Principal Investigators (PI) seeking to procure, possess, or work with radioactive materials must receive **authorization** from the Radiation Safety Committee (RSC) and be listed on the UNCG license granted by the NC Department of Health & Human Services.

Anyone working with radioactive materials at UNCG must submit a **radiation worker registration form** to the EH&S Department and complete **training**.

Any use of radioactive materials must comply with the **UNCG Radiation Protection Policy**.

The Policy and related forms are available at [https://safety.uncg.edu/LaboratorySafety.html](https://safety.uncg.edu/LaboratorySafety.html)
Definitions/Responsibilities

**UNCG License**
- License granted by the NC Dept. of Health & Human Services

**Radiation Safety Committee (RSC)**
- Oversight of the UNCG License and Radiation Safety Program

**Radiation Safety Officer (RSO)**
- Manage Radiation Safety Program

**Authorized User**
- A faculty member (PI) granted authorization to use radioactive materials at UNCG
Ordering & Receiving

All purchases or other procurement of radioactive materials must be pre-approved by the RSO. Submit the “Radiation Purchase Request Form”, signed by the Authorized User to the RSO well in advance of the order date.

All radioactive materials must be delivered to the EH&S Department (724 Stirling Street, Greensboro, NC 27412). The requisite package receipt survey(s) will be performed and the package delivered to your lab by EH&S personnel.
Penetrating Powers

The type (alpha, beta, gamma/X-ray) and energy of the radiation impacts the distance it can travel through air and the shielding material.

Range in air

- **α**: 4 MeV: 3 cm, 10 MeV: 10 cm
- **β**: H-3 (18.6 keV): 6 mm, C-14 (156 keV): 24 cm, P-32 (1,710 keV): 6 m
- **γ**: Lead, iron, other thick metal plates

Stopping material

- Paper, layer of dead skin
- Thin plates of wood, plastic, aluminum, etc. (H-3: clothing, dead skin)
It is the responsibility of the radiation worker, supervisor (PI), RSO, and RSC to keep radiation doses As Low As Reasonably Achievable (ALARA).

Radiation dose can be limited by:

- Reducing the amount of TIME spent working with or in close proximity to radioactive materials.
- Increasing the DISTANCE between yourself and the radiation source.
- Increasing the amount of SHIELDING between yourself and radiation.
Radiation Doses

**Radiation Dose**
- Energy deposited in a medium.

**Dosimetry**
- Monitoring of radiation dose received by individuals.

**Millirem (mrem)**
- Unit for effective dose, which takes into account the type of radiation and the tissue/organ exposed.

The average annual dose received by a member of the general public from background and medical sources is 620 mrem.

The occupational exposure of the average user at a research institution receives less than 10 mrem/yr.
Radiation Monitoring

Dosimetry badges are only required for high energy sources.

Badges only measure radiation exposure. They do not offer any protective/shielding value.

If assigned, badges should be worn on the torso, nearest the source of radiation, when working with radioactive materials or in designated radiation areas.

Badges should be stored away from sources of radiation and high heat.

Badges are exchanged via the RSO/EH&S Dept. on a quarterly basis.
Radiation Monitoring

Special monitoring is available for individuals who are pregnant or trying to become pregnant.

It is your choice to confidentially declare your pregnancy to the RSO.

A special monitoring program will be provided with lower dose limits for the gestational period. Additional monitoring may include fetal (waist) badge and urinalysis, on a monthly basis.
Radiation Monitoring

Our goal is to limit radiation dose to only 10% of the Occupational Exposure Limits set by the NRC.

