Consideration should be given to the location of flood sources and radioactive patients with respect to well-counters, dose calibrators, and gamma counters. Waste containers and sharps containers may also need added shielding to minimize exposure to staff. A spill kit should also be available, and its whereabouts must be known to all persons handling radioactivity.

17. Radioactive Volatiles and Gases

All unstable and/or volatile radioactive materials (ex. H-3 borohydride or C-14 methyl iodide) must be used in enclosed laboratories equipped with exhaust fume hoods.

Special Requirements for Users of Radioiodine-125 and -131

Only RPHs and technicians with prior experience using large quantities (1 mCi or greater) of radioiodine will be authorized to perform iodinations.

Each lab in which an iodination is to be done will be cleared of all individuals except those actively participating in the procedure.

All work will be done in an approved hood with a minimum air flow of 100 linear feet per minute with a sash opening of one foot.

The hood will be exhausted to the outside—laminar flow hoods recirculating air within the room will not be used.

Air samples will be taken in each lab during the use of 1 mCi or greater quantities of I-125 or I-131 until the RSO is satisfied that the vapors are contained during the procedure.

A mandatory radiation survey and wipe test for radioactive contamination is required after each use.

A baseline thyroid bioassay should be performed prior to an iodination. A thyroid bioassay is required within 24 to 72 hours following an iodination exceeding 1 mCi I-125 or I-131.

18. Signs and Postings

If you are in a laboratory at UNO and need signs, the RSO will provide the required postings for all hazards. Complete the Lab Signage Request Form if you need signage or have any changes in hazards that will require new signage. The following is a list of signs required for radioactive material use:

- "Caution, Radioactive Material" sign must be posted on the door of any area where radioactive material is used or stored.
- "Restricted Area, Authorized Entrance Only", and "No Eating, Drinking, or Smoking" signs may also be present, if available, depending on the building signage system.
- RSO phone numbers must be posted and readily available to workers in case of emergencies.

  Radiation Safety Officer
  University of New Orleans
  Administration Building, Room 1005-U
  labsafety@uno.edu
  504-280-4759
- "Notice to Employees" sign from the Louisiana Department of Environmental Quality must be posted in areas to permit employees working in or frequenting any portion of a controlled area to observe a copy on the way to or from the place of employment.
- "Caution: Radiation Area" sign must be posted at any area where a person may receive 5 mrem/hr.

- Other areas with higher radiation exposure rates or airborne radioactivity might require additional or different signage. Consult the RSO if these situations apply.

Posting Exceptions

The following areas are exempted from posting requirements:

- Areas where radioactive material is only present for less than eight (8) hours, provided that it is constantly attended by an individual who is taking measures to prevent exposure to other persons in excess of regulatory limits.
- Hospital areas with radioactive patients, provided that the patients are authorized for release.
- Areas where only a sealed source is stored, provided that the dose rate at 30 cm from the source (or source housing) is less than 5 mrem/hr.

Labeling Requirements

Stock containers of Radioactive Material shall bear a label displaying the radiation symbol; the words "Caution, Radioactive Material"; radionuclide; the quantity of radioactivity; and the date of assay. Labeling of instruments, trays, or racks containing samples is acceptable. Waste containers are labeled the same, except the date is added when full.

Also, see additional labeling requirements for chemical products in the Chemical Hygiene Plan and for regulated wastes in the Regulated Waste Guidelines.

19. Wipe Tests and Geiger Surveys

Both area surveys and wipe tests are performed to help keep worker exposure ALARA and to demonstrate compliance with regulatory limits to the general public.

Geiger Surveys

Geiger counters (GM) are portable instruments used to detect ionizing radiation and can also be used to survey areas for ambient radiation dose rates ("area surveys"), provided that the correct detector is used.

The Geiger counter is the least expensive, fastest, and generally the most reliable means of detecting and measuring radioactive contamination. The beta pancake detector is used with the Geiger counter for finding and measuring beta radiation, and will detect all beta radioisotopes used at UNO except H-3 and Ni-63. It does not detect those nuclides because their betas are too low in energy to penetrate the window of the detector. Radioisotopes that may be detected with the beta pancake include C-14, S-35, P-33, P-32, Ca-45, Cl-36, and other beta-emitting nuclides.

The low energy gamma probe is used with the Geiger counter to detect and measure gamma radioisotopes of various energies. It is most efficient for I-125, but will perform adequately for Cr-51, In-111, Co-57, and other gamma-emitting nuclides. These detectors will also detect low energy X-rays, such as those emitted by beta-emitters producing Bremsstrahlung radiation.

Wipe Tests

Wipe tests are performed to detect and quantify radioactive contamination on surfaces of work areas and/or equipment. Removable contamination can be detected and measured through a wipe test of the surface, which is counted in an appropriate counting instrument, such as a liquid scintillation counter, a sodium iodide or germanium gamma counter, or a proportional alpha/beta counter.

