



**Environmental Health & Safety**

## **Radiation Safety Program**



Kennesaw State University (KSU) is committed to providing and maintaining a safe teaching, learning, living, and working environments for all members of its community. This commitment includes ensuring the proper storage, use, transfer and disposal of radioactive materials, and the minimization of injuries and illnesses associated with exposure to ionizing radiation. This will be accomplished through training and education of personnel in radiation safety and the use of administrative controls, engineering controls, and exposure limits for all KSU employees and students. Ionizing radiation by incorporating the ALARA principle through the implementation of administrative and engineering controls, safe work practices, and the use of PPE. The requirements outlined in this document shall be in accordance with all Federal and State regulations governing the use of ionizing radiation, the requirements prescribed in the Radioactive Materials License, and with the processes and procedures approved by the KSU Radiation Safety Committee (RSC) and the Radiation Safety Officer (RSO).

## **2. Scope**

The Radiation Safety Program applies to the use of all materials that emit ionizing radiation (e.g. – radioisotopes, radioactive sealed sources, button sources, machines that emit/produce ionizing radiation, etc.), and to all KSU employees and students who may come in contact or work with these materials.

## **3. Definitions**

Activity	The rate of disintegration or “decay” of radioactive material (USNRC, 2017).
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breaking molecular bonds and displacing (or remove) electrons from atoms or molecules. This displacement in electrons can lead to changes in living cells, which can be therapeutic in certain applications, but can also be harmful if not utilized correctly. In high doses, ionizing radiation can cause severe damage to skin and tissues.

Non-ionizing radiation exists in several forms, including microwave radiation, infrared radiation, ultraviolet radiation, radio waves, and lasers. In comparison, non-ionizing radiation is not capable of producing ions, as it is less energetic than ionizing radiation. It lacks the energy needed to remove electrons from atoms or molecules. Non-ionizing radiation produces its effects through heating, which can also be harmful in high doses or if misapplied.

For the purposes of this document, the terms “radioisotope,” “radiation,” and “radioactive material” will be used when referring to ionizing radiation. Guidance for working with forms of non-ionizing

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The RSC will conduct an annual review of all Radiation Safety Program documents to ensure that KSU's radiation program complies with all applicable regulations.

### **3. Authority**

The RSC, supported by the VPR and the Deans of the affected Colleges, is authorized to implement additional radiation safety measures related to the use of radioactive materials or radiation producing machines/devices, or suspend the use thereof, if current safety practices are deemed insufficient.

### **C. Director of Environmental Health and Safety**

- Designate a Radiation Safety Officer (RSO), as prescribed by 10 CFR 20 and OCGA 391-3-17.
- In collaboration with the RSC, will review and approve the Radiation Safety Program and any amendments made by the RSO.
- Support enforcement of the elements of the Radiation Safety Program by the RSO and the RSC.
- Support all efforts of the RSO to ensure proper use of radioactive materials from cradle to grave (i.e. – receipt, handling, use, storage, and disposal).

### **D. Radiation**

- Implement and manage a personnel monitoring program to ensure that dosimeters are issued to personnel as needed, that the dosimeters are used, stored, and exchanged appropriately, and that monitoring records are maintained appropriately.
- Develop an inspection/audit program to address all radiation work areas. The inspections will include a review of all permit documentation, training records, RAM inventory, surveys of the work areas and the equipment used, and wipe testing documentation.
- Prescribe corrective actions based on the findings in the inspections/audits, and generate and distribute inspection reports to authorized users.
- Make recommendations regarding the need for additional safety measures to the RSC as appropriate.
- Maintain the RAM license, and suggest necessary amendments/changes, or renewal as needed.
- Oversee the program.

The RSO, in conjunction with the RSC, may interrupt or suspend any activity that involves the use of radioactive materials if the activity is deemed to be unsafe, contrary to the terms of the RAM license, or in violation of federal or state regulations.

The RSO may make minor changes or amendments to internal radiation safety forms, guidance documents, and or procedures as needed.

The RSO may delegate certain tasks to another individual, if the individual has been trained and has demonstrated proficiency in the tasks delegated.

## **7. End-User Roles and Responsibilities**

### **A. Directors, Supervisors, and Managers**

Directors, supervisors, and managers must be aware of the use of radioactive materials, or the use of radiation producing equipment in their units/departments and must facilitate the safe use of these materials.

They must be aware of all the necessary training, storage, and use requirements for the users of radioactive materials or radiation producing equipment.

