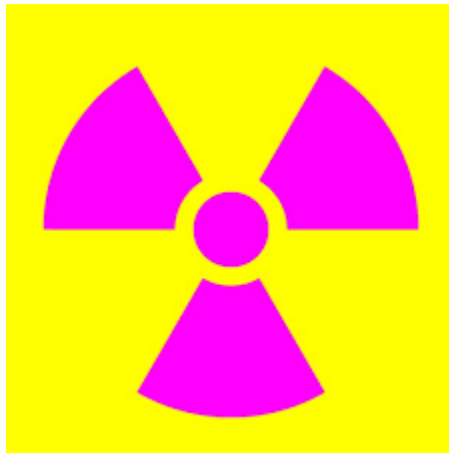


University of Virginia Radiation Safety Program Manual



Environmental Health & Safety Program

Website: [Radiation Safety, UVA-EHS \(virginia.edu\)](https://www.virginia.edu/radiation-safety)

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Table of Contents

DEFINITIONS.....	5
INTRODUCTION	7
PART A. UVA RADIATION SAFETY PROGRAM.....	8
A.1 THE IMPORTANCE OF RADIATION SAFETY	8
A.2 RADIATION SAFETY PROGRAM ORGANIZATION	8
<i>Radiation Safety Committee (RSC)</i>	8
<i>Clinical Radiation Safety Committee (CRSC)</i>	9
<i>Office of Environmental Health & Safety (EHS) Radiation Safety Program</i>	9
<i>Radiation Safety Officer (RSO)</i>	10
<i>Chief Diagnostic Medical Physicist</i>	10
<i>Radiation Oncology Director of Radiological Physics</i>	10
<i>Qualified Medical Physicist (QMP)</i>	11
A.3 LICENSES/REGISTRATIONS ISSUED TO THE UNIVERSITY OF VIRGINIA	11
<i>Broad Scope RAM license</i>	11
<i>Gamma Knife RAM license</i>	11
<i>RPE Registration</i>	11
PART B. GENERAL RADIATION SAFETY	12
B.1 TRAINING REQUIREMENTS FOR INDIVIDUALS WORKING WITH OR IN THE VICINITY OF RAM OR RPE.....	12
B.2 OCCUPATIONAL RADIATION DOSE LIMITS AND MONITORING	12
<i>Occupational Dose Limits</i>	12
<i>Dosimeter Guidelines for External Monitoring</i>	13
<i>Proper Use of Dosimeters</i>	13
<i>ALARA Letters</i>	14
<i>Pregnancy Policy/Guidance</i>	15
B.3 RADIATION WORKER EXPOSURE SAFETY.....	15
B.4 LAB AND EQUIPMENT COMMISSIONING AND DECOMMISSIONING.....	17
B.5 RADIATION SURVEY INSTRUMENTS	17
B.6 RADIATION SURVEYS.....	18
B.7 GENERAL EMERGENCY PROCEDURES.....	18
B.8 OBLIGATION TO REPORT UNSAFE CONDITIONS TO RSO.....	18
B.9 RADIATION SAFETY POLICY VIOLATION	19
PART C. RADIOACTIVE MATERIALS USE AT UVA	20
C.1 RADIOACTIVE MATERIAL (RAM) FOR NON-MEDICAL RESEARCH USE	20
<i>Principal Investigator (PI) for Possession and Use of Radioactive Material</i>	20
<i>Qualified User (QU)</i>	20
<i>General User (GU)</i>	21
C.2 RADIOACTIVE MATERIAL FOR MEDICAL USE.....	21
<i>Authorized User (AU)</i>	21
<i>Medical Use Qualified User</i>	21

<i>General User</i>	21
<i>Medical Event Reporting</i>	21
C.3 TRAINING REQUIREMENTS FOR INDIVIDUALS WORKING WITH OR IN THE VICINITY OF RAM	22
<i>Individuals with no previous experience</i>	22
<i>Individuals with previous experience</i>	22
<i>Individuals who are certified by specific examining boards</i>	23
<i>Individuals attending, or who have attended, radiation safety training provided by the Radiological Physics Support of the Radiation Oncology Department</i>	23
<i>Other individuals who may require training</i>	23
<i>Annual Refresher Training Requirement for All Radiation Workers</i>	23
C.4 RADIOACTIVE MATERIAL USE APPLICATIONS	23
<i>Blank Copies of Applications</i>	24
<i>Principal Investigator and Authorized User</i>	24
<i>General User and Qualified User</i>	24
<i>Radiation Safety Committee Letter of Approval</i>	24
C.5 IRRADIATOR USE	24
C.6 SAFE USE OF UNSEALED RADIOACTIVE MATERIAL	25
C.7 RESEARCH PROTOCOLS INVOLVING USE OF IONIZING RADIATION IN HUMANS	25
C.8 RESEARCH INVOLVING USE OF ANIMALS	25
C.9 LAB APPROVALS, COMMISSIONING AND RADIONUCLIDE POSSESSION LIMITS	26
<i>Commissioning</i>	26
<i>Lab Changes (room additions, deletions, etc.)</i>	27
<i>Nuclide and Possession Limit Changes</i>	27
<i>Signs and Postings in the Laboratory</i>	27
<i>Changes to the laboratory and in the type of experiments and protocols that are conducted</i>	27
C.10 PROCUREMENT AND RECEIPT OF RADIOACTIVE MATERIAL	28
<i>Purchase of Radioactive Material</i>	28
<i>Receipt of Radioactive Material that is Not Purchased</i>	28
<i>Response when radioactive material is shipped directly to the lab</i>	28
<i>Transfer of radioactive material within the university from one lab to another</i>	29
<i>Safe Opening of Radioactive Material Packages</i>	29
<i>Shipment of Radioactive Material</i>	30
C.11 RADIATION SAFETY NOTEBOOK AND RADIOACTIVE MATERIAL INVENTORY	30
C.12 SAFEGUARDING RADIOACTIVE MATERIAL	30
C.13 BIOASSAY	31
<i>Radioactive Iodine</i>	31
<i>Bioassay for all Other Radionuclides</i>	32
C.14 RADIATION SURVEY INSTRUMENTS	32
<i>Radiation Survey Instrument Calibration</i>	33
<i>User responsibility</i>	34
<i>Liquid Scintillation Counters (LSC) and Gamma Counters</i>	35
C.15 RADIATION SURVEYS	36

	<i>Radiation Survey Records</i>	36
	<i>Exemptions from Radiation Surveys</i>	37
	<i>Radiation Survey Results</i>	37
C.16	RADIATION SAFETY VIOLATION POLICY	38
	<i>Policy Overview</i>	38
	<i>Radiation Safety Violation Enforcement Policy</i>	39
	<i>Notification of Violations</i>	40
	<i>Violation Follow-up Procedures and Investigations</i>	40
	<i>Reporting violations and investigations</i>	41
	<i>Misconduct</i>	42
C.17	RADIOACTIVE WASTE.....	42
C.18	EMERGENCY PROCEDURES	46
C.19	LABORATORY AND EQUIPMENT DECOMMISSIONING	50
	<i>Laboratory Decommissioning</i>	51
	<i>Decommissioning Records</i>	51
	<i>Release of Equipment for Unrestricted Use</i>	51
	<i>Release of Equipment to Surplus</i>	51
	<i>Important Points to Remember</i>	51
C.20	NUCLIDE SAFETY DATA SHEETS (NSDS)	52
PART D.	RADIATION PRODUCING EQUIPMENT (RPE)	53
D.1	PERSONS PERMITTED IN X-RAY ROOMS DURING IMAGING EXAMS OR PROCEDURES	53
D.2	DIAGNOSTIC IMAGING OF INDIVIDUALS WHO ARE OR MAY BE PREGNANT	53
D.3	HOLDING OF INFANTS DURING IMAGING	53
D.4	USE OF GONADAL AND FETAL SHIELDING DURING IMAGING.....	54
D.5	MONITORING OF EXPOSURES FROM FLUOROSCOPICALLY GUIDED INTERVENTIONS (FGI's)	54
D.6	RADIATION PROTECTION	54
D.7	PROCUREMENT AND REGISTRATION OF RPE.....	54
D.8	REMOVAL OF RPE FROM SERVICE.....	55
D.9	RADIATION EQUIPMENT USE AND SAFETY	55
D.10	PROHIBITED RADIATION EXPOSURES FROM RPE	56
D.11	MODIFICATION AND REVIEW OF DIAGNOSTIC COMPUTED TOMOGRAPHY (CT) PROTOCOLS	56
D.12	INSPECTION OF PROTECTIVE APPAREL	56
D.13	USE OF LARGE MOBILE C-ARMS.....	57

DEFINITIONS

Activity - when talking about radioactive material, the units of Curie or Becquerel (SI unit) or number of nuclear disintegrations per minute (dpm) are used to describe the quantity of material that is present.

Absorbed Dose - means the energy imparted by ionizing radiation per unit mass of irradiated material. The units of absorbed dose are the rad and the Gray (Gy).

Committed effective dose equivalent - or "HE,50" means the sum of the products of the weighting factors (wT) applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to each of these organs or tissues ($HE,50 = \sum (wT HT,50)$)

Dose Equivalent - is a measure of how much energy is absorbed by the body from radiation. It is a calculation that seeks to quantify the risk of biological effect on human tissue from ionizing radiation. Dose equivalent means the product of the absorbed dose in tissue, quality factor, and all other necessary modifying factors at the location of interest. The units of dose equivalent are the rem and Sievert (Sv). 100 rem = 1 Sv. These are also the units reported on your dosimetry report and quantify how much dose you have received.

Deep Dose Equivalent (DDE) - DDE is the risk to the whole body from radiation that has enough energy to penetrate deep into the body and deposit its energy anywhere in the body. It is often called whole body dose, applies to external whole-body exposure and is the dose equivalent at a tissue depth of 1 cm.

Effective Dose equivalent (EDE) - is the sum of the products of the dose equivalent to the organ or tissue and the weighting factors applicable to each of the body organs or tissues that are irradiated. This important concept "normalizes" risk to the whole "being", from the part of the body receiving radiation dose, and allows us to combine doses to radiosensitive organs or tissues in the body, (external and internal) to account for total risk to the whole body.

Exposure - term used to describe the amount of ionization produced in air from a radiation source. The unit used for this measurement is Roentgen (R) or milliroentgen (mR). Most portable survey instruments measure exposure. Exposure rate measurements can be used to calculate dose or dose equivalent.

Gray - is the SI unit of absorbed dose. One gray is equal to an absorbed dose of 1 Joule/kilogram (100 rad)

Lens Dose Equivalent (LDE) - LDE is the external exposure dose equivalent to the lens of the eye at a tissue depth of 0.3 centimeters.

MeV - Mega electron volt (1 million electron volts). Unit of measurement which quantifies the amount of energy carried by particulate or electromagnetic radiation, e.g., Cs-137 emits a 0.662 MeV gamma ray and P-32 emits a 1.7 MeV Beta particle.

Rad - is the special unit of absorbed dose. One rad is equal to an absorbed dose of 100 ergs/gram.

RAM - Radioactive material. Materials that emit radiation.

Rem - is the special unit of any of the quantities expressed as dose equivalent. The dose equivalent in rem is equal to the absorbed dose in rad multiplied by the quality factor (1 rem = 0.01 Sievert (Sv))

RPE- Radiation Producing Equipment. Equipment that generates radiation when energized. Examples include x-ray, CT, and linear accelerators.

Shallow Dose Equivalent (SDE) - SDE is the dose equivalent, or risk, from radiation that has enough energy to pass through the dead layer of skin that we all have on our bodies, and deposit its energy in the live skin beneath. It applies to the external exposure of the skin of the whole body or the skin of an extremity and is taken as the dose equivalent at a tissue depth of 0.007 centimeter.

Sievert - is the SI unit of any of the quantities expressed as dose equivalent. The dose equivalent in Sievert is equal to the absorbed dose in grays multiplied by the quality factor (1 Sv = 100 rem)

Total Effective Dose Equivalent (TEDE) - TEDE is that total risk to the whole body from sources of radiation both inside and outside the body. It means the sum of the deep-dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

INTRODUCTION

This document describes the radiation safety program and policies at the University of Virginia. While all workers are expected to abide by university policies (e.g., SEC-009) as well as State and Federal regulations related to radiation, this document describes specific policies for individuals working with radioactive materials (RAM) or radiation producing equipment (RPE).

Parts A and B of this document apply to all RAM and RPE users.

Part C applies primarily to RAM.

Part D applies primarily to RPE, primarily diagnostic x-ray equipment.

Part A. UVA Radiation Safety Program

UVA policy SEC-009 “Radiation Safety Program” (Policy Directory (virginia.edu)) requires that the Radiation Safety Program ensures best practices are used with ionizing radiation, to monitor the use of ionizing radiation, and to comply with Virginia Department of Health regulations.

This document describes the radiation protection practices and procedures applicable to the safe use of RAM and RPE by University of Virginia (UVA) faculty, staff, students, and Medical Center employees.

