THE UNIVERSITY OF AKRON

RADIATION SAFETY PROGRAM

I. Design and Purpose of the Radiation Safety Program

A. Purpose of the Radiation Safety Manual

This manual is designed to provide information to personnel and the general public regarding the structure of The University of Akron's (UA) Radiation Safety Program. It presents those procedures adopted by the Ohio Department of Health (ODH) and the University as safe, reasonable, and enforceable. Because it is submitted as part of our application for a Broad Scope Byproduct Material License with the ODH, it is designed to conform closely to Chapter 3701:1-38 of the Ohio Administrative Code entitled, "General Radiation Protection Standards for Sources of Radiation". Copies of these regulations are on file in the Radiation Safety Office.

The Radiation Safety Program shall cover the use of all byproducts, source, special nuclear, accelerator produced, or naturally occurring radioactive materials above background levels. All materials, equipment, or items capable or producing ionizing radiations are also included. There will be no minimum activities of radioactive material exempt from University regulations.

B. The ALARA Goal

The chief goal of the Radiation Safety Program is to minimize the exposure to radioactive materials and their radiations to a level AS LOW AS IS REASONABLY ACHIEVABLE (ALARA). There are three objectives to an effective ALARA program.

1. To reduce occupational radiation exposure to levels to reasonably achievable by means of good radiation protection planning and practice.

2. To reduce radiation exposures to the general public to levels as low as is reasonably achievable.

3. Commitment of management to encourage good radiation safety planning, to establish and enforce radiation safety practice, and to remain vigilant to the goal of improving the Radiation Safety Program.

C. Administrative Line of Authority

1. Radiation Safety Officer (RSO)

The Radiation Safety Officer is vested with the responsibility and authority to administer and enforce the regulations of the Ohio Department of Health. The RSO has the full authority to immediately halt any activity judged to be a threat to health, safety, the environment, or a violation of ODH regulations, or the conditions of the license. The RSO shall have free access to all areas on campus where radioactive materials are received, handled, used, or stored, and where radiation or radioactivity is produced. The RSO reports to the Vice President of Capital Planning and Facilities Management and performs the following duties:

a. General surveillance of all health physics activities, including both personal and environmental monitoring.

b. Furnishing consulting services to personnel at all levels of responsibility on all aspects of radiation protection.

c. Reviewing and approving the credentials of all individuals who desire to use radioactive materials or radiation producing equipment.

d. Reviewing and approving all procedures for the use of radioactive materials or radiation producing equipment to determine if the proposed work can be safely accomplished within the existing licensed procedures and isotope possession limits.

e. Controlling the receipt, delivery, transfer, and shipping of all radioactive materials coming to or leaving the campus.

f. Monitoring of all materials, devices, or equipment capable of producing ionizing radiations.

g. Instructing personnel in proper procedures for the use of radioactive materials.

h. Approving all purchase requisitions for radioactive materials assuring that receipt of the ordered material will not exceed the license possession limits.

i. Approving all internal transfers of radioactive material between authorized investigators.

j. Administrating the waste disposal program. Obtaining and keeping all Federal, State, and local waste disposal records and permits.

k. Performing leak tests on all sealed sources at a minimum 6 month intervals.

l. Maintaining an inventory of radiation safety detection equipment in proper working order and recalibrated on an annual basis.

m. Maintaining a current inventory of radioactive materials on campus to be updated on a monthly basis.

n. Storing radioactive materials not in current use.

o. Maintaining permanent records of:

personnel occupational exposures
receipt of radioactive materials
disposal of radioactive materials
laboratory monitoring

p. Maintaining central storage and waste facilities.

q. Performing air quality and ventilation surveys of radioisotope areas.

r. Performing periodic audits of laboratory inventories and monitoring records.

s. Promoting the ALARA concept in all aspects of the Radiation Safety Program.

In case of a temporary absence from campus, the RSO shall empower the Assistant RSO, the Chairman of the Radiation Safety Committee, or another member of the committee with his duties and authority.