They must inform the RSO regarding certain actions or changes in protocol within their units/departments. Examples of actions that would require informing the Radiation Safety Officer include:

- Hiring researchers who will need to use radioactive materials in their

- Location in relation to other areas (e.g. – classrooms, offices, other labs, etc.)
- Availability of shielding
- Availability of detection instruments
- Security of facilities



## 8. Availability

This Radiation Safety Program document will be available on the KSU Environmental Health and Safety website (<http://www.kennesaw.edu/ehs>). Licenses, permits, manifests, and all other documents related to the use of radioactive materials will be maintained within the EHS Department.

## 9. Radiation Exposure

### A. Annual Exposure Limits – Radiation Workers

In accordance with Georgia Rules and Regulations for Radioactive Materials (OCGA 391-3-17), there are limits to radiation exposure for workers as well as members of the general public.

The annual exposure limits for adult workers can be found in Table 1 below. If any worker

exceeds the annual limit, the following actions shall be taken: (a) 1.2 (b) 1.2 (c) 1.2 (d) 1.2 (e) 1.2 (f) 1.2 (g) 1.2 (h) 1.2 (i) 1.2 (j) 1.2 (k) 1.2 (l) 1.2 (m) 1.2 (n) 1.2 (o) 1.2 (p) 1.2 (q) 1.2 (r) 1.2 (s) 1.2 (t) 1.2 (u) 1.2 (v) 1.2 (w) 1.2 (x) 1.2 (y) 1.2 (z) 1.2 (aa) 1.2 (ab) 1.2 (ac) 1.2 (ad) 1.2 (ae) 1.2 (af) 1.2 (ag) 1.2 (ah) 1.2 (ai) 1.2 (aj) 1.2 (ak) 1.2 (al) 1.2 (am) 1.2 (an) 1.2 (ao) 1.2 (ap) 1.2 (aq) 1.2 (ar) 1.2 (as) 1.2 (at) 1.2 (au) 1.2 (av) 1.2 (aw) 1.2 (ax) 1.2 (ay) 1.2 (az) 1.2 (ba) 1.2 (bb) 1.2 (bc) 1.2 (bd) 1.2 (be) 1.2 (bf) 1.2 (bg) 1.2 (bh) 1.2 (bi) 1.2 (bj) 1.2 (bk) 1.2 (bl) 1.2 (bm) 1.2 (bn) 1.2 (bo) 1.2 (bp) 1.2 (bq) 1.2 (br) 1.2 (bs) 1.2 (bt) 1.2 (bu) 1.2 (bv) 1.2 (bw) 1.2 (bx) 1.2 (by) 1.2 (bz) 1.2 (ca) 1.2 (cb) 1.2 (cc) 1.2 (cd) 1.2 (ce) 1.2 (cf) 1.2 (cg) 1.2 (ch) 1.2 (ci) 1.2 (cj) 1.2 (ck) 1.2 (cl) 1.2 (cm) 1.2 (cn) 1.2 (co) 1.2 (cp) 1.2 (cq) 1.2 (cr) 1.2 (cs) 1.2 (ct) 1.2 (cu) 1.2 (cv) 1.2 (cw) 1.2 (cx) 1.2 (cy) 1.2 (cz) 1.2 (da) 1.2 (db) 1.2 (dc) 1.2 (dd) 1.2 (de) 1.2 (df) 1.2 (dg) 1.2 (dh) 1.2 (di) 1.2 (dj) 1.2 (dk) 1.2 (dl) 1.2 (dm) 1.2 (dn) 1.2 (do) 1.2 (dp) 1.2 (dq) 1.2 (dr) 1.2 (ds) 1.2 (dt) 1.2 (du) 1.2 (dv) 1.2 (dw) 1.2 (dx) 1.2 (dy) 1.2 (dz) 1.2 (ea) 1.2 (eb) 1.2 (ec) 1.2 (ed) 1.2 (ee) 1.2 (ef) 1.2 (eg) 1.2 (eh) 1.2 (ei) 1.2 (ej) 1.2 (ek) 1.2 (el) 1.2 (em) 1.2 (en) 1.2 (eo) 1.2 (ep) 1.2 (eq) 1.2 (er) 1.2 (es) 1.2 (et) 1.2 (eu) 1.2 (ev) 1.2 (ew) 1.2 (ex) 1.2 (ey) 1.2 (ez) 1.2 (fa) 1.2 (fb) 1.2 (fc) 1.2 (fd) 1.2 (fe) 1.2 (ff) 1.2 (fg) 1.2 (fh) 1.2 (fi) 1.2 (fj) 1.2 (fk) 1.2 (fl) 1.2 (fm) 1.2 (fn) 1.2 (fo) 1.2 (fp) 1.2 (fq) 1.2 (fr) 1.2 (fs) 1.2 (ft) 1.2 (fu) 1.2 (fv) 1.2 (fw) 1.2 (fx) 1.2 (fy) 1.2 (fz) 1.2 (ga) 1.2 (gb) 1.2 (gc) 1.2 (gd) 1.2 (ge) 1.2 (gf) 1.2 (gg) 1.2 (gh) 1.2 (gi) 1.2 (gj) 1.2 (gk) 1.2 (gl) 1.2 (gm) 1.2 (gn) 1.2 (go) 1.2 (gp) 1.2 (gq) 1.2 (gr) 1.2 (gs) 1.2 (gt) 1.2 (gu) 1.2 (gv) 1.2 (gw) 1.2 (gx) 1.2 (gy) 1.2 (gz) 1.2 (ha) 1.2 (hb) 1.2 (hc) 1.2 (hd) 1.2 (he) 1.2 (hf) 1.2 (hg) 1.2 (hh) 1.2 (hi) 1.2 (hj) 1.2 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assigned to each individual radiation worker under unique identification numbers. These badges are worn on the part(s) of the body that are most likely to get the greatest amount of exposure while working with or around rad