<table>
<thead>
<tr>
<th></th>
<th>Regulatory Limit (mrem/yr)</th>
<th>UNCG Goal (mrem/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole Body</td>
<td>5,000</td>
<td>500</td>
</tr>
<tr>
<td>Lens of the Eye</td>
<td>15,000</td>
<td>1,500</td>
</tr>
<tr>
<td>Skin and/or Extremity</td>
<td>50,000</td>
<td>5,000</td>
</tr>
<tr>
<td>Minors (whole body)</td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>Embryo/Fetus</td>
<td>500 mrem in the 9 month gestation period</td>
<td>50 mrem in the 9 month gestation period</td>
</tr>
</tbody>
</table>
Personal Protective Equipment

When working with radioactive materials, you must wear:

- Gloves
- Lab coat or gown
- Safety glasses/goggles, when a splash hazard exists
- Long pants
- Close toed shoes

PPE should not be removed from the radiation use area until it has been surveyed and determined to be free of contamination.
Radiation Surveys

Personal Surveys
- Use a Geiger counter to check for contamination on your body, clothes, PPE, etc.
- Should be performed immediately after use, before leaving the area.

Area Surveys
- Use a Geiger counter to check for contamination on equipment and work surfaces and ensure radiation levels are less than 2 mR/hr at 1ft.
- Should be done Daily following the use of radioactive materials
- Survey must be documented within 7 days of use of high energy emitters (P-32, I-125).

*Personal and Area Surveys are not necessary for work with H-3, because it cannot be detected with a meter.*
Radiation Surveys

Contamination Surveys (Wipe Tests)

- Survey must be documented within 7 days of use of any radioactive materials.
- Wear gloves & lab coat
- Use swab or filter paper
- Use uniform pressure and wipe an area of ~100 cm² about 4”x4” or standard S swipe
- Wipe radiation use area, bench tops, floors, handles, knobs, equipment, pipettes, and non-use areas: lab entryway, desk, etc.
- Keep each wipe separate to avoid cross contamination
- Keep records of where swipes are taken
- Place wipe into a liquid scintillation vial with cocktail and count
Radiation Surveys

Limits & Action Levels

Exposure rate = 2.0 mR/hr measured 1 ft. from source

Most likely to occur at waste containers containing P-32. If the action level is exceeded, action must be taken to lower the radiation level below 2 mR/hr, such as adding or adjusting shielding or repositioning the waste in the container.

Removable Contamination

- General lab surfaces = 600 DPM
- Dedicated, labeled equipment = 2000 DPM
  (centrifuges, incubators, inside of refrigerator)

Wipes exceeding the limits must be immediately decontaminated and re-wiped until results are below the limits.

Wipe results less than 600 DPM, but more than twice background are likely contaminated and should really be cleaned. We recommended that each lab set a threshold (~100 – 200 DPM) at which they consider wipes contaminated.
Radiation Safety Review

Radiation Surveys

Required within 7 days of use.

Record results in DPM, not CPM (DPM = CPM / LSC efficiency)

Clean and re-wipe hot wipes

Identify areas/items wiped

Document radiation levels for high energy emitters (P-32, I-125)

An external radiation survey (Geiger meter) must be performed following use of high energy beta emitter (P-32).

All readings are < background levels (0.05 mR/hr) unless noted on map.

Record wipe results (net DPM) below or attach printout.

All authorized areas of use must be surveyed. Write "No Use" for any rooms not used.

Policy & Definitions
Dosimetry & PPE
Surveys & Inventories
Waste
Signs & Labels
Incidents & Emergencies
Post Test
Inventories

Daily Inventory Log

- Each vial of radioactive material is given a unique ID# upon receipt at UNCG.
- Keep a separate log sheet for each vial#. Log each withdrawal or transfer from the vial and the final destination (waste, transfer, etc.).
- Be sure the “Remaining Activity” reaches **ZERO** when the vial is discarded.

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**Radioactive Materials Daily Use Log**

Authorized User: ____________________________
Location: ____________________________________
Date Rec'd ______________________________

Vial#: ____________________________
Radionuclide: ____________________________
Quantity (mCi): ____________________________
Chemical Form: ____________________________

**NOTE:** A copy of this form must be maintained for each stock vial received. Retain for three years after disposal date.