2. Radiation Safety Committee (RSC)

The Radiation Safety Committee shall be appointed by the Vice President for Capital Planning and Facilities Management. The Radiation Safety Officer (RSO) and the Vice President for Capital Planning and Facilities Management (or his designee) shall be a non-voting member of the committee. At least three faculty members, appointed from the faculties of the academic units, which use radioactive materials, shall be voting members of the committee. The Vice President for Capital Planning and Facilities Management may appoint other University personnel to the committee as non-voting observers.

The committee has the responsibility for overall administration of the Radiation Safety Program, and performs the following specific functions:

a. Provides advice to the Vice President for Capital Planning and Facilities Management and RSO on policies and technical matters regarding radiation safety.

b. Reviews periodic reports from the RSO on items such as monitoring, contamination, personal exposure, and regulatory changes.

c. Conducts annual audits of the Radiation Safety Program to determine that all necessary functions are being performed at their required intervals, and all required records are intact.

d. Reviews actions taken by the RSO against individuals committing significant violations of radiation safety regulations.

e. Promotes the implementation of good ALARA practices in all aspects of the Radiation Safety Program.

The Chairman of the committee is a designated backup for the RSO during any absence from campus. The chairman has the authority to approve purchase requisitions, receive radioactive packages, and may be called upon to provide emergency response support.

3. University Policy Governing Violations of Regulations

Violations of safety regulations can range from incidental to life threatening. The RSO has the right to fully investigate a possible violation at any time. The RSO has the right to immediately terminate any activity found to be a threat to health, safety, the environment, or a violation of the ODH regulations, or the conditions of the license.

The RSO has the authority to make the final institutional decisions regarding violations of ODH or University of Akron regulations. The RSO will determine the severity of the violation and the appropriate prompt action to be taken. Those individuals committing serious violations or frequently violating safety standards will have their privilege to use radioactive materials revoked.

If necessary, individuals may appeal a decision to the Radiation Safety Committee or Vice President for Capital Planning and Facilities Management. In the event of a disagreement between the Committee and Vice President for Capital Planning and Facilities Management and the RSO, representatives of the ODH will be contacted to review the situation.

II. Personnel Involved in the Use of Radioactive Material

This section discusses the requirements for participation in the Radiation Safety Program, and outlines the training and responsibilities of each person in the program.

A. Authorized Investigator – Faculty

All investigators who desire to use radioisotopes or other forms of ionizing radiation must provide a summary of their past training and experience in handling radioactive materials to the RSO. The RSO will either accept the credentials as sufficient or require them to complete a training program and pass a written examination.

Authorized investigators are responsible for the health and safety of all personnel in their laboratory. They must ensure that procedures used to accomplish the intended research goals are as safe as possible. They are responsible for:

1. Determining that all individuals working in their laboratory have completed the necessary training programs before beginning to handle radioactive materials.

2. Assuring that all personnel working in their laboratory are included in the personnel-monitoring program if necessary.

3. Monitoring their laboratory's ambient conditions as often as necessary to determine that exposure to radiation is maintained ALARA.

4. Labeling of all areas and materials with the proper warning signs, and assuring that the information is kept current and accurate.

5. Properly disposing of radioactive wastes and preventing the accumulation of excessive quantities of waste material in the laboratory.

6. Notifying the RSO of any changes in personnel, techniques, or physical facilities from those outlined in their original approved procedures.

7. Informing all laboratory personnel who are not authorized users of radioactive materials of the storage, use and disposal locations within their work areas.

   The authorized investigator will explain the ALARA concept and the need to maintain exposures ALARA to all personnel under their supervision. The authorized investigator will review each planned use of radioactive material to ensure that doses will be kept ALARA. The investigator must also ensure that all personnel under their supervision subject to occupational exposures are trained and educated in good health physics practices and in maintaining their exposures ALARA.

   All authorized investigators shall be required to attend annual refresher training on current practices and procedures. Investigators must attend annual training sessions to continue their authorizations.

B. Authorized Users – Visiting Faculty, Postdoctoral Fellows, Technical Staff and Students

All individuals who desire to use radioisotopes or other forms of ionizing radiation must provide a summary of their past training and experience in handling radioactive materials to the RSO. The RSO will either accept the credentials as sufficient or require them to complete a training program and pass a written examination.