- In this application, a whole-body badge would be installed in the general area(s) where the radiation exposure is likely to take place.
- As with monitoring personnel, a control badge would also need to be kept in an area where only background radiation is detectable.
- At the end of the monitoring period, both the area monitor, and the control badge are sent to the vendor for analysis.

#### **D. Investigation of High-Level Exposures/Notifications**

For individuals who have been assigned badges, exposure reports will be evaluated on a quarterly basis to identify those individuals who are most at risk for exceeding the annual exposure limits. These evaluations will be conducted in commitment to the ALARA principle, to keep all exposures as low as reasonably achievable. ALARA Levels (Level I and Level II) have been established in Table 2 below. These levels will determine when the point at which additional radiation protection measures need to be taken.

<b>ALARA Investigational Levels</b>				
	<b>Annual Limits</b>	<b>Goal (10% of Annual Limit)</b>	<b>ALARA I (Quarterly)</b>	<b>ALARA II (Quarterly)</b>
<b>Whole Body</b>	5,000 mrem	500 mrem	125 mrem	375 mrem
<b>Lens of the Eye</b>	15,000 mrem	1,500 mrem	375 mrem	1,125 mrem
<b>Skin or Extremities</b>	50,000 mrem			

Any non-radiation worker who is concerned about potential exposure to radiation should contact the RSO for guidance. The RSO can conduct a hazard assessment to determine the level of exposure, if any, and if necessary, can conduct temporary personnel monitoring via badging, or area monitoring via area dosimeters.

## **F. Pregnant Radiation Workers**

KSU employees who work with radiation, or machines that produce radiation have the option of notifying the RSO of any suspected or confirmed pregnancies and are encouraged to do so in writing as soon as possible. The RSO will collaborate with the employee and her supervisor to properly monitor her radiation exposure during the pregnancy, and to implement any additional radiation protection measures to keep exposures within the annual limits prescribed by the State. The following steps will need to be taken for a suspected or confirmed pregnancy:

- The employee, if she chooses to declare pregnancy, should do so as soon as her pregnancy is confirmed. The declaration must be in writing to her supervisor and the RSO using the **Declaration of Pregnancy for Radiation Workers**, which will include the approximate date of conception.
- The RSO will determine what additional restrictions, if any, must be applied based on evaluation of her radiation exposure history.
- Any additional restrictions will be documented in writing and discussed with the employee and her supervisor.
- A copy of the document “**Instruction Concerning Prenatal Radiation Exposure**” will be provided to the declared pregnant employee as required by Federal and State regulations.
- The declared pregnant employee and her supervisor will sign a written statement indicating that they have received all necessary information.
- A fetal badge, which will be worn at the waist, will be assigned to the pregnant employee in addition to the badge(s) that she has already been assigned. If a protective lead apron is worn, the badge must be worn under the lead apron. gphat she hio of thp (n) 1TjEMC 4em2

## **A. Radiation Safety Awareness Training**

Awareness training shall be completed by workers who may work in areas where radiation is



- Recording exposure information
- Reporting high or accidental exposures
- Proper use of personnel dosimetry
- Department-specific work rules
- Procedure risks

### **E. Access to Training**

Training for the use of machines that produce radiation should be offered and scheduled through university departments and may require an outside vendor. Training records should be maintained by each department.