A.1 The Importance of Radiation Safety

The improper or unsafe use of RAM or RPE has the potential to create a health hazard for not only the user, but also for the public and the environment surrounding the area of use. The licenses and permits that are issued to UVA by the Virginia Department of Health (VDH) specify what material or devices may be used and the procedures that must be followed when used.

Those who work with RAM must adhere to the safe work practices that are taught during training and are described in this document and other procedures issued by the Office of Environmental Health & Safety (EHS), Radiation Safety Program.

Those who work with RPE must adhere to the safe work practices that are taught during training and described in this document or other procedures issued by the Chief Diagnostic Medical Physicist or Radiation Oncology Director of Radiological Physics.

Radiation Safety is the responsibility of all users. Radiation safety procedures are established for everyone’s benefit and implementation requires everyone’s support. All personnel using RAM and RPE are expected to become familiar with UVA radiation safety procedures and to conduct their operations in accordance with them. Failure to adhere to these procedures could lead to disciplinary action, up to and including termination, and can jeopardize the University’s use of RAM and/or RPE. The regulatory and University requirements described in this document are in addition to requirements of any relevant procurement policies and the medical device criteria set forth in MCP-0076 (Management of Medical Devices Used in Patient Care [Management of Medical Devices Used in Patient Care Medical Center Policy v.1 \(policytech.com\)](#)).

A.2 Radiation Safety Program Organization

Radiation Safety Committee (RSC)

[Radiation Safety Committee, UVA-EHS \(virginia.edu\)](http://virginia.edu)

VDH regulation 12VAC5-481-470 requires the establishment of an administrative structure to supervise the possession and use of RAM radiation sources on the license. This structure is independent of other administrative organizations within the University. A component of this structure, the Radiation Safety Committee (RSC), is charged with ensuring that licensed RAM be used safely and in accordance with the license and applicable regulations.

The University's RSC members are appointed by the Vice President for Research. The Committee is comprised of representatives of departments and divisions of the University that use or have management oversight over the use of RAM and RPE. The Committee meets at least once each calendar quarter to review issues of importance to radiation safety.

SEC-009, UVAs policy for the Radiation Safety Program states:

The Radiation Safety Committee is responsible for working with executive management and the RSO in implementing the Radiation Safety Program and establishing policies and procedures for managing the Radiation Safety Program. It is comprised of the RSO, representatives of executive management, and persons trained and experienced in the safe use of RAM and RPE. At a minimum, each area of use under the RAM license should be represented on the RSC.

Specific duties and responsibilities performed by the RSC include:

- Monitoring timely and effective resolution of corrective actions to assure the effectiveness of the Radiation Safety Program;
- Enforcing compliance with the program, including imposition of sanctions for non-compliance;
- Making recommendations to the Vice President of Research on risk management issues related to radiation safety;
- Reviewing and approving, modifying or denying all proposals for RAM use;
- Voting to approve, disapprove, or amend RAM license proposals;
- Reviewing the dosimetry reports and ALARA reports; and
- Reviewing and approving the annual audits conducted as part of the Radiation Safety Program.

Clinical Radiation Safety Committee (CRSC)

The CRSC oversees RPE use and safety within the Health System. The CRSC reports to the Clinical Staff Executive Committee (CSEC) and to the RSC.

Office of Environmental Health & Safety (EHS) Radiation Safety Program

[Radiation Safety, UVA-EHS \(virginia.edu\)](http://www.virginia.edu/radiation-safety)

The Radiation Safety Program resides within the Office of Environmental Health & Safety (EHS). EHS maintains the RAM license issued to UVA and is responsible for

ensuring that the use of licensed material is in compliance with the conditions of the license, its associated procedures and other regulations.

The Radiation Safety Program's primary objectives are to protect personnel and the general public from unwarranted radiation exposure.

The EHS-radiation safety program's responsibilities include:

- training personnel in the safe use of radioactive material;
- administering the personnel and environmental dosimetry program;
- procurement of all radioactive material;
- shipment and receipt of all radioactive material for the University;
- collecting, packaging, and disposing of all radioactive waste;
- performing routine laboratory inspections;
- commissioning and decommissioning of all radioactive material use areas;
- emergency response.

Radiation Safety Officer (RSO)

The Radiation Safety Officer is responsible for the implementation, coordination, day-to-day oversight, and management of the EHS-Radiation Safety Program as well as reporting overexposure events and medical events to the Virginia Department of Health in a timely manner. The RSO has the authority to enforce radiation policies and procedures regarding radiation safety and regulatory compliance of the use of ionizing radiation. If you have any questions regarding the University's license, procedures, policies, rules or regulations relating to radiation safety, please call the RSO at 434-982-4919.

Chief Diagnostic Medical Physicist

The Chief Diagnostic Medical Physicist is responsible for the registration, commissioning, administration, inspection, safe use, and decommissioning of all diagnostic RPE machines used for healing arts within the University and UVA Health. The Chief Diagnostic Medical Physicist can be reached at PIC #2281.

If you have general questions, please visit the Medical Physics website at: [UVA Medical Physics Support](#) or more urgent needs via 24/7 support at PIC# 9463.

Radiation Oncology Director of Radiological Physics

The Radiation Oncology Director of Radiological Physics is responsible for the registration and radiation safety of RPE and RAM used in the Department of Radiation Oncology. Additional responsibilities include creation, maintenance, and implementation of radiation safety policies that are applicable only to radiation oncology RPE and RAM, ensuring appropriate personal radiation dosimetry monitoring usage in radiation oncology, and reporting radiation oncology medical events to the RSO, RSC, and CSRC. If you have any questions, please visit their website at: [UVA Radiation Oncology Medical Physicists](#)

The Radiation Oncology Director of Radiological Physics can be reached at 434-824-5421.

Qualified Medical Physicist (QMP)

A QMP is an individual who is competent to independently provide clinical professional services in one or more of the subfields of medical physics, including Diagnostic Medical Physics, Nuclear Medical Physics, Therapeutic Medical Physics, or Medical Health Physics. QMPs have met academic and training requirements, and are granted certification in a specific subfield(s) of medical physics by an appropriate certification board.

National practice recommendations (e.g., by the American Association of Physicists in Medicine, American Board of Radiology, or American Society of Radiation Oncology) require/recommend that certain activities involving RPE be performed by a QMP

A.3 Licenses/Registrations Issued to the University of Virginia

Broad Scope RAM license

The UVA Broad Scope RAM license allows the University to use a wide variety of radioactive materials in many different ways. This license covers the use of radioactive material in the academic schools, medical school, Health System, and other offsite locations.

Gamma Knife RAM license

This license is a specific license that allows the University to possess and use a gamma knife stereotactic radiosurgery unit, which contains RAM, for treatment and research. This license is under the purview of UPG.

RPE Registration

In accordance with 12VAC5-481 Part II, RPE is required to be registered with the Virginia Department of Health with the following exception:

- X-ray machines in areas of exclusive federal jurisdiction (airports, military and other federal facilities)
- X-ray machines belonging to manufacturers and dealers used for demonstration purposes (See notification of temporary use requirements)
- X-ray machines from out of state used for less than 180 calendar days (See notification requirements)

While RAM usage at UVA requires the above-mentioned licenses with the VDH, for RPE, each individual RPE device must be registered with VDH.

Part B. General Radiation Safety

B.1 Training Requirements for Individuals Working with or in the Vicinity of RAM or RPE

VDH regulations require that all individuals working with, as well as in the vicinity of RAM or RPE, must have adequate training and experience.

Good training is the key to reducing and maintaining low exposures to individuals. Training allows an individual to make informed decisions regarding the acceptance of risk as part of their job and to use protective methods that will keep doses As Low As Reasonably Achievable (ALARA).

Radiation safety instruction shall be provided:

- To individuals who work with RAM as part of their job;
- To individuals who routinely work with radioactive patients;
- To individuals who could receive a radiation dose that is equal to or greater than 10% of any applicable dose limit;
- Whenever there is a significant change in duties, regulation, and terms of the license or type of radioactive material or therapy device used

A general radiation safety training course is required prior to being issued a dosimeter at UVA.

Specific training requirements for the use of RAM and RPE is covered below in their applicable parts.

If you have questions regarding radiation safety training, you may contact the RSO.

B.2 Occupational Radiation Dose Limits and Monitoring

The University is required to limit doses to radiation workers in accordance with 12VAC5-481-640.

Occupational Dose Limits

The maximum allowable radiation dose that a radiation worker may receive at the University of Virginia is shown in Column 2 (Annual Limit) of the following table.

Tissue or Organ of interest	Annual Limit	ALARA Level II
Whole body; head; trunk including male gonads; arms above the elbow; or legs above the knee	5 rem	2.5 rem
Hands; elbows; arms below the elbow; feet; knee; leg below the knee; or skin	50 rem	25 rem
Lens of the eye	15 rem	7.5 rem

Dosimeter Guidelines for External Monitoring

Dosimeters are used to monitor the dose you receive while working with or around RAM or RPE. Information obtained from your dosimeter allows us to evaluate the safety of your work environment and maintain doses ALARA.

Wearing your dosimeter is important. Not only does it provide you with a measure of the dose you receive while performing your work, but it also provides information that can alert us to the need for review of equipment performance and individual work practices. Ultimately, it is you who decides what dose level and corresponding risk is acceptable to you based on this information.

All individuals who have the potential to receive greater than 10% of the dose limits will be issued a dosimeter to monitor their dose. Before working with RAM or RPE, you may contact the EHS-radiation safety program at 434-982-4919 or visit our webpage ([Radiation Safety Dosimetry, UVA-EHS \(virginia.edu\)](http://www.virginia.edu/radiation-safety-dosimetry)) regarding the need for a dosimeter.

Proper Use of Dosimeters

If you are issued a dosimeter, you must comply with the following:

- Your dosimeter should be worn at all times while working with or around RAM or RPE. It should be worn on the portion of the whole body which will receive the highest dose. The front or name side of the dosimeter must be facing the source of radiation;
- If you wear a lead apron, your dosimeter should be worn on the lapel outside of the lead apron;
- Do not take your dosimeter home with you;
- Protect your dosimeter from radioactive contamination;
- Do not store or leave your dosimeter near RAM or RPE;
- Do not loan your dosimeter to a coworker; it is for the assigned individual's use alone;
- Do not wear your dosimeter for personal medical exposures, i.e., do not take it to the dentist or physician if you are to receive an x-ray;

- Do not intentionally expose your dosimeter to radiation. The dosimeter and its subsequent reading is an official record of your occupational radiation exposure. Intentionally exposing it to radiation will result in an inaccurate record of your occupational dose;
- Do not disassemble or otherwise tamper with your dosimeter;
- Contact the dosimetry program coordinator promptly if your dosimeter is lost, damaged, or destroyed;
- Contact the dosimetry program coordinator if you believe your dosimeter has been accidentally exposed to radiation;
- When a new dosimeter is received at the start of a new wear period, replace the old dosimeter with the new one. Do not wear the old dosimeter once a new one is received;
- Return your dosimeters to your department coordinator at the end of the wear period. The dosimeters will be collected by EHS-radiation safety personnel. An unreturned dosimeter provides no information; and
- When wearing ring dosimeters, always check to be sure that the label portion of the ring is facing the source of radiation. Fingers can act as shielding and affect the accuracy of skin and extremity doses recorded.

The EHS-radiation safety program returns the dosimeters to a dosimetry vendor for reading and results are reported back to us. Each area has a designated dosimeter coordinator. Check with this individual regarding receipt and return schedules for dosimeters issued in your department. If your dosimeter is not returned on time, UVA will be charged for late or unreturned dosimeters.

If you receive medical care that involves radioactive material except HDR or Gamma Knife treatments, you should contact the RSO to discuss. You must continue to wear your dosimeter while at work. Any elevated readings reported on your dosimeter will be discussed with you and a notation can be made in your permanent dose record to address the dose received from the medical procedure.

ALARA Letters

The radiation safety program strives, to the extent practicable, to maintain doses at levels that are As Low As Reasonably Achievable (ALARA). Workers' doses are continually evaluated and when necessary, investigations are conducted which examine the adequacy of techniques and equipment used to minimize personnel doses.

If your doses exceed the ALARA levels shown in Column 3 above, you will receive an ALARA letter from the EHS-Radiation Safety Program. After receipt of an ALARA letter, you must provide a written response to EHS-Radiation Safety Program, which should include a description of methods that will be employed to reduce future doses.

If the EHS-Radiation Safety Program does not receive a response, you may not be allowed to work with RAM or RPE until an ALARA letter response is received.

Pregnancy Policy/Guidance

It is known that cells in the body that reproduce rapidly are more sensitive to radiation damage. The cells of the embryo/fetus are rapidly dividing during early development and are therefore, considered to be much more sensitive to radiation.

The first three months of fetal development are particularly critical. If you are considering becoming pregnant, you should review the Radiation Safety Protection webpage (<http://ehs.virginia.edu/Radiation-Safety-Pregnancy.html>) for information on policies, risks and recommendations regarding exposure to radiation during pregnancy.