Authorized users must work under the supervision of an authorized investigator. Authorized users will be responsible for setting up and completing their experiments in as safe a manner as possible. They shall report all unsafe or non-ALARA conditions to the authorized investigator responsible for that area or the RSO.

C. Ancillary Personnel

All ancillary personnel (e.g., safety, security, cleaning, maintenance, etc.) who enter laboratories containing radioactive materials will be trained on current policies and procedures at the beginning of their employment and periodically updated thereafter. Ancillary personnel will be instructed in the ALARA philosophy and informed that the University is committed to its implementation.

Receiving personnel will be instructed in the specific procedures to be followed for receiving and handling radioactive packages.

II. Policies and Procedures

A. Authorization of Radioactive Materials Locations

All rooms in which radioactive materials or radiation producing equipment are used or stored must be specifically approved for that purpose by the RSO. Approval will consider the isotope to be used, the maximum activity expected, the volatility and dispersibility of the radioactive materials, and the specific procedures to be carried out in the area. Other factors, which may influence a decision, are the amount of bench space, fume hoods, bio-hoods, shielding, storage space, and waste handling facilities.

All rooms approved for use of radioactive materials must also be under the direct control and supervision of an authorized investigator. The investigator must accept full responsibility for the continual safe conditions in that laboratory.

The use or storage of radioactive materials in shared departmental facilities must also be approved by the Departmental Chairman. The authorized investigator is responsible for informing all departmental members in writing of the intention to use or store radioactive materials, and of any special precautions that need to be taken.

Definitions: The ODH defines areas as follows:

1. Unrestricted Area – "means any area, access to which is neither restricted nor controlled by the licensee or registrant."

2. Restricted Area – "means an area access to which is limited by the licensee or registrant for the purpose of protecting individuals against undue risks from exposure to sources of radiation. Restricted area does not include areas used as residential quarters, but separate rooms in a residential building may be set apart as a restricted area."

3. Controlled Area – "means any area, outside of a restricted area but inside the site boundary, access to which can be limited by the licensee or registrant for any reason."

4. Radiation Area – "means an area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.05 millisievert (0.005 rem) in one hour at thirty centimeters from the source of radiation or from any surface that the radiation penetrates."

5. High Radiation Area – "means an area, accessible to individuals, in which radiation levels radiation sources could result in an individual receiving a dose equivalent in excess of one millisieverts or 0.1 rem in one hour at thirty centimeters from the radiation source or thirty centimeters from any surface that the radiation penetrates."

6. Very High Radiation Area – "means an area, accessible to individuals, in which radiation levels could result in an individual receiving an absorbed dose in excess of five Gy, or five hundred rad, in one hour at one meter from a source of radiation or from any surface that the radiation penetrates. At very high doses received at high dose rates, units of absorbed dose, gray and rad, are appropriate, rather than units of dose equivalent, sievert or rem."

   Additionally, all area using radioisotopes will be classified as Minimum Significant Quantity (MSQ), Type C, Type B, or Type A according to the International Atomic Energy Agency's (IAEA) radiotoxicity classification scheme as follows:

Class I – Very High Toxicity

^{90}Sr	^{90}Y	^{210}Pb	210Bi

Class 2 – High Toxicity

^{22}Na	$^{36}C1$	^{45}Ca	^{47}Ca	^{47}Sc	^{54}Mn	^{56}Co	^{60}Co	^{85}Sr	^{89}Sr
^{91}Y	^{95}Zr	^{106}Ru	^{106}Rh	$^{110}Ag^{m}$	$^{115}Cd^{m}$	$^{114}In^{m}$	^{124}Sb	^{125}Sb	$^{127}Te^{m}$
$^{129}Te^{m}$	^{124}I	^{125}I	^{126}I	^{131}I	^{133}I	^{134}Cs	^{137}Cs	^{140}Ba	^{141}Ce
^{144}Pr	^{151}Sm	^{152}Eu	^{154}Eu	^{160}Tb	^{170}Tm	^{181}Hf	^{182}Ta	^{192}Ir	^{203}Hg
$^{204}T1$	^{207}Bi	^{210}Bi							