### **F. Retraining Frequency**

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

## **11. General Radiation Safety Rules and Considerations**

The use of radioactive materials in research and teaching laboratories has the potential to cause health hazards to faculty, students and staff who work with or around the materials. Therefore, some general considerations must be made when working with radioactive materials.





## **12. Laboratory and Facility Requirements**

KSU laboratories are designed in accordance with the University System of Georgia's Design Criteria for Laboratories, and as designed, are suitable for working with low levels of stable, non-volatile radioactive materials.

### **A. Laboratory Features**

The following design features are required for laboratory use of radioactive materials:

- Smooth, non-absorbent floors (e.g., no carpet, rugs, etc.)
- Smooth, non-porous countertops that will not absorb radioactive materials.
- Non-porous furniture that will not absorb radioactive materials.
- Hand washing sinks with non-permeable surfaces designed to allow complete draining.
- HVAC system with negative directional airflow and one-pass ventilation

### **B. Additional Features**

An increase in the possession limit, volume of radioactive materials used, and/or a change in the level of stability of the materials may require the lab to incorporate additional features to rsc.9 8i1 (b)3(, and

- Doors must be closed and locked when the lab is not occupied.
- Radiation permit holders must choose a method of securing the radioactive materials they possess (in addition to key-

- Designated areas where radioactive materials are used must be labeled with the universal radiation symbol and the words “Caution, Radiation Area.”
- Labeling of instruments, secondary containers, racks of samples, or trays is also recommended.
- Radioactive waste must be labeled with the universal radiation symbol, the words, “Caution, Radioactive Materials,” the radioisotope, the estimated activity, and the date when the container was closed, or became full.

## 15. Procurement of Radioactive Materials

Radioactive materials must be procured with prior authorization from EHS, and only from vendors who have a radioactive materials license through the NRC and/or an Agreement State. Each vendor that sells radioactive materials is required by state and federal regulations to possess a valid license to package, sell, and ship these materials. Prior to ordering radioisotopes, a copy of the KSU broad scope license will be provided to the vendor. Other information may need to be provided as well, such the location to deliver the material and payment information.

### A. Ordering Radioactive Materials

- EHS will communicate with the vendor and confirm the delivery date and time (if available) that the radioisotope(s) will be delivered to the appropriate designated/restricted area at KSU.

## **B. Transferring Radioactive Materials**

There may be circumstances that require a permit holder to request the transfer of radioactive materials at no cost, such as a transfer from another institution, or to ask for a replacement product from a vendor/supplier. If possible, a requisition with zero cost entered should be entered and submitted. The same procedure for ordering radioactive materials applies.

## **C. Transferring Radioactive Materials within KSU**

When transferring radioactive materials between permit holders within KSU, the following steps must be followed:

- EHS must verify that the recipient has an active permit to possess the material, and that the transfer of the radioactive materials will not exceed the possession limit.
- Once this is verified, a **Transfer Agreement** must be completed and signed by both parties involved in the transfer.
- The Transfer Agreement must be submitted to the RSO for approval before the material is transferred.
- The Transfer Agreement must be approved and signed by the RSO prior to the transfer of the material.
- The material must not be released to the recipient until the transferor receives the Transfer Agreement signed by the RSO.

***Any transport of radioactive material across public roads must be done in compliance with all DOT/IATA regulations. Contact EHS for information for assistance with hazardous materials transportation.***

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## **16. Receiving Packages of Radioactive Materials**

Packages of radioactive materials cannot be delivered directly to laboratories from the courier. EHS will receive the package(s) and will open and check the package for accuracy of contents and any possible leakage/contamination. Once the package(s) has been checked-in, EHS will deliver them to the requestor and obtain a signature of receipt.

### **A. Procedure for Receiving Packages**

The receipt of packages/shipments of radioactive materials must follow specific steps to ensure that all the appropriate information is accounted for, and that the end user receives a package that is free of contamination. Any EHS staff member who will be responsible for the initial receipt of packages from the courier must be trained in the procedure and the proper precautions to be taken. For more information, access the **Procedure for Radioactive Package Receipt**.