If you are pregnant, you may formally declare your pregnancy for radiation protection purposes. If you are pregnant and work with or around RAM or RPE, you may also inform your supervisor.

Declaration of a pregnancy is voluntary and is accomplished by completing a Voluntary Declaration Form available on the Radiation Safety website or through the program. Once the declaration form is completed and reviewed, Radiation Safety will monitor your occupational dose more closely by issuing an additional dosimeter to monitor the dose to the fetus. Upon declaration of a pregnancy, UVA will be required to ensure that the dose to the embryo/fetus during the entire pregnancy, due to occupational exposure, does not exceed 500 mrem.

Handling of radioiodine compounds, particularly when there is potential for volatilization of iodine, should be avoided for the term of the pregnancy.

If you are uncomfortable with your work schedule during pregnancy or have concerns regarding your exposure during pregnancy, you should speak with your supervisor and/or the RSO.

For more information regarding pregnancy and radiation exposure, please visit our webpage at: [Radiation Safety Pregnancy, UVA-EHS \(virginia.edu\)](#).

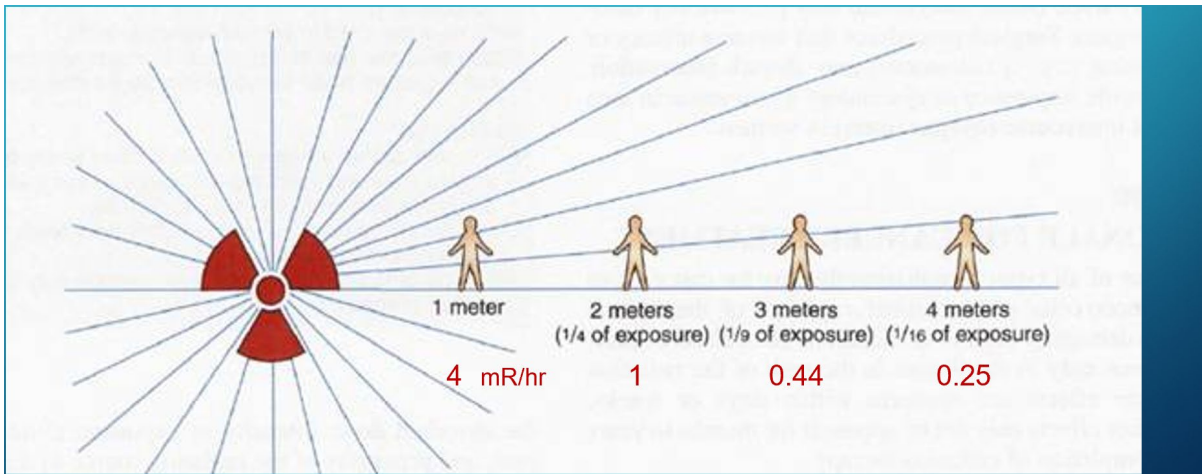
UVA policy SEC-0010, addresses radiation protection during pregnancy. You may find it at: <https://uvapolicy.virginia.edu/policy/SEC-010>.

B.3 Radiation Worker Exposure Safety

UVA radiation safety training stresses the importance of maintaining your exposure ALARA. The three methods to utilize in this endeavor are: time, distance and shielding.

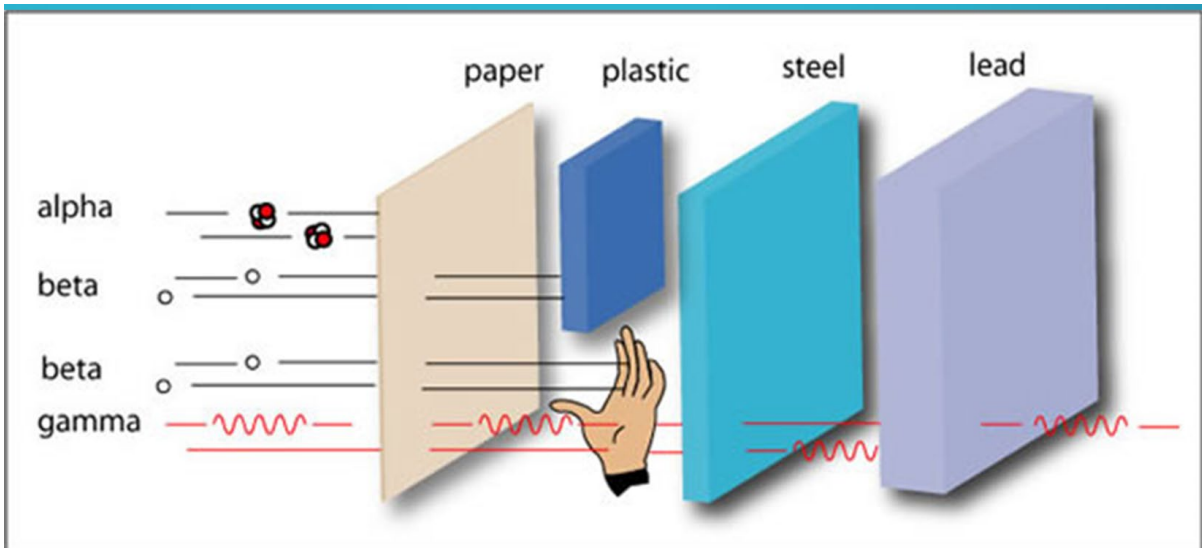
To minimize your exposure, you can lessen the time of your radiation exposure..

Distance is a great way to keep your exposure ALARA. This illustration depicts the impact of your exposure by being further away:



If you Double your distance from a source you will decrease your exposure by **more than half**. You will reduce it to a **fourth** of the original exposure.

Shielding can also be used to reduce radiation exposure. This illustration depicts the best kind of shielding to be used for each type of radiation source:



For individuals working with or around RPE, the most widely used form of shielding used is lead aprons. For those who wear lead aprons, the following figure shows the recommended way to appropriately wear lead aprons:

Lead Apron Protective Apparel

LEAD “APRON” AND THYROID SHIELDS

- Thyroid shield - there should **NOT** be a gap between your thyroid shield and lead apron
- **Double** wrapped **0.35 mm** light weight composite separate top and bottom “apron” aka “wraparound” style
- The wraparound style is **required** for CT procedures since it provides full protection (front and back)
- Goggles are **recommended** for those involved in long procedures



B.4 Lab and Equipment Commissioning and Decommissioning

For areas using RAM, commissioning and decommissioning must be performed by the EHS-Radiation Safety Program. More information is provided in the RAM section below.

For areas using diagnostic RPE, commissioning and decommissioning must be performed by the Radiology Medical Physics Support group. More information is provided in the RPE section below.

For areas using therapeutic RPE, commissioning and decommissioning must be performed by the Radiation Oncology Radiological Physics staff.

B.5 Radiation Survey Instruments

Areas using RAM must have the appropriate radiation survey instruments. Information is described in the RAM section below.

Areas where diagnostic RPE is used are not required to have radiation survey instruments. Staff from the Radiology Medical Physics Support group will maintain RPE survey instruments. More information is available in the RPE section below.

Areas where therapeutic RPE is used are required to have appropriate radiation survey instruments. These instruments are maintained by the Radiation Oncology Radiological Physics staff.

B.6 Radiation Surveys

Areas using RAM must perform surveys as required by VDH regulations. These surveys must be properly documented. More information is provided in the RAM section below.

Areas where diagnostic RPE is used will not perform surveys. Radiology Medical Physics Support group staff will perform the surveys and properly document. More information is available in the RPE section below.

Areas where therapeutic RPE is used must perform surveys as required by VDH regulations. Radiation Oncology Radiological Physics staff will perform the surveys and properly document.

VDH regulations require that a **Notice to Employees** form containing instruction to workers on these matters be posted in a conspicuous location.

This is what the Notice to Employees looks like: [NOTICE TO EMPLOYEES \(virginia.edu\)](#)

If you have not seen one in an RAM or RPE area, please contact the RSO, Chief Medical Physicist or Director of Radiological Physics.

B.7 General Emergency Procedures

VDH regulations require emergency procedures to be available/posted/reviewed.

Emergency procedures for RAM areas are discussed in detail in the RAM section below.

For diagnostic RPE emergency procedures, contact the Radiology Medical Physics Support at PIC# 9463.

For therapeutic RPE emergency procedures, contact the Director of Radiological Physics at 434-924-5421.

B.8 Obligation to Report Unsafe Conditions to RSO

All radiation workers have an obligation to report any unsafe conditions in their workplace. Your safety, your coworker's safety and the safety of the surrounding general public may be jeopardized if unsafe work conditions are not corrected. You also have a responsibility to report promptly any condition which may lead to or cause a violation of VDH regulations or unnecessary exposure to radiation.

You must notify the RSO immediately if any of the following occur:

- Individuals inappropriately using RAM or RPE; Individuals not properly wearing lead and/or dosimetry when required;
- Routine surveys of the work area identify unexpectedly high or low radiation levels, or unexpectedly high or low contamination levels. (Note: unexpectedly low exposure rates could indicate that material has been moved or stolen or your instrument is not functioning properly);

- Medical event;
- A patient or human research subject (involving use of radioactive material or sources) has a medical emergency or dies; and
- Loss or theft of any radioactive material.

All spills involving radioactive material must be reported to the EHS-radiation safety program at 434-982-4919.

B.9 Radiation Safety Policy Violation

SEC-009 states:

Failure to comply with the requirements of this policy may result in disciplinary action up to and including termination or expulsion in accordance with relevant University policies and may result in prosecution in accordance with state law.

Violations of state law may result in significant financial penalties. Such penalties will not be paid from central University resources but must be borne by the laboratory, department, College, or School responsible for the facility in violation.

The Radiation Safety Committee enforces compliance with the program and imposes sanctions for non-compliance.

Questions about this policy should be directed to the Radiation Safety Officer in Environmental Health and Safety.

Part C. Radioactive Materials use at UVA

C.1 Radioactive Material (RAM) for non-medical Research Use

There are three categories of radioactive material authorizations assigned for use of radioactive material in the research setting. These are: Principal Investigator (PI), Qualified User (QU) and General User (GU).

Principal Investigator (PI) for Possession and Use of Radioactive Material

The PI category is typically reserved for the Laboratory Director. A person designated as a PI may use and possess radioactive material as specified in a letter of authorization that is sent from the RSO on behalf of the Chairman of the RSC. The PI is responsible for the safe, proper use and security of materials under their permit and may supervise other individuals in the use of these materials.

The PI is the principal contact for all correspondence from the RSC and Radiation Safety Program. The PI's responsibilities include, but are not limited to, assuring that:

- Lab surveys are performed properly and at the required frequency
- Contamination is controlled
- Exposure rates are controlled
- Work areas and equipment are properly controlled and labeled
- Radiation safety records are maintained
- Radiation workers in the lab have received required training and authorization
- Material is properly secured against unauthorized use or access
- Incidents and abnormal occurrences are promptly reported to Radiation Safety
- Radioactive material inventory is accurate
- Use is in compliance with applicable radiation safety rules and regulations
- During any extended absences (greater than one month), the responsibilities of the PI are transferred to a QU in the lab, or to another PI with approval from Radiation Safety.

Qualified User (QU)

This category of user is primarily intended for permanent faculty and staff members who wish to work with radioactive material and who are qualified by education and experience to use radioactive material independently. The responsibilities of the QU are the same as the PI (see above list), excepting the automatic approval to order material. The PI may delegate portions of radiation safety management responsibilities to a Qualified User in the lab. The PI may approve any QU in the lab for ordering material by indicating the same on the bottom of the QU application.

General User (GU)

Most individuals will be authorized as a General User. The GU can work independently with, or in the vicinity of, radioactive material, but cannot order radioactive material. The GU is not directly responsible for other lab personnel's use of radioactive material and may not supervise an unauthorized individual's use.

C.2 Radioactive Material for Medical Use

Authorized User (AU)

Additional regulations and training requirements apply to authorization for use of radioactive material in or on humans. In accordance with our Broad Scope license, the use of radioactive material in or on humans shall be by an individual who meets the training and experience requirements in 12VAC5-481. These individuals must be approved by the RSC and designated as Authorized Users under our license.

Medical Use Qualified User

This designation is used for individuals who may administer radioactive material to humans but do not meet the training and experience requirements for AU. These individuals may administer radioactive material only under the supervision of an Authorized User and must receive instruction as specified in 12VAC5-481-1710 (e.g., Radiology residents, fellows, other Medical Specialty Board Certified Physicians, registered technologists in their respective fields: nuclear medicine, radiation physics, and nuclear cardiology).

General User

Any worker, student, physician in training, etc. who does not administer radioactive materials, but spends significant and continuous time in radioactive material use areas and is routinely present during the administration of radioactive materials. These individuals must meet basic radiation safety training requirements specified by Radiation Safety.

Medical Event Reporting

A medical event generally involves the delivery of a dose to a patient that was different than the planned dose, the dose was delivered to the wrong organ or was not within 20% of the prescribed dose. This can result from administration of the wrong amount, nuclide, wrong patient, etc. Any medical event, event, accident or injury involving radiation exposure to staff or patients shall immediately be reported to RSO to ensure that timely evaluation and appropriate actions can be taken. The RSO must make the determination as to whether a medical event may have occurred in accordance with VDH regulations regarding such events and must report such within time frames specified in the regulations.