Class 3 – Moderate Toxicity

^{7}Be	^{14}C	^{18}F	^{24}Na	$^{38}C1$	^{31}Si	^{32}P	^{35}S	^{41}A	^{42}K
^{43}K	^{47}Sc	^{48}Sc	^{48}V	^{51}Cr	^{52}Mn	^{56}Mn	^{52}Fe	^{55}Fe	^{59}Fe
^{57}Co	^{58}Co	^{63}Ni	^{65}Ni	^{64}Cu	^{65}Zn	$^{69}Zn^{m}$	^{72}Ga	^{73}As	^{74}As
^{76}As	^{77}As	^{75}Se	^{82}Br	$^{85}Kr^{m}$	^{87}Kr	^{86}Rb	^{91}Sr	^{90}Y	^{92}Y
^{93}Y	^{97}Zr	$^{92}Nb^{m}$	^{95}Nb	^{99}Mo	^{96}Tc	$^{97}Tc^{m}$	^{97}Tc	^{99}Tc	^{97}Ru
^{103}Ru	^{103}Pd	^{109}Pd	^{105}Ag	^{111}Ag	^{109}Cd	^{115}Cd	^{113}Sn	^{122}Sb	$^{125}Te^{m}$
^{127}Te	^{129}Te	$^{131}Te^{m}$	^{130}I	^{132}I	^{134}I	^{135}I	^{135}Xe	^{131}Cs	^{136}Cs
^{131}Ba	^{140}La	^{141}Ce	^{143}Ce	^{142}Pr	^{143}Pr	^{147}Nd	^{149}Nd	^{147}Pm	^{149}Pm
^{153}Sm	^{152}Eu	^{155}Eu	^{153}Gd	^{159}Gd	^{165}Dy	^{166}Dy	^{166}Ho	^{169}Er	^{171}Er
^{171}Tm	^{175}Yb	^{177}Lu	^{181}W	^{185}W	^{187}W	^{183}Re	^{186}Re	^{188}Re	^{185}Os
^{191}Os	^{193}Os	^{190}Ir	^{194}Ir	^{191}Pt	^{193}Pt	^{197}Pt	^{196}Au	^{198}Au	^{199}Au
^{197}Hg	$^{197}Hg^{m}$	^{200}Tl	^{201}Tl	^{202}Tl	^{203}Pb	^{206}Bi	^{212}Bi		

Class 4 – Low Toxicity

^{3}H	^{15}O	^{37}A	$^{58}Co^{m}$	^{59}Ni	^{69}Zn	^{71}Ge	^{85}Kr	^{87}Rb	$^{91}Y^{m}$
^{93}Zr	^{97}Nb	$^{96}Tc^{m}$	$^{99}Tc^{m}$	$^{103}Rh^{m}$	$^{113}In^{m}$	^{129}I	$^{131}Xe^{m}$	^{133}Xe	$^{134}Cs^{m}$
^{135}Cs	^{147}Sm	^{187}Re	$^{191}Os^{m}$	$^{193}Pt^{m}$	$^{197}Pt^{m}$				

GUIDELINES FOR MAXIMUM ACTIVITIES IN LABORATORIES

Type of Working Laboratory Area

Radiotoxicity of Radionuclide	Minimum Significant Quantity Area	Type C Area	Type B Area	Type A Area
1. Very High	0.l µCi	< 10 µCi	10 µCi – 10mCi	> 10 mCi
2. High	1.0 µCi	< 100 µCi	100 µ Ci – 100 mCi	> 100 mCi
3. Moderate	10.0 µCi	< 1 mCi	1mCi – 1 Ci>	1 Ci
4. Low	0.1 mCi	< 10 mCi	10 mCi – 10 Ci	> 10 Ci

Type A areas are specially designed laboratories for handling large activities of radioactive materials. A Type B area is a specially designed radioisotope laboratory. A Type C area is a good quality chemical laboratory with enhanced ventilation or fume hoods, and non-absorbent surfaces. With the approval of the Radiation Safety Officer, it may be possible to increase the upper possession limits for Type C laboratories towards those of Type B laboratories for toxicity classes 3 and 4. Minimum Significant Quantity areas (MSQ) are laboratories that are not equipped with enhanced ventilation or fume hoods, but do possess adequate general ventilation. MSQ areas are intended for simple procedures such as scintillation vial counting and materials storage.