- Once received, the appropriate information from the packing slip and/or other documentation must be entered into the RadioLogistix database.
- The package must be delivered to the end user by an EHS staff member.
- Upon delivery, the PI or a lab employee must sign for receipt of the package.
- If there is no one present to sign for the package upon delivery, it will be returned to the EHS delivery location.
- After a failed delivery, an EHS staff member will attempt to contact a lab employee to schedule a time for delivery.
- Once the package has been delivered to the lab, the labels (e.g., white I, yellow II) on shipping boxes must be defaced.
- If the shipping box will be discarded, it must first be defaced, wipe tested, and have no removable contamination. If removable contamination is found, the container should be disposed of as radioactive waste.

## **17. Transport of Radioactive Materials**

### **A. Regulatory Requirements**

- Radioactive materials to be shipped must be packaged and transported in accordance with state and federal regulations.
- Radioactive materials can only be packaged and shipped by individuals who have been trained and are current in the Department of Transportation (DOT) and International Air Transport Association (IATA) training per regulations.
- DOT regulates the shipping of hazardous materials by road, rail, or water, and training on their regulations must be completed every 3 years.
- IATA regulates the shipping of hazardous materials by air, and training on their regulations must be completed every 2 years.

### **B. Transporting Radioactive Materials at KSU**

- Contact EHS for assistance with transporting/shipping of radioactive materials.
- Radioactive materials must not be transported in personal vehicles, on public transportation, on the Big Owl Bus (BOB), or any other means of transportation on or around campus.
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- Date when the container was closed or became full.
- Waste containers should not be overfilled.
- All waste containers should remain closed unless adding waste to prevent spills and the potential spread of contamination.
- Radioactive waste must be shielded to minimize exposure to lab personnel.
- Prior to disposal, all short-lived radioactive waste must be stored for ten half-lives, or until the radiation level reaches background. This will be done after EHS has picked up the radioactive waste.
- Deface all primary containers/vials before disposing of radioactive waste (i.e., mark through all radiation symbols and precautionary statements).

## **B. Collection of Radioactive Waste**

Radioactive waste must be collected in containers provided by the EHS and are as follows:

- Dry waste is collected in 5-gallon sealable buckets or 20-gallon drums
- Liquid scintillation vial waste is collected in 5-gallon sealable buckets
- Liquid waste is collected in plastic 1-gallon containers
- Any alternative containers used to collect radioactive waste must be first approved by EHS.

## **C. ~~1873.0156~~ 217(c)7.3 (o)-0.6 (ll)10.7 (c)-3.6 (t)2 (r)1.9 (ad)12.5 (i)-3.6 6[S32.5 (i)21**





- Prior to approving applications for the use of radioactive materials, the RSO and the RSC will review the application to ensure that the appropriate instrumentation is available to detect the radioisotopes that are in the application.
- If the applicant does not have the appropriate instrumentation for radiation detection and/or counting, the proper instrumentation must be purchased for use in the lab, or borrowed from another permit holder. While borrowing is an option, it is not meant to be a long-term solution, as each permit holder needs his/her own instrumentation.
- Permit holders who need GM survey meters to detect radiation should plan on purchasing their own instrument. However, more expensive equipment such as liquid scintillation counters and gamma counters may be shared by permit holders within a department.

## B. Geiger Muller Survey Instruments

Geiger Muller (GM) survey meters are used to detect surface contamination during/after use of higher energy radioisotopes that can be detected using them.

GM Survey meters can be purchased from several manufacturers/suppliers, including Ludlum Measurements, Spectrum Technologies, Eberline Industries, ThermoFisher Scientific, etc.

One of the most common, and highly recommended survey meters is a Ludlum Model 3 GM survey meter with a Model 44-9 “pancake” probe. The survey meter must meet two requirements:

1. It must have an external detector for surveying surfaces for contamination
2. It must be able to read in either millirem per hour (mrem/hr.), counts per minute (CPM), counts per second (CPS), or a combination.

Survey meters must be calibrated every 12 months from the date last calibrated while radioactive materials are being actively used in the lab. They should be returned to the manufacturer for calibration or shipped/transported to a qualified vendor that provides calibration services.

Calibration must be accompanied by the following:

- A calibration certificate.
- A calibration label to 27 >>BD >>BDd<006 >>L50I (g)-5 (.6 (o) 1x3.4 (n)s.)T0 Tc 0.1 (o)36.5 (C)2>>BD

## **21. Working With Radiation-Producing Machines**

“Radiation-producing machines” include x-ray machines, DEXA bone scanners









## **F. Environmental Release**

If radioactive materials are accidentally released into the environment (e.g., via drain, chemical fume hood, etc.), inform the RSO immediately.