When to Perform Surveys

Dose-rate surveys, at a minimum, must be performed in locations where workers are exposed to radiation levels that might result in radiation doses in excess of 2 mrem/hr. Contamination surveys must be performed:

- To evaluate radioactive contamination that could be present on surfaces of floors, walls, laboratory furniture, and equipment;
- After any spill or contamination event;
- When procedures or processes have changed;
- To evaluate contamination of users and the immediate work area;
- At the end of the day when radioactive material is used; and
- In areas adjacent to restricted areas and in all areas through which radioactive materials are transferred and temporarily stored before shipment.

How to Perform Surveys

To ensure achieving the required sensitivity of measurements, survey samples will be analyzed in a low-background area.

A gamma counter system with a single or multi-channel analyzer can be used to count samples containing gamma-emitters (ex. Cesium-137 or Cobalt-60).

A liquid scintillation or gas-flow proportional counting system can be used to count samples containing beta-emitters and gamma-emitters. Results must be documented in disintegrations per minute (dpm) on a facility diagram. The instrument must be sufficiently sensitive to detect the presence of 200 dpm/100 cm^2 of removable contamination.

A radioactive source with a known amount of activity should be used to convert sample measurements, usually in counts per minute (cpm), to dpm.

Each laboratory using gamma-emitting or high energy beta-emitting material must have a suitable survey meter available. The survey instrument must be checked for consistent response with a dedicated source before each use. Do not use an instrument that does not respond appropriately to the source. It is not necessary to keep records of these checks.

Required Frequency of Surveys

When working with radioactive material, hands, lab coats (especially edge of sleeves), and shoes should be monitored before leaving the laboratory both during the work day and at the end of the work day before leaving the workplace.

Perform radiation level surveys with a survey meter sufficiently sensitive to detect 0.1 milliroentgen per hour (mR/hr) in the following areas, at the frequency specified:

- Survey at the end of each day of use all radiopharmaceutical elution, preparation, assay, and administration areas (except patient rooms, which will be surveyed at the end of the therapy instead of on the day of administration) when using radiopharmaceuticals requiring a written directive (ex. all therapy doses and any Iodine-131 dosage exceeding 30μCi).
- Survey weekly all radionuclide use, storage, and waste storage areas. If diagnostic administrations are occasionally made in patients' rooms (ex. bone scan injections, Tc-99m heart agents) and special care is taken to remove all paraphernalia, those rooms need not be surveyed.
- Survey all sealed-source and brachytherapy-source storage areas during the semi-annual inventory.
- Removable contamination survey samples should be measured in a low-background area. The following areas and frequencies should be followed:
    - Perform removable contamination surveys weekly for:
        - Laboratory areas where only small quantities of radioactive material are used (<1 millicurie at a time), or
        - Radionuclide storage and radionuclide waste storage areas, or
        - Areas where radiopharmaceuticals with half-lives of less than 2 hours are eluted, prepared, assayed, or administered.
    - Perform removable contamination surveys daily for areas where generators and multi-use bulk vials of radiopharmaceuticals with half-lives of more than two (2) hours are eluted, prepared, or assayed.
    - Perform removable contamination surveys weekly for areas where radiopharmaceuticals are administered.
    - If diagnostic administrations are occasionally made in patients' rooms (ex. bone scan injections, Tc-99m heart agents), with special care taken to remove all paraphernalia, those rooms need not be surveyed.

Action Levels

The table below lists the action levels for area surveys and wipe tests.

Action Level for Ambient Surveys:	
Unrestricted Areas	>2 mR/hr @ 30 cm >2 mR/hr @ contact for personal clothing & skin
Restricted Areas	>10 mR/hr @ 30 cm (protective clothing used only in restricted areas)
Wipe Test Action Levels in Unrestricted Areas (dpm/100 cm^2)	

Nuclide	Removable
Any Beta or Gamma Emitters	200 dpm/100 cm²
Wipe Test Action Levels in Restricted Areas (dpm/100 cm²)	
Nuclide	Removable
Any beta or gamma emitters	2000 dpm/100 cm²

If action levels for dose rates are exceeded, you must shield the source in order to reduce the dose rate to within the action level. You must notify the RSO if you discover an unrestricted area has received more than 2 mrem in an hour.

If action levels for removable contamination are exceeded, then you must perform decontamination steps until the amount of contamination is below the action level. Contamination found in unrestricted areas and on personal clothing will be immediately decontaminated to background levels. The worker must retain a copy of the survey in the laboratory radiation records in the Lab Safety Binder documenting that an effort was made to reduce ambient radiation levels through decontamination or shielding.