Modifying factors must be applied to the allowable quantities indicated according to the complexity of the procedures to be followed. The following factors are suggested, but due regard must be paid to all circumstances affecting individual cases.

Procedure	Modifying Factor
Storage (stock solutions or materials)	X 100
Very simple wet operations	X 10
Normal chemical operations	X 1
Complex wet operations with increased risk of spills	X 0.1
Simple dry operations	X 0.1
Volatile radioactive compounds	X 0.1
Exposure of non-occupational personnel	X 0.1
Cry and dusty operations	X 0.01

Accordingly, most UA radioisotope laboratories will be regulated as Restricted Type C areas. Areas such as the Radiation Safety Office's radioactive materials and waste storage area, Auburn Science and Engineering Center 9B-E, will be regulated as a Restricted Type B area. UA currently has no Restricted Type A areas.

B. Before Beginning an Experiment in an Approved Area

Before working with radioactive materials, all personnel must be authorized as outlined in Section 2. The authorized investigator must contact the RSO and arrange for personnel radiation exposure monitoring, including bioassay, if necessary. The authorized investigator supervising the research project is responsible for the health and safety of all personnel on the project. The investigator must be certain that all requirements and preparations have been met before assigning someone to work with any radioactive materials or radiation-producing equipment. All personnel must also know how to contact the RSO in the event of an emergency, and be familiar with the emergency procedures outlined in Section 6.

The RSO must approve all new procedures and applications using radioisotopes. The authorized investigator must submit detailed materials and methods for each of the procedures to be performed. The RSO will review the procedures and determine if they can be safely performed in accordance with the ALARA concept. The RSO will assign a protocol number to each approved procedure with an expiration limit of 2 years.

Before attempting any new procedures with radioactive materials, it is required that a "dry run" be carried out to help anticipate possible hazards during the experiment. An aid in detecting potential flaws is to perform the experiment with a fluorescent material or dye. Ultraviolet light can be used to survey the area following an experiment to help indicate where materials may have contaminated the area.

C. Purchasing Radioactive Materials

All purchase orders for radioactive materials must be approved by the RSO, or acting designee. Authorized investigators should complete a purchase request form, indicating the assigned protocol number corresponding to the procedure to be performed, and forward same to the Radiation Safety Office for approval. The RSO will verify that both the University and investigator are authorized for the material being purchased, and that the quantity of material being purchased will not exceed licensed possession limits. Upon approving the radioactive materials purchase request, the RSO will contact the investigator. The investigator may then submit a requisition for the desired material through The University of Akron's purchasing program. The purchase of radioactive materials using a University of Akron issued credit card is specifically prohibited.

It is imperative that the Radiation Safety Office is notified of the specific delivery date of all radioactive materials. This is necessary to ensure that all materials will be properly received, and that receipt of materials will not exceed license limits.

D. Receiving Radioactive Materials

The Central Receiving Department, presently Central Stores, is open between 8:00 a.m. and 5:00 p.m. weekdays. Radioactive materials will only be received during normal working hours.

When a package of radioactive material arrives on campus, the receiving personnel will inspect the package for gross signs of damage (i.e., crushed box or wet areas due to leaks) before accepting it from the carrier. If the package appears damaged, the receiving personnel shall ask the carrier to remain at the dock, and contact the RSO immediately. The RSO will monitor the package, the receiving area, the carrier's vehicle, and all personnel who handled the package to determine the extent of possible contamination.

All radioactive packages received at the central receiving facility will be secured in the cabinet or refrigerator/freezer designated for such materials until the Radiation Safety Office is contacted. The RSO, or authorized designee, will verify that the material was properly ordered and determined if the package requires monitoring. The RSO, or authorized designee, will proceed to the receiving area, monitor the package if required, record its receipt, and deliver it to the authorized investigator's area. Any radioactive material(s) shipment, which cannot be delivered to the authorized investigator, or secured in the investigator's approved area, will be taken to the ASEC 9-B-E complex. The material will be placed in storage until delivery to the authorized investigator can be made.