The RSO will investigate the event through consultation with individuals involved in the event in order to make a determination. The Health System's representative on the RSC as well as the appropriate department chair and the RSC Chair will be notified by the RSO about any events investigated and decisions made about reporting.

The procedure for notification of any event shall be directly by phone to the RSO.

C.3 Training Requirements for Individuals Working with or in the Vicinity of RAM

Individuals who have not completed training and approval are not allowed to work independently with radioactive material. They may, however, work under the direct supervision of their PI, QU or AU until they have completed their training requirements. These individuals must be provided dosimetry before working around radioactive material.

Individuals with no previous experience

These individuals must satisfactorily complete the following:

- Radiation Safety Training Course (RSTC)
- Radiation Safety Training Course Examination
- An application for the category of user desired

The RSTC is available as on-line training from the Radiation Safety website ([Radiation Safety Training, UVA-EHS \(virginia.edu\)](http://www.virginia.edu/radiation-safety-training)).

Individuals with previous experience

The Radiation Safety Training Course may be waived at the sole discretion of the RSO, or the Assistant RSO, based on the following:

The individual supplies documentation of training from the institution at which he or she was authorized to use radioactive material. A letter from that institution's RSO or Radiation Protection Manager (RPM) must be provided that contains the following information:

- A statement attesting that the individual attended and completed the Radiation Safety Training Course offered by that facility
- A copy, or description, of the course syllabus
- Duration of the course in hours
- Date of the course
- The RSO, or RPM, signature
- This letter must be dated

The RSO or Assistant RSO is not bound to accept previous training even upon satisfactory evidence that a previous course was completed. Reasons for not waiving attendance at the UVA RSTC may be that the earlier training was not of sufficient scope or was over 7 years in the past.

If documentation of previous training is accepted and completion of the UVA RSTC is waived, the individual will be required to satisfactorily complete the following:

- Radiation Safety Guide Lecture
- An application for the category of user type desired

Individuals who are certified by specific examining boards

Individuals who are certified by the boards listed on the NRC's medical licensee toolkit website, are exempt from the requirement for completion of the RSTC, but must satisfactorily complete the following training:

- Radiation Safety Guide Lecture for Patient Care Staff
- An application for the category of user desired

Individuals attending, or who have attended, radiation safety training provided by the Radiological Physics Support of the Radiation Oncology Department

These individuals must satisfactorily complete the following:

- Radiation Safety Guide Lecture for Patient Care Staff
- An application for the category of user type desired

Other individuals who may require training

Ancillary personnel such as housekeeping staff, dishwashers, etc. may require radiation safety training under certain conditions. Individuals working with special sources may require specialized training. Radiation Safety provides customized training for these groups of individuals. Please contact us for further information if you think you fall into this category.

Annual Refresher Training Requirement for All Radiation Workers

In addition to the initial training requirements, there is a refresher training requirement. Anyone who uses radioactive material while working at UVA, must complete annual refresher training. During surveys or audits, Radiation Safety staff will remind all radiation workers of the need to complete the retraining. If a user fails to complete the required retraining, they may lose the authorization to work with radioactive material. Re-authorization can only be obtained by completing retraining.

Re-training is available on line through the Radiation Safety Program website ([Radiation Safety Training, UVA-EHS \(virginia.edu\)](http://Radiation%20Safety%20Training,UVA-EHS(virginia.edu))). A live lecture can be provided if a request is made to the Radiation Safety Program.

C.4 Radioactive Material Use Applications

Before an individual can become authorized for the use of radioactive materials, they must complete an application and submit it to the Radiation Safety Program. These applications are available on-line through our website.

Blank Copies of Applications

Copies of the most current revision of each application are available on the Radiation Safety Program website: <http://ehs.virginia.edu/Radiation-Safety-Forms.html>.

Principal Investigator and Authorized User

Applications for AU or PI will be reviewed by the RSO, the Assistant RSO and/or the Health Physicist. If approved during this initial review, the application will be submitted to the RSC for vote of approval.

Applications for Authorized User (along with a preceptor statement if necessary) must be submitted to the RSO to document that the individual meets the training criteria specified in 12VAC5-481. The application must be approved and the individual must be designated an Authorized User under our license by the RSC.

General User and Qualified User

The GU or QU application must be signed by the applicant's PI or AU. The application is reviewed by the RSO or the Assistant RSO and the user will be tentatively approved. The applicants will then be reviewed and approved by the RSC at the next meeting.

Radiation Safety Committee Letter of Approval

Upon approval of your application, you will receive a letter from the RSO authorizing you to work with radioactive material at UVA. You are encouraged to use the Radiation Safety Program as a resource. If you have any questions regarding the use of radioactive material or radiation producing equipment, please feel free to contact us.

C.5 Irradiator Use

Irradiators are devices designed to provide a uniform gamma dose to small biological samples, materials and animals. Most irradiators contain the following major components: a radioactive source, shielding, a sample chamber, and a control panel. Some models may have an air supply to provide the sample chamber with ventilation.

The irradiator in use at the University is designed to minimize the radiation reaching the exterior surface of the device. During normal operation of the University's irradiator, it presents minimal hazard to users. Irradiators do not cause induced radioactivity; in other words, the material subjected to the gamma radiation, at the energies produced by these irradiators, does not become radioactive.

Enhanced security programs for these devices are required by regulation. All individuals who wish to use the irradiator must contact the Radiation Safety Program at 434-982-4919 for scheduling its use.

C.6 Safe Use of Unsealed Radioactive Material

All individuals working in a laboratory or other area where radioactive material is used or stored shall follow the general rules for safe use that include:

- Wear a laboratory coat, or other protective clothing, and eye protection at all times in areas where radioactive materials are used.
- Wear closed toe shoes. DO NOT wear sandals or other open toe shoes!
- Wear disposable gloves at all times when handling radioactive material.
- After each procedure or before leaving the area, monitor hands, shoes, and clothing for contamination in a low-background area.
- Do not eat, drink, smoke or apply cosmetics in any area where radioactive material is stored or used.
- Do not store food, drink or personal effects in areas where radioactive material is stored or used.
- Wear personnel monitoring devices, if required, at all times while in areas where radioactive material is used or stored.
- Dispose of radioactive waste only in designated, labeled and properly shielded receptacles.
- Never dispose of radioactive material down sink drains or in regular trash receptacles.
- Never pipette by mouth.
- Store radioactive solution in clearly labeled containers.
- Secure all radioactive material when it is not under the constant surveillance and immediate control of the user(s).

C.7 Research Protocols Involving Use of Ionizing Radiation in Humans

Research involving exposure of humans to ionizing radiation requires additional specific approval. These research protocols require review and approval by the Human Investigations Involving Radiation Exposure Subcommittee (HIRE) <https://med.virginia.edu/radiology/resources/staff-resources/medical-physics-support/human-investigations-involving-radiology-exposure-hire-committee/> or the Radioactive Drug Research Committee (RDRC) <http://ehs.virginia.edu/Radiation-Safety-RDRC.html> before approval by the IRB.

C.8 Research Involving Use of Animals

The University requires that, before any investigator purchases/obtains and begins research involving vertebrate species of animal, an animal research protocol must be submitted for review and approval by the Institutional Animal Care and Use Committee (IACUC).

The IACUC office assists investigators in completing the appropriate animal research proposal forms. The website address for the IACUC is:

<http://www.virginia.edu/vpr/iacuc/>

The transportation of radioactive animals to and from the vivarium from different buildings utilizing vehicles must be performed by Radiation Safety staff. Contact the Radiation Safety Program at 2-4919 to coordinate transportation of animals.

Housing of radioactive animals, including cage changes, is covered in the Center for Comparative Medicine SOP # 230.

The PI is responsible for informing vivarium staff that they will be housing radioactive animals. They also must label the cages with the universal radiation symbol, the investigator's name, name of the isotope, the dose (activity) of isotope, the date the isotopic material was injected and the date when 10 half-lives of decay will occur. If this information is not present on the cage, the vivarium staff should contact the RSO immediately. Vivarium staff are responsible for cage and rack changing.

C.9 Lab Approvals, Commissioning and Radionuclide Possession Limits

All radioactive material use areas and radionuclide possession limits must be approved by the Radiation Safety Program. Laboratory space may not be used for radioactive material work without proper approval. Only the PI or AU may request changes to items specified in their authorization.

Commissioning

The PI and AU application contains a section that requests information about the intended use of radioactive material. The application requests information on the amount of each nuclide that is to be used, the location of the use area(s) and the equipment that will be used. After a PI application has received final approval, a representative from the Radiation Safety Program will visit the lab and determine what is necessary to commission the lab. This typically includes:

- determining what signs and postings are needed;
- determining the number and type of solid waste containers needed;
- determining the number and type of liquid waste containers needed;
- setting the lab up with a Radiation Safety Notebook;
- determining the type of survey instruments that may be needed;
- explaining the types of radiation surveys that must be performed;
- determining the recommended frequency of radiation surveys (minimum of 1 survey per week while radioactive work is being performed);
- explaining the proper method for keeping material inventory accurate;
- reviewing, with the PI, the need for proper material security; and
- instructions on segregation of hazardous wastes.

During this visit, or subsequent one, a Radiation Safety Program technician will perform a lab “set up” at which time the lab will be provided with all required containers, postings, etc. After this is completed, work with radioactive material may proceed in the areas designated for use.

Failure to follow this procedure may result in violations of license provisions and State regulations. You may NOT move RAM or RAM-contaminated items into a room before it is properly posted for radioactive work. Only Radiation Safety Program staff may commission a lab or radioactive workspace.

Lab Changes (room additions, deletions, etc.)

After the initial lab set-up, the PI may add or remove rooms from their permit by emailing or calling the RSO and providing the necessary information. The request will be processed and a visit to the lab must be scheduled. A Radiation Safety Program technician will visit the lab and review the request with a knowledgeable representative of the lab.

If desired, the request may be made in writing by completing the “New Location” Application and submitting it to the RSO. As in the initial process, the PI will be notified of the approval authorizing the change in use space.

Nuclide and Possession Limit Changes

Nuclides may be added and existing limits may be increased by contacting the RSO and providing the necessary information by email. All amendments to an existing authorization must be approved by the RSO. The request must be approved before the PI may place an order for the material requested. This type of request is normally approved within 3 working days.

Signs and Postings in the Laboratory

Radiation warning signs and postings are required by regulations and internal policy. They must not be removed or altered once they are posted by radiation safety personnel. If you discover a problem with any posting or sign, e.g., missing, damaged, or out of date, please call the Radiation Safety Program at 434-982-4919.

Changes to the laboratory and in the type of experiments and protocols that are conducted

Significant changes to the laboratory (e.g., use of different nuclides, different types of equipment, structural changes which affect nuclide use and new experiments) must be approved by the RSO. Significant increases in the amount of material used may increase the radiation hazard associated with use of the material.

Any experimental change that would result in the generation of an EPA listed hazardous chemical waste that would be “mixed” with radioactive waste must be

carefully evaluated. Disposal of this type of waste can be extremely difficult and expensive. Please contact Radiation Safety if you plan to generate this type of waste.

C.10 Procurement and Receipt of Radioactive Material

All radioactive material used at UVA must be ordered and received through Radiation Safety, unless otherwise approved by the RSO.

Radiation Safety staff will perform the required “check-in” of the material and will deliver it to the appropriate storage location. This process is in place to ensure that the material is received in accordance with VDH regulations and to ensure that the package or contents have not been damaged during transportation. The check-in procedure also allows the Radiation Safety Program to ensure that the license possession limits are not exceeded and that the individual receiving the material is authorized to receive the material.

Please call Radiation Safety Program at 434-982-4919 if other arrangements are required for special shipments.

Purchase of Radioactive Material

At the time the order is placed, the Radiation Safety Program will verify that the PI/AU is authorized for the type and quantity of material to be received.

Discrepancies will be corrected before the order is placed. Radioactive orders for academic use must be placed using Workday. Instructions for ordering radioactive materials through Workday can be found here: <http://ehs.virginia.edu/Radiation-Safety-Order.html>

For orders in the medical center, follow PeopleSoft purchasing guidelines.

Receipt of Radioactive Material that is Not Purchased

If you are expecting a shipment of radioactive material from another university or institution, that material must also be shipped to the Radiation Safety Program. Contact us for instruction on shipment, shipping address and other license requirements prior to having the material shipped from the other institution. As noted above, the Radiation Safety Program will verify that the PI/AU is authorized for the type and quantity of material to be received. Discrepancies will be corrected before the material is delivered.

Response when radioactive material is shipped directly to the lab

If material is inadvertently shipped directly to your lab, you must immediately contact the Radiation Safety Program and arrange for it to be properly processed.