If the dose rates cannot be brought below the action levels:

- Shield the radiation
- Post the area to restrict its access
- Notify the RSO
- Assist in investigating what caused the action level to be exceeded. Records of dose-rate surveys and wipe tests must include the following:
    - A diagram of the area surveyed or a list of items and equipment surveyed;
    - Specific locations of the area surveyed or a list of items and equipment surveyed;
    - Specific locations on the survey diagram where the wipe test was taken;
    - Measured dose rates in mR/hr and contamination levels in dpm/100 cm²;
    - Name or initials of the person who conducted the survey and the date;
    - Make and model number of equipment used;
    - Action taken in case of excessive dose rate or contamination, and
    - Follow-up survey information

20. Sealed Sources

Sealed sources or source holders must identify isotope, activity, and date of assay of the source. Sources must be stored in such a manner that the dose rate in adjacent unrestricted areas does not exceed 2 mrem in one hour and 50 mrem in one year.

Leak Tests and Inventory of Sealed Sources

Any source of 100 µCi or more (or 10 µCi or more for sources designed to emit alpha particles) with a half-life greater than 30 days (excluding H-3) must be tested for leakage or contamination prior to initial use, any time there is reason to suspect that the source might be leaking, and at least every six (6) months. Sealed sources will be leak-tested by

the RSO. Leak tests are not required on sources that are stored and are not being used, but are required before use or transfer.

All sealed sources will be inventoried by the RSO every six months.

21. Radionuclides Commonly Used in Research Laboratories at Universities

Isotope	Beta/Gamma	Personnel Monitoring	Shielding	GM Meter	Hazard	Laboratory
H-3	Beta	None	None	No	Low	Up to 10 Ci
C-14	Beta	None	None	Yes	Moderate	Up to 100 mCi
F-18	Positron/Gamma	Yes	Lead	Yes	Moderate	Up to 100 mCi
Na-22	Gamma	Yes	Lead	Yes	High	Up to 1 mCi, med-100 mCi
Na-24	Gamma	Yes	Lead	Yes	Moderate	Up to 100 mCi
P-32	Beta	wb>50 mCi ring>1mCi	Plexiglas	Yes	Moderate	Up to 100 mCi
P-33	Beta	None	None	Yes	Moderate	Up to 100 mCi
S-35	Beta	None	None	Yes	Moderate	Up to 100 mCi
Cl-36	Beta	None	None	Yes	High	Up to 1 mCi, med-100 mCi
Ca-45	Beta	None	None	Yes	High	Up to 1 mCi, med-100 mCi
Mn-54	Gamma	Yes	Lead	Yes	Moderate	Up to 10 mCi
Fe-55	Electron Capture	None	None	No	Low	Up to 10 mCi
Rb-86	Beta	Yes	Plexiglas	Yes	Moderate	Up to 100 mCi

Cu-64	Gamma	Yes	Lead	Yes	Moderate	Up to 100 mCi
Y-90	Beta	Yes	Plexiglas	Yes	Moderate	Up to 100 mCi
Cr-51	Gamma	wb>10 mCi	Lead	Yes	Moderate	Up to 100 mCi
Tc-99m	Gamma	Yes	Lead	Yes	Low	Up to 10 Ci
In-111	Gamma	Yes	Lead	Yes	Moderate	Up to 100 mCi
I-123 I-125 I-131	Gamma	>1 mCi	Lead	Yes	High	Up to 1 mCi, med-100 mCi

22. Accidents, Incidents, and Emergencies

The UNO Environmental Health and Safety Office (EHSO) provides helpful information for students, faculty, and staff to use in the event of an emergency. Information that pertains to accidents, incidents, and emergencies involving radioactive materials are listed below.

Personal Contamination

Any personal contamination must be reported to the RSO immediately.

Contaminated skin should be washed with mild soap and water.

Contaminated clothing must be removed promptly and folded inward to prevent the spread of contamination. The clothing should then be placed in a plastic bag and labeled for decay or disposal as radioactive waste in accordance with the UNO Regulated Waste Guidelines.

The RSO will record contamination levels observed and procedures followed for incidents involving contamination of individuals. An incident record will be documented that includes names of individuals involved, description of work activities, calculated dose, probable causes (including root causes), steps taken to reduce future incidents of contamination, times and dates, and the surveyor's signature.

Accidents, Injuries, or Illnesses

In the event personnel are injured, seek medical attention immediately. Employee accidents, injuries, and illnesses are reported to the UNO EHSO via a paper form on their website. Inform the employee's supervisor, staff leadership, and/or safety representative. Report near-misses in the same manner. If the employee is unable to report the accident, injury, or illness, the supervisor, staff leadership, and/or safety representative may report the incident for them.