<table>
<thead>
<tr>
<th>USE RECORD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transfers from shipping vial/stock solutions</td>
</tr>
<tr>
<td>Date</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

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University of North Carolina at Greensboro
Inventories

The **Monthly Inventory Log** serves as a summary of all radioactive materials on hand. The monthly inventory only needs to be updated if daily inventory logs have changed. If any inventory has changed, update monthly inventory statements for all vials on hand.

### Monthly Inventory Log

<table>
<thead>
<tr>
<th>Date/ Month of record (Ex. 2-1-13 / January)</th>
<th>Vial#</th>
<th>Nuclide</th>
<th>Chemical Form</th>
<th>Beginning Balance</th>
<th>Transfer to other User (Specify)</th>
<th>Decay</th>
<th>Waste</th>
<th>Ending Balance</th>
</tr>
</thead>
</table>
Radioactive waste is segregated by **Type** and **Half-Life**.

**Type:**
- **Dry/Solid**
  - Box, bucket, or drum, with plastic liner and lid
  - Contains no free liquids, absorb any residual liquid with paper towel.
- **Liquid**
  - Stored with secondary containment and lid secured
  - Attach a “Waste Tag” identifying the bottle/form# and nuclides
- **Scintillation Vials**
  - Bucket or drum with plastic liner and lid
  - Do not attempt to empty vials
  - Collect vials and contents in clear bags of no more than 100 vials each
Waste

Radioactive waste is segregated by **Type** and **Half-Life**.

**Half-Life:**

- **Short-Lived:** half-life < 180 days  
  (P-32, P-33, I-125, S-35)

- **Long-Lived:** half-life ≥ 180 days  
  (H-3, C-14)
Waste

Waste Containers:

- Must be labeled with the universal radiation symbol
- Must have a lid in place at all times
- Attach “Waste Form” to container or post nearby for liquid waste with a reference tag on the bottle
- Log all waste and activity on waste form
- Do not “decay-away” waste
- Submit pick-up request to Eric Zack, EH&S Dept.
Signs, Labels & Postings

**Lab Entryways** must be labeled with the Universal Radiation Symbol and the words “Caution Radioactive Materials”.

**Storage Containers** must be labeled with the Universal Radiation Symbol and the words “Radioactive Materials”.

Policy & Definitions
Dosimetry & PPE
Surveys & Inventories
Waste
Signs & Labels
Incidents & Emergencies
Post Test
Lab Equipment used to store or work with radioactive materials must be labeled with at least the Universal Radiation Symbol.

- Fume Hood/BSC
- Incubators
- Water Baths
- Centrifuges
- Analytical Equipment
- Pipettes
- Benchtop Work Areas
- Refrigerator/Freezer
NC DHHS “Notice to Employees” must be posted in a conspicuous location.
Large Radioactive Spills

When cleaning up a spill of radioactive materials, special care needs to be taken not to track contamination to other areas.

- Identify “Hot” & “Cold” zones
- Notify others in the lab of the spill
- Focus efforts on known contaminated areas to avoid spreading contamination to a larger surface area
- Clean spill from the outside toward center
- Place clean-up materials in appropriate radioactive waste containers
- Survey your hands, body, clothing, shoes
- Conduct and document appropriate surveys
- Notify RSO
Emergency Response

Accidental release / Inhalation ingestion or suspected exposure
- Notify RSO

Fire
- Notify Fire department and RSO

Theft
- Notify RSO
Radioactive Material Security

- Radioactive materials must be secured against unauthorized access at all times.
- Lock lab doors or secure material in locked containers.
- Report suspicious activity.
Resources

UNCG Lab Safety Website: https://safety.uncg.edu/LaboratorySafety.html
- UNCG Radiation Protection Policy
- Forms

RSO: Eric Zack
e_zack@uncg.edu
(336)334-3249
UNCG EH&S Department
724 Stirling Street
Greensboro, NC 27282
Radiation Safety Review

Post-Test

Take the Post-Test