Transfer of radioactive material within the university from one lab to another

Radioactive material may be transferred from one lab to another provided the following requirements are met:

- The receiving PI/AU is authorized to possess the type and amount of material that is being transferred (i.e., nuclide and millicurie amount) and that the amount of nuclide to be received will not cause the PI/AU's authorization limits to be exceeded.
- The receiving lab should notify the Radiation Safety Program prior to the transfer to obtain approval.
- The material has been properly packaged
- The material is clearly labeled as to isotope and amount and is packaged in a manner that will prevent it from leaking.
- The transfer has been approved by both PIs.
- The Radiation Safety Program must transport the material from the current lab to the new lab ensuring the material is properly packaged, labeled and secured.

Safe Opening of Radioactive Material Packages

Packages which have been externally surveyed but not opened by the Radiation Safety Program must be opened promptly to confirm receipt of the correct material. The packaging and contents of the package should be inspected to determine if any damage to the contents has occurred.

It is recommended that the package be opened in a hood or other radioactive material work area with a prepared surface to contain any spills should they occur during package opening.

- Wear gloves and lab coat to prevent personal contamination
- Visually inspect the package for any sign of damage (e.g., crushed, punctured). If damage is noted, stop and notify the Radiation Safety Program.
- Open inner package to verify contents (compare requisition, packing slip and label on the bottle or other container). Check integrity of the final source container (e.g., inspect for breakage of seals or vials, loss of liquid, discoloration of packaging material, high count rate on smear) and perform a survey. If anything other than expected is found (i.e.; exposure rate readings higher than expected or if there is any reason to suspect contamination, stop and notify the Radiation Safety Program at 434-982-4919.
- Record the receipt of radioactive material in your radioactive material inventory log in your Radiation Safety Notebook.
- Survey the packing material and the empty package for contamination with a radiation detection survey meter or scintillation counter.

If contaminated, treat this material as radioactive waste and notify the Radiation Safety Program at 434-982-4919.

If not contaminated, remove or completely obliterate (i.e., make illegible) the radiation labels before discarding in the regular trash.

Shipment of Radioactive Material

The shipment of radioactive material is strictly regulated by the U.S. Department of Transportation and VDH. Material must be properly packaged, labeled and surveyed before shipment. In addition, VDH requires UVA to have proof that the recipient is licensed to receive the material. In order to ensure that all of these requirements are met.

Only Radiation Safety Program staff are authorized to ship radioactive material to another facility that is outside of the immediate grounds of the University.

C.11 Radiation Safety Notebook and Radioactive Material Inventory

Each radioactive material laboratory must utilize a radiation safety notebook.

There are two ways to utilize a radiation safety notebook, one is electronically and a second is a paper notebook.

The Radiation Safety Program utilizes a web-based program called HP Assist, which allows for the laboratory staff to enter all the required information. Training for HP Assist use is provided by Radiation Safety Program staff.

The paper notebook contains information regarding: radioactive material inventory, radiation surveys, blank forms related to radionuclide use, maps of the laboratory, waste disposal procedures and other information important to good lab practices and radiation safety. Additionally, the Notebook contains your PI Radioactive Material Project Data Summary Sheet for authorized radionuclides, possession limits, approved rooms and personnel. This notebook will be reviewed by Radiation Protection Program staff during audits.

The Nuclear Medicine Department, Nuclear Cardiology Department and Radiation Oncology Department utilize electronic programs for their information. This is reviewed by the Health Physicist and RSO.

C.12 Safeguarding Radioactive Material

VDH regulations require that ALL radioactive material (including waste) must be secured from unauthorized removal or access.

It is essential that everyone take responsibility for ensuring that all radioactive material is either under direct observation by authorized personnel, or when unattended, be secured (locked in a cabinet, refrigerator, room, etc.) at all times.

For additional information and requirements regarding security of radioactive material, please visit the "Security of Radioactive Material (FAQ)" webpage: [Radiation Safety Security, UVA-EHS \(virginia.edu\)](#).

The test for compliance is straightforward: Can someone remove radioactive material from your area without you, or another person in your area, knowing it? If the answer is yes, then the security in your area of use is not satisfactory. That is the test that Radiation Safety Program staff will use in evaluating individual laboratory security plans.

Do not hesitate to call or consult with Radiation Safety Program staff if any questions arise regarding the proper method for ensuring radioactive materials are secured at all times.

C.13 Bioassay

A bioassay is an evaluation of radioactive material in the body, either by direct measurement or by the analysis of biological samples. For example, a urine sample will be collected from individuals whose use of radioactive material exceeds a certain trigger level. When the Radiation Safety Program has determined that bioassays are required, a baseline evaluation should be performed prior to radioactive material use.

Bioassays may also be required following radioactive material spills or other release of radioactive material. Events that have the potential to cause an intake of radioactive material must be reported to the Radiation Safety Program so that bioassays can be obtained as soon as possible.

Radioactive Iodine

The University requires that all volatile iodine work be performed in a **"fume hood insert"** which is installed inside an approved fume hood posted with the radioactive symbol. These inserts, typically constructed of Plexiglas, function as a primary "hood" and draw air first through an activated charcoal filter before exhausting it into the main volume of the permanent fume hood, thus trapping any volatile iodine. EHS maintains a list of labs which currently have hood inserts, and can provide you with information on the purchase of an insert.

Type of Operation	Activity handled at any one time or cumulatively over a period of 3 months	
	volatile, dispersible or unbound	bound to non-volatile agent
bench top use, not in fume hood	0.1 mCi	1.0 mCi
use in an OEHS-certified fume hood	1.0 mCi	10.0 mCi

In addition to the individual(s) handling the material, it may be necessary to perform bioassays on individuals who work in close proximity to the radioiodine process being performed. This may include persons observing or assisting in the procedure. Determination of which individuals require a bioassay will be made by Radiation Safety staff.

A baseline bioassay should be performed prior to beginning work with radioiodine in quantities stated above. An initial bioassay, i.e., the first bioassay after work was performed, should be conducted between 6 and 72 hours following the beginning of the radioiodine work. Therefore, it is important to schedule a bioassay with Radiation Safety as soon as possible when initial use is scheduled. Holidays, vacations, and weekends should be considered when planning radioiodine use. Bioassay frequency following initial use will be determined by Radiation Safety.

Bioassay for all Other Radionuclides

Use of more than 75 mCi of any unsealed radionuclide requires an evaluation by the Radiation Safety Program to determine if bioassay will be necessary. Radiation Safety Program staff should be contacted in advance of any such work to allow for the performance of baseline and post-work measurement.

C.14 Radiation Survey Instruments

Selection of a radiation survey instrument must be based on the intended use. Instruments used for contamination surveys typically use a different type of probe and readout (cpm) than those used for exposure rate measurements (mR/hr). If you are unsure about the type of instrument, you will need to perform required surveys, contact the Radiation Safety Program for guidance. The program can assist you in choosing an appropriate instrument and can provide you with a list of vendors, products and price information. In general, a survey instrument should be capable of detecting the nuclide of interest, it should be easy to use, calibrate, and it should be reliable. Consult the table at the end of this document for additional information on selection of appropriate instruments.

Survey Instrument Guidance

The following table provides information on recommended instruments for performing surveys.

Isotope	Type of radiation	Geiger Counter with Geiger tube	Geiger Counter with Pancake	Geiger Counter with NaI crystal	Liquid scintillation counter	Gamma Counter
H-3	Beta	N	N	N	Y	N
C-14	Beta	N	Y*	N	Y	N

S-35	Beta	Y	Y*	N	Y	N
P-33	Beta	Y	Y*	N	Y	N
P-32	Beta	Y	Y*	N	Y	N
I-125	Gamma	N	N	Y	Y	Y
I-131	Beta, Gamma	Y*	N	Y	Y*	Y
Cr-51	Gamma	Y*	N	Y	Y	Y

N = Do not use this instrument

Y = Recommended instrument

Y* = Not recommended but may be acceptable if detector efficiencies have been determined.

Although I-125, I-131, and Cr-51 can be detected using a survey instrument with a Geiger Mueller probe attached, the counting efficiencies associated with these nuclides are very low. We recommend using either a sodium-iodide (NaI) probe with the survey instrument or a liquid scintillation or gamma counter for detection of these radionuclides.

Radiation Survey Instrument Calibration

All instruments used for radiation safety purposes should be properly calibrated and in good working order. Survey instruments (e.g., Geiger counters) must be in proper operating condition to ensure that surveys performed with these instruments are reliable and accurate. All instruments used to perform surveys must be calibrated annually and operationally checked before each use. The Radiation Safety Program can perform the required annual calibration on most instruments used at the University.

Geiger-Muller (GM) Counters

GM counters are required to be calibrated annually. This will be performed by Radiation Safety Program staff or a pre-approved calibration company. After each calibration, a report will be returned with the GM and must be kept in the corresponding section of the Radiation Safety Records notebook. This report describes the instrument, which was calibrated (e.g., manufacturer, model and serial number). It also indicates which units must be used when reading and recording survey results and the efficiencies to be used for selected radionuclides. Efficiencies are also noted on the case of the GM. The normal background, which is a reading taken in a non-radioactive work area, is provided in CPM. The report also provides any special operating instructions.

A lab which purchases a new meter for performing surveys or brings an instrument from another institution, should call Radiation Safety Program staff so that the meter may be picked up for initial calibration and entry into the HP Assist database. During the initial calibration, nuclide specific efficiency factors will be determined if required.

Calibration Sticker

Survey instruments must have current calibration stickers. Laboratory personnel are responsible for calling our program to schedule an instrument for its yearly calibration. A sticker on the side or bottom of the unit indicates the instrument's date of last calibration, the calibration due date and the initials of the person who performed the calibration. Always check the due date before using the instrument. If the calibration due date has passed, do not use the instrument. Call us immediately to arrange for calibration. The program can provide a loaner if necessary.

For liquid scintillation or gamma counters, refer to the instruction manual and/or ask the manufacturer's representative to perform a calibration.

Refer to the owner's manual for additional information on proper use and operation of the survey instrument. Most contamination survey instruments at UVA are calibrated in counts per minute (CPM). If you intend to perform exposure rate measurements, you will require an instrument that has been calibrated in mR/hr. Check the calibration sticker to confirm proper units for measurement. Survey measurements may only be made in the units that the instrument has been calibrated for (i.e., you cannot measure mR/hr with an instrument which has only been calibrated to provide a reading in cpm). Call our program for further assistance.

Detector Efficiency:

Each detector has a unique efficiency. GMs from the same manufacturer with similar model numbers may have different efficiencies. Instrument efficiencies are determined by the Radiation Safety Program and are noted on the calibration sticker affixed to the instrument.

GM detectors are not considered acceptable survey instruments for detection of low energy beta emitters. H-3, C-14, P-33, and S-35 surveys must be performed using swipes and counting in a liquid scintillation counter.

User responsibility

Each meter should be checked before use to ensure it is "in calibration". A calibration sticker should be affixed to the meter, which shows the date of calibration, the date the meter is due for recalibration, the units in which it was calibrated, and any efficiencies that were determined. If the meter does not have a Radiation Safety Program calibration sticker affixed, if it is coming due for calibration, or if its calibration has expired, contact us so that it can be picked up, entered into the system, calibrated or recalibrated.

It is your responsibility to ensure that the meter is in calibration, the batteries are good (and are replaced otherwise), and that the unit is responding properly. If there

are any problems with the function of your survey instrument, tag the instrument out of service and contact the Radiation Safety Program. Minor repairs can sometimes be performed by Radiation Safety Program staff.

Before each use, the following operational checks should be made:

Check calibration sticker to ensure meter is not out of calibration

Check calibration sticker to determine which units on the meter face should be used (i.e., cpm or mR/hr). The instrument is normally only calibrated to read in one or the other. Perform battery check (if batteries are low, change batteries, most take D cell batteries.)

Turn scale switch to appropriate scale and hold probe to check source in geometry specified on op-check sticker on the side of the meter. Reading should fall within range specified on the sticker.

If reading falls outside the range specified on the calibration sticker, do not use the instrument, call the Radiation Safety Program.

Liquid Scintillation Counters (LSC) and Gamma Counters

Fixed counting systems such as liquid scintillation counters and gamma counters may be needed to count wipes taken to assess potential laboratory contamination. The Radiation Safety Program does not calibrate LSCs or gamma counters. These instruments are usually purchased from the manufacturer with a "maintenance agreement". Calibration, repair, and maintenance should be arranged through the manufacturer or vendor of the machine. Factory representatives will typically calibrate and maintain these counters on an annual basis. If, however, you are having difficulty operating one of these machines or you are using a "new" radionuclide for which you have no detector (counter) efficiency, Radiation Safety can assist you.

If possible, avoid organic solvent-based scintillation cocktails as these incur a higher cost for disposal. Alternatively, eco-friendly cocktails can be used.

Liquid scintillation and gamma counters should be serviced annually. During this routine maintenance, the factory representative should check that the unit is functioning correctly and provide the owner with efficiency information. It is the responsibility of all users of liquid scintillation and gamma counters to maintain these counters if they are used for required surveys.