Medical Assistance

If there is an emergency, call 911 and UNO Campus Police. Notify the employee's supervisor or their designee within twenty-four (24) hours of the incident.

Spills in General

The decision to implement a major spill procedure instead of a minor spill procedure depends on many incident-specific variables, such as the number of individuals affected; other hazards present; the likelihood of spread of contamination; and types of surfaces contaminated as well as the radiotoxicity of the spilled material. For some spills of short-lived radionuclides, the best spill procedure may be restricted access pending complete decay.

As a general guideline, a spill involving more than one millicurie of radioactive material or more than one liter of radioactive liquid is a major spill which must be reported immediately to the RSO. The initial responder can determine if the clean-up will require additional radiation safety assistance.

Minor Spills of Liquids and Solids

1. Notify persons in the area that a spill has occurred.
2. Prevent the spread of contamination by covering the spill with absorbent paper. Paper should be dampened if solids are spilled.
3. Clean up the spill, wearing disposable gloves and using absorbent paper.
4. Carefully fold the absorbent paper with the clean side out and place in a plastic bag for transfer to a radioactive waste container. Put contaminated gloves and any other contaminated disposable material in the bag.
5. Survey the area with an appropriate radiation survey meter set on lower scale. Check the area around the spill for contamination. Also check hands, clothing, and shoes for contamination.
6. Report the incident to the RSO as soon as possible.
7. Cooperate with the RSO in discovering the root cause of the spill and in providing requested bioassay samples if indicated.
8. Follow the instructions of the RSO concerning decontamination techniques, surveys, provision of bioassay samples, and requested documentation.

Incidents Involving Dusts, Mists, Fumes, Organic Vapors, or Gases

1. Notify all personnel to vacate the room immediately.
2. Shut down ventilation system, if possible, unless it is determined that the room ventilation system needs to be used to clear the air for access purposes.
3. Vacate the room. Seal the area, if possible.
4. Notify the RSO immediately.

5. Ensure that all access doors to the area are closed and posted with radiation warning signs or post guards (trained) at all access doors to prevent accidental opening of the doors or entry to the area.
6. Survey all persons who could have possibly been contaminated. Decontaminate as directed by the RSO.
7. Promptly report suspected inhalation ingestions of radioactive material to the RSO.
8. Decontaminate the area only when advised and/or supervised by the RSO.
9. Allow no one to return to work in the area unless approved by the RSO.
10. Cooperate with the RSO in discovering the root cause of the incident and in providing requested bioassay samples if indicated.
11. Follow the instructions of the RSO concerning decontamination techniques, provision and collection of bioassay samples, and providing requesting documentation.

Minor Fires

1. If other fire hazards or radiation hazards are not present, immediately attempt to put out the fire by approved methods (ex. fire extinguisher).
2. Notify all persons present to vacate the area and have one individual immediately call the fire department and the RSO.
3. Once the fire is out, isolate the area to prevent the spread of possible contamination.
4. Survey all persons involved in combating the fire for possible contamination.
5. Decontaminate personnel by removing contaminated clothing and flushing contaminated skin with lukewarm water, then washing skin with a mild soap.
6. In consultation with the RSO, determine a plan of decontamination and the types of protective devices and survey equipment that will be necessary to decontaminate the area.
7. Allow no one to return to work in the area unless approved by the RSO.
8. Cooperate with the RSO in discovering the root cause of the incident and in providing requested bioassay samples, if indicated.
9. Follow the instructions of the RSO concerning decontamination techniques, provision and collection of bioassay samples, and providing requested documentation.

Major Fire, Explosion, or Major Emergencies

1. Notify all persons to vacate the area immediately.
2. Notify the fire department.
3. Notify the RSO and other facility safety personnel.

4. Upon arrival of firefighters, inform them where the radioactive materials are stored or where radioisotopes were being used; inform them of the present location of the radioactive material and the best possible entrance route to the radiation area, as well as any precautions to avoid exposure or risk of creating radioactive contamination by use of high-pressure water, etc.
5. Cooperate with radiation safety personnel in discovering the root cause of the incident and in providing requested bioassay samples if indicted.
6. Allow no one to return to work in the area unless approved by the RSO.
7. Follow the instructions of the RSO concerning decontamination techniques, provision and collection of bioassay samples, and providing requested documentation.

Release into the Environment

1. Immediately report to the RSO any unplanned release of radioactive material into the environment.
2. The RSO will determine, based on the quantity released, if the event is required to be reported according to the regulations.

Missing Radioactive Material

Once a loss of radioactive material has been discovered, it must be immediately reported to the RSO. The RSO will:

- Gather information regarding the disappearance of the radioactive material;
- Initiate steps to locate and recover the material;
- Determine if the loss is required to be reported according to regulations; and
- If required, report the loss in the required time frame.