The RSO, or authorized designee, who receives the package, will complete a "Receipt of Radioactive Materials Form" (see page 14). The receipt form, packing slip, and purchase approval form will be retained by the Radiation Safety Office and made available for ODH inspection.

Packages containing radioactive material must be inspected within three (3) hours if received during normal working hours (8:00 a.m. – 5:00 p.m. weekdays). Inspection of the package must be performed in accordance with the following:

UA shall monitor the external surfaces of each package known to contain radioactive material for radioactive contamination and radioactive levels if the package:

1. is labeled as containing radioactive materials; or

2. has evidence of potential contamination, such as a package that is crushed, wet, or damaged

This will normally include all Radioactive Material-Excepted Limited Quantity, N.O.S.; Radioactive White I; Radioactive Yellow II; or Radioactive Yellow III packages.

Monitoring shall consist of surveys and wipe tests using approved instruments and techniques. Wipe tests shall be performed by wiping a 300 cm^2 area of the exterior package with filter paper disks moistened in 50%-70% ethanol. Surveys shall be performed with calibrated instruments and recorded in mR/hr. If removable contamination in excess of 10^{-5} uCi/cm^2 (22 dpm/cm^2 or 6,600 dpm for 300 cm^2); or radiation dose levels in excess of 200 mRem/hr at the surface or 10 mRem/hr at one (1) meter are detected, the RSO will immediately notify the final carrier and the ODH.

RECEIPT OF RADIOACTIVE MATERIALS REPORT

Investigator _____ Isotope _____
P.O. # _____ Activity _____
Date Received _____ Assay Date _____

Shipping Label

No Label _____
Excepted Limited Qty. _____
White I _____
Yellow II _____
Yellow III _____

Package Conditions

Good _____
Other: (Describe below)
_____
_____
_____

Vendor (attach packing slip)

New England Nuclear _____
ICN Biochemicals _____
Amersham _____
_____ _____
_____ _____

Carrier

Federal Express _____
Purolator _____
Federal Express _____
_____ _____
_____ _____

Package Monitoring	**Meter Survey (mR/hr)**	**Filter Wipe (dpm) (attach printout)**
Exterior package	_____	_____
Inner container #1	_____	_____
Inner container #2	_____	_____
_____	_____	_____
Background	_____	_____

*** * * MONITORING IS REQUIRED FOR * * ***

1. All packages containing external Radioactive Materials shipping labels of any kind; and

2. All potentially damaged packages with only internal labeling.

E. Storage

All radioactive materials must be stored in an area of controlled access to prevent unauthorized removal. Normally, the material will be stored in an area that can be locked when personnel authorized to handle the material are not present. Radioactive materials stored in unrestricted areas must be secured against unauthorized removal.

The authorized investigator is responsible for assuring that all items containing radioactive material are marked with an approved label bearing the isotope symbol and the words "Caution Radioactive Material".

F. Use

All radioactive materials must be used and stored in designated areas approved by the RSO. Radioactive materials should be treated as hazardous substances and handled with all cautionary procedures normally accorded such substances. Normal precautions shall include the following safety measures.

1. No eating, drinking, smoking, applying cosmetics, or any other procedure that could lead to inadvertent ingestion is permitted in any area where radioactive material is used or stored.

2. Film badges must be worn when using high-energy beta-producing isotopes and/or high activities of gamma ray or x-ray-producing isotopes.

3. Lab coats and disposable gloves must be worn when handling radioactive materials. Care must be taken not to contaminate other surfaces when working with gloves. Traces of radioactive material are often inadvertently transferred to refrigerator handles, telephones, sink faucets, centrifuge doors and rotors, and instrument dials when handling them with a "hot" glove. Be sure to monitor such surfaces following use to assure no contamination has taken place. Potentially contaminated clothing is not to be worn out of the laboratory area.

4. Glassware, tongs, pipettes, and other similar materials used for radioisotope work should be suitably marked, and must be decontaminated before being used in a non-radioactive area. "Hot" glassware should be disposed or decontaminated promptly.

5. Work should be confined to as small an area as possible. This simplifies the problem of confinement and shielding, and aids in limiting the affected area in case of an accidental contamination.