Scintillation counters may contain internal radioactive sources depending on the type of machine and must be decommissioned by Radiation Safety prior to disposal or transfer. If a new scintillation or gamma counter is purchased, please notify Radiation Safety.

Please feel free to call us if you have any questions regarding radiation detection equipment.

Dose Calibrators

If your work requires the use of a dose calibrator, you must ensure that the instrument is calibrated in accordance with the requirements of 12VAC5-481.

C.15 Radiation Surveys

Radiation surveys are performed to locate sources of radiation and to detect removable surface contamination in lab areas or on equipment, personnel and clothing. Surveys are required by regulation and the conditions of our license.

When work with radioactive material is performed in a laboratory, at least one survey is required to be performed and recorded each week.

All required surveys must be recorded in the Radiation Safety Records notebook. Every PI/Lab should have this notebook. For those labs using HP Assist, the notebook will be removed.

Areas and equipment that may be contaminated, such as the primary work bench(s), water baths, centrifuges, etc., used during the radioactive experiment, should be surveyed. The floor in front of the primary workbench, door handles, etc. should also be surveyed.

Surveys should be started in primary work areas and expanded radially. If the primary work area is free of contamination, the expanded survey area can be small. If contamination is detected in the work area, the expanded survey may need to encompass the entire laboratory.

Areas found to have unacceptable radiation levels or contamination must be shielded and/or cleaned as soon as possible. Radioactive contamination may be labeled with radioactive material warning tape and/or cleaned. Follow-up surveys must be performed to confirm that contamination problems have been corrected.

Radiation Survey Records

Always record surveys. A survey is considered incomplete if it is undocumented.

- Complete all items on the University of Virginia Laboratory Survey Sheet or enter into HP Assist;
- Be sure to note the purpose of the survey. A routine weekly survey is different than a spill response survey. Check the box for routine daily/weekly surveys, after performing a regular weekly survey. Record all non-routine surveys as well. Record results of follow-up surveys as well and note "Resurvey of spill." This survey confirms that the cleanup was successful.
- Record survey results in blue or black ink and initialing each survey;
- Use proper units (DPM or mR/hr units only), only pre-approved labs may use mR/hr;
- record survey results numerically (descriptive expressions such as "not hot" or "background" are not acceptable);
- Enter the full date (month, day and year) that the survey was performed.

- Signature of person who performed the survey

The “no work this week box” should be checked if no work is performed during that week. No survey is required if no radiation work has been performed. Alternatively, a written comment may be provided if no work with radioactive material will be performed for a longer period of time (e.g., “No radioactive work will be performed from *month/day/year* until *month/day/year*.”) A notation should be made if work was performed and the weekly survey was missed. From a regulatory standpoint, it is better to indicate that a survey was missed rather than make no comment at all or enter a survey result when none was performed.

Converting CPM units to disintegrations per minute (DPM) units:

Contamination surveys must be recorded in units of DPM in the survey records. Survey results must contain numeric values; descriptive results (e.g.; "background") are unacceptable.

The equation for converting CPM to DPM is:

$$\frac{\text{CPM gross} - \text{CPM background}}{\text{detector efficiency}} = \text{DPM}$$

All survey records must be kept until the termination of your authorization.

Regulations require that the University maintain all survey and use records indefinitely for the purpose of eventual decommissioning of facilities. At the termination of an authorization, survey records must be provided to OEHS for inclusion in the University-wide decommissioning records file.

Exemptions from Radiation Surveys

Radioactive material users may be exempted from the requirement to perform weekly radiation surveys if no material is used, or in any way manipulated, during the week or for an extended period of time. In this case an entry must be made in the survey records stating no work was conducted during the period noted.

All other requests for exemptions from performing surveys are made to, reviewed by and approved by the RSO.

Radiation Survey Results

Labs working with high-energy beta and gamma producing radioactive sources must perform ambient radiation surveys with an appropriate survey meter. The unrestricted dose rate level may not exceed 2 mR/hr. If the measured dose rate exceeds 0.1 mR/hr you must contact the Radiation Safety Program. These labs must also perform contamination surveys utilizing a survey meter.

Labs working with low energy beta producing radioactive material must perform contamination surveys with a liquid scintillation counter. These devices, when used for official surveys, must be properly calibrated.

If your contamination survey indicates counts that are twice background, retake the wipes and contact the Radiation Safety Program if the counts are confirmed.

Contamination results may not exceed the following limits:

Nuclide ¹	Average ^{2, 3}	Maximum ^{2, 4}	Removable ^{2, 5}
I-125, I-129	1.7 Bq/100 cm ² (100 dpm/100 cm ²)	5.0 Bq/100 cm ² (300dpm/100cm ²)	0.3 Bq/100 cm ² (20 dpm/100 cm ²)
I-126, I-131, I-133, Sr-90	16.7 Bq/100 cm ² (1,000 dpm/100 cm ²)	50.0 Bq/100 cm ² (3,000 dpm/100 cm ²)	3.3 Bq/100 cm ² (200 dpm/100 cm ²)
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.	83.3 Bq/100 cm ² (5,000 dpm/100 cm ²)	250 Bq/100 cm ² (15,000 dpm /100 cm ²)	6.7 Bq/100 cm ² (1,000 dpm/100 cm ²)

1 Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should apply independently.

2 As used in this table, dpm (disintegration per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

3 Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.

4 The maximum contamination level applies to an area of not more than 100 cm².

5 The amount of removable radioactive material per 100 cm² of surface area should be determined by wiping that area with filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

C.16 Radiation Safety Violation Policy

A radiation safety violation occurs when established radiation safety practices or procedures are not being followed as described in internal UVA policy or applicable external regulations associated with the use of radioactive material. These violations may occur in research labs, teaching labs and areas in the Medical Center where radioactive material is used for diagnosis and treatment.

Policy Overview

Radiation Safety policies and procedures are established by the Radiation Safety Program with oversight by the RSC. The RSO is appointed by the University's Executive Vice President and Provost and is responsible for ensuring the safe use of radioactive material. The RSO is responsible for managing the radiation protection program; identifying radiation protection problems; initiating, recommending, or

providing corrective actions; verifying implementation of corrective actions; stopping unsafe activities; and ensuring compliance.

The RSO is delegated the authority necessary to meet those responsibilities, including prohibiting the use of radioactive material by employees who do not meet the necessary requirements and shutting down operations were justified by safety concerns. The RSO is required to notify management if staff do not cooperate and do not address radiation safety issues. In addition, the RSO is free to raise issues with VDH at any time.

You must call the Radiation Safety Program if any of the following types of events occur:

- radioactive material security events;
- radioactive material spills;
- lost or misplaced radioactive material;
- contamination of personnel by radioactive materials;
- unauthorized removal of material;
- radioactive waste removed with the regular trash;
- equipment contamination;
- missed radiation surveys; and
- discrepancy in inventory records.

It is important that notification be made promptly. Certain events such as loss of material may require immediate notification to VDH. Radiation Safety Program staff will review the above events as necessary, and institute required corrective actions.

Surveys/Inspections are conducted in all research and medical use areas in which radioactive materials are used or stored and are conducted either quarterly, semi-annually, or annually, depending upon the types and amounts of radioactive material used. Radiation Safety staff perform a semi-annual comprehensive radiation protection audit in each lab. Radiation Safety Program staff utilize a Laboratory Survey Form or other audit form to identify violations and determine compliance. Labs that use large amounts of material may be audited with greater frequency as needed. These audits may include a review of records, postings, labeling, personal dosimetry use, training, housekeeping, survey meter calibration and a general contamination survey.

Radiation Safety Violation Enforcement Policy

Minor radiation safety violations* are typically identified during routine laboratory inspections and resolved through verbal or written communication between the PI, individuals working under the PI's authorization and Radiation Safety Program staff. This process ensures that problems are promptly identified and corrected.

The Radiation Safety Program believes that there are good working relationships at UVA and that continued noncompliance with established safety rules is a rare

occurrence. The Radiation Safety Program recognizes the possibility of a problem and has established a follow-up enforcement program.

Violations of a serious nature**, or those that are not resolved in a timely manner, are presented to the RSC for discussion. The responsible PI or AU may be requested to appear before the RSC to report on what occurred, why it occurred and how they intend to prevent a recurrence and ensure safe continuation of the authorization.

* Examples of minor violations include: training not current, unlabeled equipment (i.e., freezers), food and drink violations.

** Examples of serious violations may include: posing immediate harm to the health or safety of employees, students, the public, or the environment, a serious deviation from Radiation Safety policy or procedures, or knowingly failing to apply for authorization to conduct research with radioactive material or administer radioactive material to humans.

Notification of Violations

Following an inspection or investigation, any violations or recommendations are reviewed with the PI or lab representative present during the survey. They are then asked to sign the Laboratory Survey form acknowledging that they have been informed of the violations and required corrective actions.

Radiation Safety Program staff will conduct a complete and thorough review of the circumstances that led to the deficiency or violation. They will talk with personnel involved, review relevant procedures for completeness or need for revisions, and review the training of those involved to see if a lack of training may have contributed to the problem. If they are not routine or reoccurring situations, they are usually corrected during or shortly thereafter and do not present further problems.

Violation Follow-up Procedures and Investigations

The Radiation Safety Program staff surveyor and/or survey supervisor will determine if violations found during laboratory inspections must be followed-up with increased surveillance and in-services as appropriate to ensure the violations are corrected. All follow-up activities will be recorded on the Laboratory Survey Violation Follow-Up Form. Repeat violations will be reported to the Radiation Safety Program Survey Supervisor and the RSO. The follow-up survey frequency will be determined by the Survey Program Supervisor. The Survey Program Supervisor will determine when to terminate increased surveillance based on personal observation and staff recommendations.

Follow-up communications and laboratory inspections are regularly performed based upon the severity of the violation until all deficiencies are addressed. In the event these same problems reoccur, a more aggressive approach needs to take place to

find the cause of the problem(s), rectify the situation, and take measures to ensure that these conditions do not occur again in the future. In situations where satisfactory resolution is not achieved in a timely manner, notifications may be elevated to the director, department chairperson, or the RSC.

If an investigation is necessary, the RSO may obtain additional information by direct communication with the PI, contact person, co-workers, etc., review of laboratory procedures, training records, or via other related lab/facility documents. In some cases, an unannounced visit to a laboratory of concern may be prudent.

The RSO may suspend activities if there is a significant threat to public health or compromise of safety and regulatory compliance. Radiation Safety will work with the RSC to bring all activities into compliance. Committee enforcement or disciplinary action may include but is not limited to: a letter of reprimand from the RSC Chair or RSO, mandatory retraining, and suspension or termination of RSC approval and/or privileges.

Reporting violations and investigations

Violations are documented and lab inspection results are entered into the radiation safety program management database. Survey and audit findings are reported to the RSC during the quarterly meetings.

Incident reports are kept on file by the Radiation Safety Program. Incidents may be reported to VDH if required by regulation.

Reporting mechanisms:

- Any individual who has concerns may contact the RSO by email or phone
- Report through the EHS website for accidents or safety concern:
- <https://researchcompliance.web.virginia.edu/report/user/concern.cfm> .
- By direct observation from Radiation Safety Program staff during inspections or routine outings
- During an incident investigation where additional violations are observed

If an individual identifies an issue that presents a significant risk to human health and safety or to the license; they are strongly encouraged to self-report such findings to the RSO. The Radiation Safety Program maintains a positive safety culture commensurate with the safety and security significance of our activities and makes available through its website (<http://ehs.virginia.edu/Radiation-Safety-Culture.html>) a Safety Culture Policy Statement describing programs and practices in place at the University that support the organizational traits deemed necessary for the existence of a positive safety culture. Any employee, student, or associate of UVA reporting a Radiation Safety-related concern will be protected against reprisal. Every effort will be made to protect the individual's confidentiality in accordance with UVA policy.

Misconduct

Fabrication, falsification, plagiarism, or other practices that seriously deviate from those that are commonly accepted within the research community for proposing, conducting, or reporting research are considered research misconduct. Where there is willful or negligent violation of established radiation safety practices and procedures, or if a PI continues research activities after notification by the RSO to cease and desist, it may be deemed research misconduct. The Research Integrity Officer will be notified for administrative review and determination of action. Refer to the UVA Policy on Research Misconduct (RES-004 <http://uvapolicy.virginia.edu/policy/RES-004>) for more information.

C.17 Radioactive Waste

Radiation Safety Program provides all radioactive waste containers, radioactive waste pickup services and consultation. To request a radioactive waste pickup, email the electronic ticket to ehs-radwaste@virginia.edu. You may also call the Radiation Safety Program at 434-982-4919. The waste ticket must include the following information:

- Name of caller
- PI name and PI number
- Today's date and lab phone number
- Waste location: building and room
- Waste container size, radionuclide(s) and activity in mCi
- Type of container to be replaced or emptied
- Indicate the presence of contamination
- Note any problems with the waste.

Radioactive waste will be picked up on scheduled weekdays. Free (unbound) Iodine-125, high-activity waste and biological waste will be picked up on an expedited schedule. To expedite pickup, please call Radiation Safety before generating these types of wastes.