23. Procurement

Radioactive materials (except for clinical uses) must be procured from NRC or Agreement State licensed suppliers. Each supplier of radioactive material is required by the state and federal regulations to possess a valid license to manufacture and prepare such material. The RSO will provide copies of the broad scope license to suppliers. If a copy is needed by a new or prospective supplier, the RPH must ask the RSO for a copy to be forwarded to the supplier.

All requisitions must be ordered by the RSO. Orders cannot be placed directly with the vendor.

The RPH must be authorized to use the isotopes and amounts prior to submitting an order.

Replacements for an incorrect order or unusable shipments must be negotiated by the Purchasing department with consent of the RSO.

The requisition must contain the following information:

- Name of the RPH
- Name of the Vendor

- Catalogue Number
- Isotope
- Compound
- Activity in µCi or mCi
- Quantity (number of units)

After verification by the RSO that the RPH is authorized to possess the material and that the order will not exceed the possession limit, the order will be transmitted to the Purchasing department by the RSO.

24. Receiving Radioactive Material

All personnel involved with the receipt of radioactive material shipments must be instructed in the proper procedures and precautions. These include:

- Putting on the proper PPE and dosimetry before accepting the package from the courier.
- Visually inspecting the package for damage or evidence of leaking contents.
- Monitoring the external surfaces of the package for radioactive contamination via a wipe test and Geiger survey. These tests must be conducted within three (3) hours of delivery.
- Letting wipe test run through the liquid scintillation counter (LSC) before opening the package to ensure no contamination has occurred.
- Keeping documentation of the surveys and keep them in the Lab Safety Binder.
- If any contamination has occurred or radiation dose rates are excessive, contacting the RSO and the courier immediately.

25. Radioactive Material Inventory

Upon receipt of radioactive materials, the AU/RPH is responsible for maintaining accurate inventory records for all radioactive materials possessed. Materials received in the lab must be recorded in the lab's inventory system. All laboratory radioactive material users must send updated inventories to the RSO annually by January 31.

Inventory information must include:

- Isotope
- Lot Number
- Initial Volume
- Initial Activity
- The date(s) the radioactive material is removed from the stock vial
- The volume(s) of radioactive material removed from the stock vial (in milliliters)
- Activity each time radioactive material is removed from the stock vial (decay)
- The waste stream (dry, liquid, or mixed with liquid scintillation fluid) that it is destined for
- The container number of the radioactive waste stream that it is destined for

26. Transporting Radioactive Material

All radioactive material shipped from UNO must be shipped by or under the direction of the RSO. Clinical departments are generally authorized to return radioactive material to their vendors. However, only staff currently trained in DOT radioactive material regulations can package shipments for transport. As of the writing of these Guidelines, DOT training is required every three (3) years for road transport, and IATA training is required every two (2) years for shipping by air.

Driving with Radioactive Material

No student, staff, faculty, or volunteer affiliated with UNO may transport radioactive material in any vehicle.

Shipping Radioactive Material

Laboratories or other areas not specifically authorized for packaging and shipping of radioactive materials must contact the RSO for assistance. Items must be brought to the RSO in unsealed shipping cartons. Pick-up can be arranged for shipments from off-campus locations.

Before any radioactive material can be shipped to any licensed recipient, UNO must have a copy of the recipient's NRC or Agreement State radioactive materials license to ensure that they are authorized to receive the material n the quantity being sent. For shipments other than routine returns to vendors, a Transfer Form must also be completed which has been signed by the RSO of the recipient indicating approval of the transfer. Contact labsafety@uno.edu to request a copy of the Transfer Form.

Records of radioactive material shipments must be kept in the Lab Safety Binder and sent to labsafety@uno.edu.

27. Waste Management

Collecting, storing, and disposing of radioactive waste must be managed in accordance with the UNO Regulated Waste Guidelines.

Containers must be labeled with the completed UNO Radioactive Waste Label.

Remove or deface any radioactive markings from primary containers (ex. boxes) before placing materials in landfill or recycling bins.

When sealed for disposal, add the following information to the UNO Radioactive Waste Label:

- Amount of activity
- Radiation exposure rate (in mR/hr) at surface of the container
- Exposure rate (in mR/hr) at 1 meter from the container
- Name of the surveyor
- Date of survey

Lead shielding must be disposed of as hazardous waste in accordance with the UNO Regulated Waste Guidelines. Never place lead in radioactive waste containers.

Separating Radioactive Waste

Mixed chemical and radioactive waste generation must be approved by the RSO prior to beginning the experiment.

Short-Lived Dry Waste (half-life <120 days) must be placed in separate containers according to half-life. Examples of isotopes that must be in separate containers include P-32, S-35, and I-125.