Please do not stockpile any radioactive waste. Submit waste requests regularly, even if the container(s) are not full. Regular removal of waste reduces radiation exposure to lab occupants and reduces the likelihood that waste content knowledge will be lost.

Radioactive waste must be segregated by radionuclide.

Each radionuclide has a unique half-life and environmental release limit. Improper co-mingling of radionuclides can delay the disposal of waste and may necessitate shipment of the material to a radioactive waste repository at a significantly greater cost to the University. Please contact Radiation Safety if you find it necessary to co-mingle radionuclides. It may be done only if it does not impact the University's waste processing and reduction program.

The University of Virginia's license requires waste containing isotopes with half-lives greater than 120 days (e.g., Co-57, Co-58, Na-22, Cl-36, Zn-65), to be shipped offsite for disposal. Radiation Safety will advise your lab on methods to minimize waste containing long-lived isotopes.

Radioactive waste must be segregated by physical form.

Dry Solids: This category includes such items as contaminated paper, plastic, glass, and metal. No standing liquids or blood-contaminated items are allowed in our solid waste boxes. A small volume of liquid (< 50 ml total) is permissible in the dry solid waste container.

Do not place Sharps in solid waste boxes. Sharps must be placed in approved and radioactively labeled sharps containers (provided by Radiation Safety) prior to disposal. The closed sharps containers may then be placed in the solid waste boxes.

Waste Scintillation Vials: All scintillation vials must be placed in trays and treated as a separate waste item with its own waste ticket. Vials containing radionuclides with half-lives greater than 120 days, i.e., Carbon-14 (¹⁴C) or Tritium (³H), must be segregated from other radionuclides and placed back in the empty cardboard tray they were received in. Carbon-14 and H-3 vials may be placed in the same tray. Clearly label each tray with the radionuclide name. Label the tray with radioactive warning tape. Place the waste vials in the tray in an up-right position and ensure that they are securely capped to minimize spills. Be sure to keep the cardboard tray in secondary containment (e.g., in a tray) in case of spills.

Organic Solvent-Based Scintillation Vials: Organic solvent-based scintillation fluors must be packaged separately. Since these vials may leak, do not store this waste for long periods of time.

Complete a waste ticket in the same manner you would for other forms of radioactive waste and be sure to check the **“liquid” check-box and indicate you have scintillation vials to be picked up.** If your lab does not purchase scintillation vials in cardboard trays, or you do not have empty trays available for your waste, please contact our program and they will be provided to you.

Bulk Liquids: Any liquid whose volume is greater than 50 ml is defined as a bulk liquid. The following must be performed:

- Use a separate waste container for each nuclide.
- Separate aqueous from organic liquid waste.
- Record all chemicals contained in the waste, along with measured pH.
- Do not overfill waste containers.
- Leave room for potential expansion of the waste.
- Do not place solid material (e.g., biological material, filter paper, pipette tips) in your liquid waste. Obstructions in the spout can create a splashing and disposal hazard.
- Try to reduce the amount of acidic waste, which can damage containers.

- Add bleach or use other methods to neutralize biological liquid waste (e.g., blood, urine, cells).

Use a funnel when pouring liquid into the waste container to prevent spills and minimize contamination on the outside of the container.

When washing contaminated glassware, etc. you must collect the first rinse wash water and place in the radioactive liquid waste container. Count a sample of subsequent rinse water if you suspect significant remaining contamination before washing as usual. Never pour radioactive material down the lab sink.

Stock Vials, Other Vials or Capped Containers (< 50 ml): Vials and other capped containers with less than 50 ml of liquid may be disposed in the dry solid waste container. Note: Stock vials (with <50ml) may be placed in dry solid waste, however, the lead containers they come in must not go into the waste box. The lead must be kept separate and can be picked up by Radiation Safety as a separate waste item. Old stock vials should not be stockpiled. Dispose of them promptly if they will no longer be used or have expired.

Biological Tissue: This waste includes animal carcasses, animal bedding and blood-soaked items. These items must be packaged to prevent leakage. Sharps must be put in an approved sharps container. Freeze or refrigerate this waste, when possible, until pickup.

Radioactive/EPA classified hazardous chemical waste. All labs that generate waste that is both radioactive and is an EPA classified chemical waste must consult our program for proper disposal instructions to ensure that all local, state and federal regulations are followed. Containers that will be used for disposal of mixed hazardous material must be provided by Radiation Safety. Mixed hazardous waste must be clearly described on the waste ticket.

Do not place this type of waste in the normal lab radioactive waste container.

Lead: Lead is a hazardous material and must be separated from other types of waste. Place lead in a box, label as lead waste, and call Radiation Safety for pickup.

Waste Handling and Disposal Procedures

The Radiation Safety Program provides radioactive waste containers upon request, at no cost to the lab. No other containers are permitted to be used unless approved by our program. This reduces the likelihood that radioactive waste will be mistaken for routine, non-regulated trash and disposed of improperly or that the container will leak.

Survey waste container for contamination. The Radiation Safety Program must be notified if contamination is found on the outside of waste containers. When requesting a waste pickup, ensure the waste ticket notes that contamination is present. Include the contamination level in the comment section of the waste ticket. Notify the technicians when they come to pick up the container.

Keep accurate records of the contents of your radioactive waste containers. Provide the Radiation Safety Program with an accurate estimate of waste activity. Call us if you need assistance with determination of waste activity.

Never store bulk liquid waste uncapped.

Treat bulk liquids to prevent gas formation. Microorganisms should be killed using bleach or another method. If you plan to combine chemicals that can react to produce excessive heat or gas, consult our program prior to producing the waste.

Biological material must be packaged to prevent leakage and stored in a freezer prior to pick-up unless prior arrangements have been made with Radiation Safety. Blood contaminated items should be considered biological waste and packaged accordingly.

If you use a Plexiglas shielding enclosure, place waste boxes on blue pads outside of the Plexiglas shielding prior to pick up if space permits. If not, periodically survey the Plexiglas enclosure for contamination.

Instructions for Completing a Radioactive Waste Ticket

A Radioactive Waste Ticket must be completed for each container of waste generated. The completed waste ticket must list radionuclides, activity, and waste type as well as other pertinent waste information. Please enter all information. The ticket should be emailed to ehs-radwaste@virginia.edu.

The following information is supplied to assist in completing the waste ticket:

- A space for the signature of the individual completing the waste ticket is located at the bottom of the form. No waste will be picked up if the signature is missing. The signature confirms that the required survey of the waste container surfaces has been completed and verifies that all information on the waste ticket is correct.
- Survey the outside of the waste containers before requesting a waste pick-up and record this information on the waste ticket in the space provided. In accordance with DOT regulations, all radioactive waste containers must be certified free of removable surface contamination exceeding 2,200 dpm/100 cm². Inform the Radiation Safety Program technicians when they arrive to pick up the waste if the survey results are greater than background. Contaminated waste containers will be encapsulated in plastic bags by Radiation Safety Program technicians prior to removal.
- A space is provided for reporting the measured pH of bulk liquid samples. The pH must be measured using pH paper or other measuring device. Incorrect pH readings will be investigated by Radiation Safety Program technicians.

C.18 Emergency Procedures

Spills of quantities of radioactive material normally present in laboratories at the University present little or no immediate external exposure hazard. Of greater concern is the possibility of internal and external contamination of personnel and the spread of contamination into uncontrolled areas. Immediate action should be taken to prevent the spread of contamination unless an injured person requires immediate medical attention, volatile radioactive materials are present, or unacceptable external radiation exposure rates exist.

Radioactive spills during weekdays between 8 am and 5 pm, should be handled in the following manner:

If a radioactive emergency involves a fire, injury or risk to personnel or property, call 911. Radiation Safety Program will be notified.

If there is no fire, injury or risk to personnel or property, confine the spill to the smallest area possible by using paper towels or other absorbent materials and dispose of as radioactive waste. Do not allow spilled radioactive material to enter any floor drains, if possible. Call the Radiation Safety Program at 434-982-4919 for assistance, not 911.

For **radioactive spills** which occur during **evening hours, weekends, or holidays**:

Call 911 for the appropriate emergency services in the event of a radioactive emergency that involves fire, injury or risk to personnel or property. Tell the dispatcher that the emergency involves radioactive material. Radiation Safety Program will be notified.

If there is no fire, injury or risk to personnel or property, contact the Radiation Safety Program at 434-924-3190 for assistance, not 911.

Be prepared to provide the following information: Lab location and call back phone number(s), radioisotope and activity, a brief description of the incident.

If you remain in the laboratory, keep the call back phone free in case Radiation Safety Program staff needs to contact you. If you must leave the lab, call the

Radiation Safety Program from your new location. Only leave the lab if required by the emergency or requested by emergency response personnel.

Minor spills are those which do not result in:

- external personnel contamination
- radioactive material ingestion
- unacceptable external radiation exposure
- loss of use of laboratory facilities

Perform the following steps for a “minor” spill:

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. Control access to the spill area as soon as possible by posting warnings on all entrances into the room and by closing off the affected area to prevent the spread of contamination.
4. If there is no external exposure to laboratory personnel (i.e., clothing, shoes), put on protective clothing (e.g., gloves, shoe covers) and clean up the spill. Clean up the spill using absorbent paper. If you are unsure how to properly clean up the spill, call the Radiation Safety Program as soon as possible for assistance. Radiation Safety Program staff can offer consultation, equipment and assistance.
5. 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 and then call the Radiation Safety Program to report the incident.
6. If there is radioactive contamination on clothing, shoes, or personnel, call the Radiation Safety Program for assistance as soon as possible. Potentially contaminated personnel must not leave the area until they have been surveyed by either Radiation Safety Program staff or trained laboratory personnel.
7. If radioactive material goes down a floor drain or spills out of the authorized room into unauthorized areas, call the Radiation Safety Program as soon as possible for assistance.
8. Survey the area with an appropriate low-range radiation detector survey meter or other appropriate technique. Check the area around the spill for contamination. Also check hands, clothing, and shoes for contamination. All clean-up surveys must be documented in your Laboratory Survey Records.
9. Allow no one to return to work in the area unless approved by the RSO. A written report must be submitted to the RSO within five (5) working days of the incident for all spills that involve contaminated personnel or involve unauthorized areas.
10. Cooperate with the RSO and Radiation Safety Program staff (e.g., investigation of root cause, provision of requested bioassay samples). Follow

the instructions of the RSO and the Radiation Safety Program staff (e.g., decontamination techniques, surveys, provision of bioassay samples, requested documentation).

Major spills of liquids or solids are those that result in:

- external personnel contamination
- radioactive material ingestion
- unacceptable external radiation exposure
- loss of use of laboratory facilities

Perform the following for a “major” spill:

1. Notify other personnel in the room where the spill occurs.
2. Clear the area. If appropriate, survey all persons not involved in the spill and vacate the room.
3. Prevent the spread of contamination by covering the spill with absorbent paper (paper should be dampened, if solids are spilled), but do not attempt to clean it up. To prevent the spread of contamination, limit the movement of all personnel who may be contaminated.
4. Shield the source only if it can be done without further contamination or significant increase in radiation exposure.
5. Close the room and lock or otherwise secure the area to prevent entry. Post the room with a sign to warn anyone trying to enter that a spill of radioactive material has occurred. Stay in the immediate vicinity of the affected room to prevent the spread of contamination and provide the Radiation Safety Program with information and assistance. Control access to the spill area as soon as possible by posting warnings on all entrances to the room and by barricading the affected area to prevent the spread of contamination.
6. Notify the Radiation Safety Program immediately. Radiation Safety Program staff will assist you in planning the decontamination procedures.
7. Survey all personnel who could possibly have been contaminated. Decontaminate personnel by removing contaminated clothing and flushing contaminated skin with lukewarm water and then washing with a mild soap. Begin personnel surveys to determine if individuals are contaminated. Assume that all persons in the affected area may be contaminated. Do not allow anyone to leave the immediate vicinity until Radiation Safety Program staff has confirmed the results of your preliminary surveys.
8. Allow no one to return to work in the area unless approved by the RSO. Radiation Safety Program staff will control access to all areas where the exposure rate is greater than 2 mR/hr. Your detector must be calibrated in units of mR/hr to obtain a measurement in mR/hr; most UVa survey instruments are calibrated in units of CPM. The Radiation Safety Program maintains instruments calibrated to perform exposure rate measurements (mR/hr).

9. With permission and possible assistance by Radiation Safety Program staff, put on protective clothing provided by EHS and begin decontamination and cleanup.
10. All clean-up surveys must be documented in your Laboratory Survey Records.
11. A written report must be submitted to the RSO within five (5) working days of the incident for all spills that involve contaminated personnel or involve unauthorized areas.
12. Cooperate with the RSO and the Radiation Safety Program staff (e.g., investigation of root cause, provision of requested bioassay samples). Follow the instructions of the RSO and the Radiation Safety Program staff (e.g., decontamination techniques, surveys, provision of bioassay samples, requested documentation).

Incidents Involving Radioactive Dusts, Mists, Fumes, Organic Vapors, and 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 Radiation Safety Program 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 or Radiation Safety Program staff.
7. Promptly report suspected inhalations and ingestions of radioactive material to the Radiation Safety Program.
8. Decontaminate the area only when advised and/or supervised by the RSO or Radiation Safety Program staff.
9. Allow no one to return to work in the area unless approved by the RSO or Radiation Safety Program staff.
10. Cooperate with the RSO and Radiation Safety Program staff (e.g., investigation of root cause, provision of requested bioassay samples). Follow the instructions of the RSO and Radiation Safety Program staff (e.g., decontamination techniques, surveys, provision and collection of bioassay samples, requested documentation).

Minor Fires

1. Immediately attempt to put out the fire by approved methods (e.g., fire extinguisher) if other fire hazards or radiation hazards are not present.

2. Notify all persons present to vacate the area and have one individual immediately call the Radiation Safety Program and fire department (as instructed by 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 with a mild soap.
6. In consultation with the RSO or Radiation Safety Program staff, 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 or Radiation Safety Program staff.
8. Cooperate with the RSO and Radiation Safety Program staff (e.g., investigation of root cause, provision of requested bioassay samples). Follow the instructions of the RSO and Radiation Safety Program staff (e.g., decontamination techniques, surveys, provision of bioassay samples, requested documentation).

Fires, Explosions, or Major Emergencies

1. Notify all persons in the area to leave immediately.
2. Call 911
3. Notify the Radiation Safety Program and other facility safety personnel.
4. Upon arrival of firefighters, inform them where 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 the RSO and Radiation Safety Program staff (e.g., investigation of root cause, provision of requested bioassay samples).
6. Allow no one to return to work in the area unless approved by the RSO or Radiation Safety Program staff. Follow the instructions of the RSO and Radiation Safety Program staff (e.g., decontamination techniques, surveys, provision of bioassay samples, requested documentation).

C.19 Laboratory and Equipment Decommissioning

Decontamination is the cleaning and removal of radioactive contamination from equipment and surfaces. Decommissioning is the process of ensuring that all contamination and radioactive material is removed from the area(s) where it was used. Decommissioning also entails the removal of all signs, postings, radioactive material tape, and performance of final swipe surveys to ensure that all equipment and surfaces are free of contamination. An area or piece of equipment must be decontaminated and decommissioned before it is released for unrestricted use.

Laboratory Decommissioning

If a lab will no longer to be used as a radioactive material use area, it must be formally decommissioned by Radiation Safety Program technicians. Please call the Radiation Safety Program to arrange for a lab decommissioning. Under no circumstance shall a lab be vacated, renovated or used by others without proper decommissioning.

Decommissioning Records

All laboratories and other material use or storage areas are decommissioned in accordance with Radiation Safety Program policies and procedures. The Radiation Safety Program must maintain records of all decommissioned rooms and material use areas.

Release of Equipment for Unrestricted Use

Any piece of equipment (e.g., centrifuge, HPLC, LSC and similar equipment) that was used for the manipulation or handling of radioactive material must be decontaminated to a level at which any remaining contamination cannot be distinguished from background radiation. A Radiation Safety Program technician will verify adequate decontamination prior to its release for unrestricted use. If you anticipate the need to have equipment decontaminated for use in a non-radioactive area, call the Radiation Safety Program for assistance. Under no circumstance shall any equipment be abandoned, sent to surplus or transferred without proper decommissioning.

Release of Equipment to Surplus

Large pieces of equipment (refrigerators, centrifuges, incubators, etc.) that are no longer needed must be decommissioned by Radiation Safety Program technicians. Do not send equipment used for radioactive work to surplus or trash unless they have been surveyed by Radiation Safety Program technicians. **Do NOT remove any radioactive signs or stickers from items before they have been decommissioned.** All radioactive labels and or sources must be removed by Radiation Safety Program staff after decommissioning and prior to disposal or transfer to surplus. Certain scintillation counters have internal radioactive sources that must be removed prior to disposal.

Important Points to Remember

- Lab areas and equipment cannot be abandoned without prior decommissioning.
- Laboratory personnel are responsible for the decontamination and general cleanup of the lab.
- Signs related to radiation and radioactive material can only be posted and removed by Radiation Safety personnel.

- The PI/AU is responsible for the lab area until the final decommissioning survey has been performed by Radiation Safety Program technicians.

C.20 Nuclide Safety Data Sheets (NSDS)

For information on the NSDS's, please visit our webpage at:

[Radiation Safety NSDS, UVA-EHS \(virginia.edu\)](#)

Part D. Radiation Producing Equipment (RPE)

D.1 Persons permitted in x-ray rooms during imaging exams or procedures

The Radiology Technologist (RT) or highest-ranking operator who is performing a radiographic procedure for a patient is responsible for the radiation hygiene during the case.

A family member or friend may request to be present in the room; however, unless that person is needed to assist the RT, the RT shall politely decline the request. In the case of children as patients, parents should receive instruction regarding the procedure. Parents may be invited into the room to stand behind a lead barrier, unless needed at tableside.

The RT may request the assistance of a related person, but the related person shall not be required to participate. Assisting related persons shall be required to wear, during exposure, a protective apron (also lead gloves and/or thyroid collars, if the type of procedure requires such protection.)

For such exceptions, the related person shall not be a pregnant. If the RT determines that the related person is or could be pregnant, then that person shall be excluded from the room during the exposure.

D.2 Diagnostic imaging of individuals who are or may be pregnant

While knowing the pregnancy status is an important part of the medical history and workup, with proper technique and collimation, many exams need NOT be considered a threat for imaging due to their low or zero fetal dose. However, some exams present a considerable risk to the fetus

Female patients between the ages of 12-50 years of age shall be evaluated for pregnancy prior to undergoing imaging or therapy with ionizing radiation. The Clinical Radiation Safety Committee is responsible for advising UVA Health entities on the development of guidance documents to assist clinicians with clinical decisions regarding testing.

Emergent exams should proceed as necessary to protect the health/life of the mother.

For the policy on pregnancy imaging decision making, click on the following link: [Pregnancy Testing Before Receiving Ionizing Radiation Guideline v.1 \(policytech.com\)](https://www.policytech.com/pregnancy-testing-before-receiving-ionizing-radiation-guideline-v.1)

D.3 Holding of Infants during imaging

Positioning devices shall be utilized as appropriate for the exam. If positioning devices are not available or appropriate, a Health Care Provider (HCP) shall hold the patient if health care skills are required for positioning. If a health care skill is not

necessary in positioning the patient, the radiology technologist should ask a family member to hold the patient.

The RT shall provide basic information to the parent, other family member or friend. This will consist of stating that the study uses x-rays and that the radiation dose is similar to that of a chest x-ray or dental x-ray.

All appropriate radiation safety precautions, including the use of appropriate protective apparel, will be followed for the person holding the patient during the exam. If the patient is not being held by a family member or friend and it is deemed necessary by the technologist that they be present to obtain an optimal study, the family member or friend may stay in the room, and will be required to wear an apron.

D.4 Use of gonadal and fetal shielding during imaging

Consistent with the recommendation of the AAPM, and the ACR, gonadal and fetal lead shields shall NOT be used for routine diagnostic imaging, and the technologist shall follow standard work for discontinuation.

If patients and parents/guardians request that the patient be shielded for the exam, the RT shall shield the patient.

D.5 Monitoring of exposures from Fluoroscopically Guided Interventions (FGI's)

A QMP in Medical Physics shall monitor each area providing services for FGI's. Monitoring will include patient exposures from current and historically relevant available exposures.

Medical Physics staff will determine if Substantial Radiation Dose Levels (SRDL's) were reached during FGI's, and perform the appropriate investigation or calculations to determine if there is elevated risk to the patient. Risk statements shall be provided back to the primary physician if dose levels require follow up.

D.6 Radiation Protection

Team Members operating or working near RPE who cannot leave the room and are needed for procedures using X-ray radiation shall wear protective apparel with an equivalency of not less than 0.25 mm of lead per 12VAC5-481- 1591.5(b)

Team members (including trainees) directly working with fluoroscopy may request from their department, appropriate protective eyewear to protect the eye lens from radiation during procedures.

D.7 Procurement and Registration of RPE

Prior to construction for, or delivery of RPE, a structural shielding plan for the equipment and room will be created and approved by a QMP per 12VAC5-481-280. Modifications to existing areas with RPE also require a structural shielding plan.

Prior to first patient use, RPE shall be registered and inspected by a QMP.

A Registrant is responsible for registering RPE with VDH as required by 12VAC5-481-290. The Registrant shall review any applicable federal and state regulations, as well as any applicable standards of non-governmental regulatory agencies and determine how to best inspect the equipment prior to RPE arrival. The Registrant or QMP will also verify as needed, shielding adequacy post installation.

D.8 Removal of RPE from service

The Registrant shall be notified in writing of removal or discontinued use of devices registered with VDH.

The registration certificate from the VDH shall be saved and turned over to the Registrant upon removal. The only person authorized to officially remove a device from service is a Registrant.

D.9 Radiation Equipment Use and Safety

All Team Members working with or around RPE shall adhere to the following and be aware of the radiation hazards associated with its operation.

Individuals using RPE must be approved by the Registrant.

All operators of Fluoroscopic equipment shall be either an MD, Radiologic Technologist (RT), Physician's Assistant (PA), Radiology Assistant (RA) or Cardiovascular Tech/RCIS (CVT and RCIS for Quality Control Only, not human use).

All operators of Fluoroscopic equipment shall have refresher safety retraining every 2 years.

Periodic surveys of radiation producing machines may be conducted by QMP's to ascertain that the equipment complies with federal and state requirements.

When operating mobile or dental units, the operator should stand as far as possible from the tube and patient during the exposure and shall wear a protective apron or step behind an adequate barrier. Without either the leaded apron or other protective barrier, the operator shall stand at least six (6) feet from the x-ray tube.

The hand of the fluoroscopist should not be placed in the useful beam unless the beam is attenuated by leaded gloves.

The radiation area is cleared of all non-essential personnel. The operator shall insist that all non-essential personnel leave the exam room before operating the unit and that all essential personnel are adequately shielded.

During FGI's, all appropriate safety devices shall be used when they do not interfere with the procedure. These devices include but are not limited to: over table, under table and hanging leaded shields.

D.10 Prohibited Radiation Exposures from RPE

Individuals shall not be exposed to the useful beam except for healing arts purposes and a licensed practitioner of the healing arts has authorized such exposure.

Deliberate exposure for the following purposes is specifically prohibited:

- Exposure of an individual for training, demonstration or other nonhealing-arts purposes;
- Use of Team Members or patients for equipment calibration, QA or other such activities; and
- Exposure of an individual for the purpose of healing arts screening except in the case of healing arts screening programs approved in advance by the State Health Commissioner.

Violation of this policy must be reported to the Registrant or a QMP immediately.

D.11 Modification and Review of Diagnostic Computed Tomography (CT) Protocols

Global changes to any CT protocol (or creation thereof) must be authorized in writing (including electronically) by the Division Head (or their designee), the division CT QA Technologist AND a QMP. Further, all CT protocols will be reviewed by a QMP every 2 years.

All protocol changes on a per patient basis may be modified by a Radiologist and CT Technologist at the time of the procedure IF medically necessary. This standard is consistent with recommendations from the Conference of Radiation Program Control Directors (CRCPD).

It is preferred that protocol creations or revisions be submitted via the following link on the Radiology Intranet: [CT Protocol Modification/New Protocol Request Form — UVA Health System \(virginia.edu\)](#)

Output from form will be automatically sent to the CT QC Technologists, as well as Medical Physics Team Members, who will make efforts to respond to the request within 5 business days. Should this team have any concerns with, or be delayed in responding to the suggested protocol change, the requesting Radiologist will be consulted to determine an alternative solution. For a protocol requiring immediate modifications due to non-diagnostic scan quality or imminent concerns of a Radiologist, contact the CT Chief Technologist or designee.

D.12 Inspection of Protective Apparel

All lead aprons must be inspected and tracked annually in the program QC-Track by individuals within each department recognized by their leadership as 'apron trackers'.

Protective garments wear out, and may develop defects. Annual inspection shall occur to protect the user from worn apparel and to track where the garments reside.

The annual apron inspection is tactile only, and if further investigation of possible defects is needed, a scout of the garment using CT may be utilized.

For training on how to perform the inspection, you may take the following in Workday: [Lead Apron Inspection Training | Learning \(myworkday.com\)](#)

D.13 Use of Large Mobile C-arms

Setup/Removal of Large C-arms used in Surgical Procedures shall be performed by an RT.

RT's are specially trained in proper use, manipulation, and power up/down procedures on all imaging equipment. Improper shut-down of imaging equipment can lead to costly damage, loss of critical PHI, delays in patient care, and Team Member injury. During surgical procedures, Physicians may activate fluoroscopy with a foot pedal (or request activation by an RT). In extenuating circumstances, non-RT's may aid in the C-arm manipulation, but operation by trained Team Members should be the goal in all circumstances.