Short-Lived Aqueous Waste (half-life <120 days) is collected in plastic bottles. Examples of isotopes that must be in separate containers include P-32, S-35, and I-125. Aqueous waste used with potentially biohazardous materials or capable of supporting bacterial growth must be disinfected by the lab before disposal.

Long-Lived Dry Waste (half-life >120 days) must be placed in 20-gallon or 5-gallon containers. The primary components of this waste are H-3 and C-14.

Long-Lived Aqueous Waste (half-life >120 days) is collected in plastic bottles. The primary components of this waste are H-3 and C-14.

Liquid Scintillation Vials

Vials should only be collected in small, sturdy containers due to weight. Separate containers must be used for each isotope being collected.

Sharps must be stored in biohazard sharps containers.

Liquid scintillation vials must be managed otherwise as radioactive waste in accordance with the UNO Regulated Waste Guidelines.

Animal Waste

Cage/pen waste (ex. other excreta and bedding) must be collected in appropriate biohazard bags, sealed with tape, and labeled with:

- Contents
- RPH's name
- Nuclide
- Total collected activity
- Date of collection

Bags must be placed in designated storage area.

Carcasses and tissues must be placed in appropriate biohazard bags (with double-bagging for heavy carcasses), sealed with tape and labeled with:

- Contents
- RPH's name
- Nuclide
- Total activity
- Date administered

When double-bagging is used, all labels must be on the outside of the outermost bag.

Carcasses and animal tissues must be frozen and stored in designated freezers until disposal can be arranged through the RSO.

Liquid Waste Drain Disposal

In-lab disposal via sanitary sewer is allowed with RSO approval only on a case-by-case basis, usually when research generates a large volume of low activity waste. Clinical areas are authorized for in-house waste disposal of short-lived radioactive waste. The protocol below must be followed:

- Survey the container with a GM survey meter.
- If the reading is background, the material is ready for disposal.
- Otherwise, it is held until it reaches background.
- Run water in the designated sink for several minutes to ensure that it is draining properly.
- Use proper personal protective equipment (PPE) to prevent contamination including lab coat, double latex or nitrile gloves, disposable apron, disposable protective sleeves, and face shield.
- Discharge liquid waste slowly to minimize splashing with water running, to be sure that the material moves out of the sink and into the sewer system.
- Triple-rinse each container with water.
- Survey the sink and surrounding work surfaces to confirm that no residual material or slight contamination is present, and decontaminate if necessary.

Request for Radioactive Waste Disposal

Researchers submit a radioactive waste disposal request through emailing the RSO at labsafety@uno.edu.

In-Lab Decay

Storing waste in the lab for decay is discouraged. The RSO will pick-up, manage, and document the disposal.

28. Use of Radioactive Material in Animals

General Guidance in Vivo

The Institutional Animal Care and Use Committee (IACUC) protocol must be submitted to the RSO before experiments involving radioactive materials and animals may occur. IACUC has the prerogative to approve the use of animals.

The RSO performs quarterly radiation safety audits of all Animal Use areas. Records such as: animal care records, cage records, survey records, waste records, and training records are checked during the audit. The RSO also performs contamination and radiation level surveys if needed.

All use of radioactive material must be conducted under the supervision of an RPH who has approval from IACUC and the RSO.

All investigators using radioisotopes in animals are required to design and perform their studies in a manner which prevents unnecessary exposures to radiation and keeps necessary exposures ALARA. This requirement applies to the use of all animal care facilities.

Standard Procedures

All animal care personnel and research staff must have current training on the safe use and sources of radiation. Personnel shall be aware of the significance of radioactive signs and labels and follow precautionary measures included on such signs.

Main entry doors of animal care facilities where radioactive material is present must be posted with a sign bearing the radiation hazard symbol and the words "CAUTION RADIOACTIVE MATERIAL."

Primary enclosures containing live animals that have received radioactive material must be properly identified in the animal care facility. Cage records must be attached to the cage in which radioactive animals are housed.

Radioactive animals must be transported in such a manner to prevent contamination of hallways, elevators, etc. Solid bottomed transfer containers are mandatory.

The RPH must evaluate the radiation dose in the work place, the excretion rate of radioactive material, and any special hazard that may be associated with the radionuclide or its chemical form.

If routine animal care is handled by staff other than the RPH's staff, specific instructions must be provided on animal care such as feeding, watering, cage and pen cleaning, and waste handling.

In the event animals undergo necropsy during the period of radioactivity, procedures for radiation protection, sample collection, and waste disposal must be specified to necropsy personnel prior to the beginning of procedures.

Radioactive animal carcasses and tissues must be collected and stored for decay by trained staff.

Waste logs must be maintained. Radiation survey must be conducted after ten (10) half-lives, and survey results must be documented in the waste log. Radiation levels must not exceed background radiation levels.

Standard Protocols

Authorized radioisotope users who require care for animals treated with radioactive materials must provide, by direct supervision and/or complete written instructions, the procedures which the animal caretaker must follow with respect to cage handling and collection and disposal of radioactive waste.

Investigators often house animals containing radioactive material in general animal care facilities which are used by several investigators at the same time. Such facilities, by necessity, are accessible to people with widely varying training in radiation safety.

To assist investigators who must maintain animals treated with radioactive material, a set of protocols have been developed for animal care and specify the radiation conditions permitted for their use. Animal care protocols must be specified in the IACUC protocol.

The presence and degree of potential radiation hazards should be readily and easily demonstrated to any person in the vicinity of each animal cage that contains radionuclides. This can be accomplished through signage or other similar means.

The decision on whether animals containing radioactive material may be housed in general care facilities or if they must be placed in isolation rooms depends in part on the radiotoxicity of the radionuclides being used and the maximum activity excreted daily per cage or room. Limits are based on the chemical and physical forms of the radionuclide and its excretion rate.

Radiotoxicity classifications and maximum daily excretion for commonly used radionuclides are listed below:

Radiotoxicity Classification:	
Hazardous	Ca-45, I-123, I-125, I-131
Moderately Hazardous	Cr-51, Cu-64, Ga-68, F-18, P-32, S-35, Se-75, Tl-201
Slightly Hazardous	H-3, C-14, Tc-99m, In-111

Maximum Permitted Daily Activity Excretion			
Radiotoxicity Classification	Housed in General Animal Facilities		Housed in Isolation Rooms
	Care by Non-Radiation Workers (Blue Protocol)	Care by Radiation Workers (Yellow Protocol)	Care by Radiation Workers (Red Protocol)
Hazardous	< 100 µCi / cage **And** < 500 µCi / room	> 100 µCi / cage **And** < 500 µCi / room	> 500 µCi / room
Moderately Hazardous	< 1 mCi / cage **And** < 5 mCi / room	> 1 mCi / cage **Or** > 5 mCi / room	> 25 mCi / room
Slightly Hazardous	< 5 mCi / cage **And** < 10 mCi / room	> 5 mCi / cage **Or** > 10 mCi / room	> 50 mCi / room

Selecting Proper Animal Care Protocol

Each of the standardized protocols for animal care is designated by a color card. Selection of appropriate protocol (and hence the appropriate color) is essential to ensuring the safe handling of animals containing radioactive material. Animal care protocols are selected based on radiotoxicity, isotope half-life, dose rate, and likelihood of contaminated

bedding. In order of increasing potential hazard, the color codes used are as follows: Blue – Yellow – Red.

Blue Protocol

The blue protocol is used with any animal that does not require care by radiation workers or isolation. It is used only with short-lived isotopes (physical half-life < 10 hours) as long as the quantity does not exceed the limits established for non-radiation workers. Radiation dose rate in normal work space does not exceed 2 millirem/hour. The color card may not be appropriate with animals requiring daily pen/cage cleaning unless the physical half-life of the radionuclide is less than 2.5 hours. Radiation dose rate in normal work space does not exceed 2 millirem/hour.

Researchers must complete the color cards based on the information posted in the scan room. Cards will be returned to the RPH's staff at the end of the study.

Animal holding area surveys must be conducted and documented on the card by research staff. Radiation levels for animal bedding and waste must be checked at the end of the study. Radiation levels must not exceed background radiation levels.

Yellow Protocol

The yellow protocol is used with animals requiring care by radiation workers, but not requiring isolation. This protocol is used for radioisotopes with a physical half-life > 10 hours, as long as the quantity does not exceed the limits established for non-radiation workers. The radiation dose rate in the immediate work area may exceed 2 millirem/hour, but the radiation dose rate in adjacent work areas must not exceed 2 millirem/hour.

Animal litter is contaminated and must be collected and stored as radioactive waste. The RPH or other trained radiation worker provides all routine care of animals as required by the RSO and IACUC for the designated care period.

Records must identify the persons who provide animal care. Animal litter and waste will be collected by trained radiation workers. Waste must be checked before regular disposal.

The cages must be checked for contamination at the end of the studies.

Animal holding area surveys must be conducted and documented by the Radiation Permit Holder or other trained radiation worker. Radiation levels must not exceed background radiation levels.

Red Protocol

The red protocol is used for any animal requiring isolation. The degree of hazard requires isolation of the treated animal(s). Access to the isolation room is restricted to necessary personnel. Arrangements for an isolation room must be made with the RSO and IACUC prior to the start of the experiment.

The RPH together with the RSO and IACUC will determine the duration of isolation and the specific procedures to maintain satisfactory animal care and radiation protection.

The RPH or other trained radiation worker provides all routine care of the feeding, watering, cage washing, and room cleaning.

Waste and contaminated equipment must be collected and stored for decay by the RPH or other trained radiation worker. The room must be checked by the RSO before releasing the room for general use.

29. Instrumentation

You are required to list the surveying and counting instrumentation available for use in your laboratory when applying for an authorization. When an application is sent to the RSO, the RSO determines that the correct instrumentation is available to detect the radionuclides requested.

If a necessary piece of instrumentation is missing, the RPH must purchase the equipment or receive permission from another RPH to use their equipment.

Most laboratories purchase their own GM survey meter when needed, but liquid scintillation and gamma counters are often shared within departments.

The equipment must be on order prior to submission of the application.

GM Survey Meters

A GM survey meter can be purchased from Ludlum Measurements, Johnson Nuclear, Thermo Scientific, or other major manufacturer of radiation detection equipment. The most popular and commonly used GM survey meter at UNO is the Ludlum Model 3 with a Model 44-9 “pancake” probe.

The survey meter must have an external detector for surveying surfaces for contamination and can read in either mR/hr, CPM, CPS or a combination.

For clinical use, there must be a dedicated check source available, and a GM survey meter must be used:

- For uptake, dilution, and excretion studies for which a written directive is not required, a meter with a range of 0.1 to 50 mrem/hr is required; and
- For procedures requiring a written directive, a meter with a range of 0.1 to 50 mrem/hr and a meter range of 1 mrem/hour to 1000 mrem/hour is required.

Survey meters must be picked up by the RSO for calibration before first use (unless accompanied by a calibration certificate), annually, and following any repair that will affect the calibration. The calibration sticker on the instrument will indicate the date by which the instrument must be recalibrated. The record of each meter calibration must be maintained by the RPH for three (3) years or per UNO policy, whichever is longest. It is the responsibility of the RPH to see that the instrument is free of contamination. Most laboratories can arrange to share an instrument with a neighboring lab while their instrument is being calibrated, but some “loaner” meters are available.

Calibration of GM survey meters can take up to two (2) weeks, but may take longer if additional repairs are needed.

Lab personnel may borrow or loan a calibrated GM survey meter from another lab if their meter is due for calibration and they are actively working with radioactivity. The lending lab must consent to the borrowing/loaning.

If your GM survey meter requires repairs, contact the RSO for an assessment. The GM survey meter will have to be repaired by the instrument manufacturer at the expense of the lab/department. GM survey meters returned to the manufacturer must be wipe tested prior to shipment.

Quality Control Requirements

Quality control checks for gamma counters, well counters, liquid scintillation counters, and thyroid probes must be performed as recommended by the manufacturer. These checks must include a background and constancy check each day the instrument is used for clinical purposes.

Periodic tests to assure proper performance of the instrument, such as a chi-square test, must be performed quarterly or as recommended by the manufacturer.

The efficiency of the well counter for the isotopes of interest and the window of detection must be checked annually for non-human use, daily for human use.

Procedures and forms for the tests mentioned here must be sent to the RSO annually via labsafety@uno.edu and stored in the Lab Safety Binder.

Dose Calibrators

An AU authorized to administer radiopharmaceuticals shall possess and use a dose calibrator to measure the activity of unsealed radioactive material prior to administration to each patient or human research subject.

The dose calibrator must be tested in accordance with nationally recognized standards or the manufacturer's instructions, which shall include the following:

- Constancy check each day of use with sealed source(s) of not less than fifty (50) microcuries of a photon-emitting source, such as Cs-137.
- Linearity check upon installation and quarterly thereafter and following adjustment or repairs.
- Accuracy check annually and following adjustment or repair.
- Geometry dependence upon installation and following adjustment or repair.
- Records must be kept.

Disposing of Instruments

If you need to dispose of a liquid scintillation counter, gamma counter, or Geiger counter, use the UNO Equipment Hazard Tag to complete a full decontamination. Adhere the completed tag to the instrument before putting in a pick-up request with UNO Property Control Management.

Make sure you check all equipment for internal radioactive sources. Liquid scintillation counters contain Cs-137, Ba-133, or Ra-226. The instrument manufacturer must remove the radioactive source from the instrument before disposal.

Failing Instruments

If your survey or counting instrument fail,s and you are unable to survey for contamination, contact the RSO and attempt to find a temporary replacement from another lab while your instruments are being repaired.

Other Equipment

Area monitors, hand and food monitors, and stack monitors must be calibrated on an annual basis.

Breathing zone monitors may be necessary if working with volatile radioactive compounds within a fume hood. The monitors must be calibrated annually. A base line bioassay may be necessary depending on the radioisotope of interest.