6. All work involving the likelihood of aerosols, dusts, or gaseous products, must be done in hoods, glove boxes, or similar protective devices. All releases from these systems shall be ALARA, and may never exceed the maximum permissible concentration in air.

7. Work surfaces should be covered with an absorbent paper with waterproof backing. Procedures involving high activity liquids should be confined to an impervious tray. Change paper and wash trays frequently to prevent the spread of radioactive contamination.

8. Pipetting radioactive materials by mouth is prohibited.

9. Food or drink, even in sealed containers, must not be stored in the same refrigerator or freezer where radioactive materials are stored.

10. Each laboratory or area utilizing high energy beta, gamma or x-radiation shall be equipped with a portable survey meter available from the Radiation Safety Office. Work and storage areas shall be monitored after each use to detect contamination and to maintain exposure levels within the allowable limits.

11. Minimize the exposure to high activities of gamma, x-ray, and high-energy beta emitting radioisotopes. Confine such isotopes to a suitably shielded storage box in a remote spot of the laboratory (e.g., back corner of a hood or refrigerator). Use long-handled forceps or tongs when possible to reduce hand exposures. Suitable approved eye protection shall be worn whenever handling >5.0 mCi ^{32}P.

12. Any equipment used with radioactive materials (refrigerators, ovens, centrifuges, lyophilizers, vacuum pumps, etc.) shall not be removed from its authorized area until demonstrated to be free of contamination. No potentially contaminated equipment shall be repaired by Physical Plant or other personnel without first being demonstrated to be free of contamination prior to servicing. These regulations also apply to any equipment being returned to the manufacturer for servicing.

G. Animal Use

1. The authorized investigator is responsible for obtaining the permission of the Animal Care and Use Committee and the RSO before beginning experiments involving the use of radioactive materials in animals. The investigator must complete and submit an "Animal Use Committee Clearance Form" to the committee for approval.

2. The authorized investigator is responsible for assuring that all personnel frequenting the area where radioactive materials will be used are trained in the proper safety precautions to be exercised in conjunction with the experimentation.

3. The authorized investigator, or subordinate authorized users, are responsible for performing all routine animal care duties associated with the normal day-to-day care of their animals. Authorized investigators, or subordinate authorized users, must perform all cage cleaning and package all bedding and feces as radioactive waste, unless said materials are proven to be non-contaminated.

4. Radioactive materials may only be administered to animals owned by the University. All animals must be identified to ensure proper identification and disposal.

5. All cages containing treated animals must be labeled with radioactive warning tape. The door to the room containing the cages must also be labeled and locked when not under direct supervision. The authorized investigator is responsible for monitoring, and if necessary decontaminating, any equipment used in their experimentation.

6. All dead animals must be treated as radioactive waste. Feces and urine from animals must also be treated as radioactive waste unless proven otherwise. Radioactive waste may not be disposed without the approval of the Radiation Safety Officer.

7. Possible hazards resulting from air concentrations of radioactive metabolites must be controlled. Metabolic cages may be required in order to meet safety standards.

H. Inventory

The RSO is responsible for maintaining inventory records of all radioactive materials on The University of Akron campus, and ensuring that the possession limits for each specific isotope are not exceeded. Authorized

investigators are responsible for maintaining up-to-date records of the receipt, use, and disposal of radioactive materials under their supervision.

The RSO will send each investigator a radioisotope inventory form (see page 19) indicating the activity of each radioisotope under their supervision at the beginning of the month. The RSO notes the activity of any isotopes received through the office during that month and calculates the activity of each isotope lost by decay using the following formula. (Note that the duration of a month is taken as 30.5 days, an annual average number of days per month.)

$A = A_o$ e, where A = remaining activity; A_o = initial starting activity;

e = 2.718; T = half-life of material; and, t = elapsed time (in half-life units).

On receipt of their inventory form, each investigator is responsible for promptly completing the information on the form and returning it to the RSO. All entries should be made in millicuries.

The RSO must approve all transfers of radioactive material between investigators. Transfers from one investigator to another should be noted in the transferred column of the form.

The RSO will review all inventory forms to make certain that the receipt, storage, disposal, and decay balance to the nearest microcurie. The RSO will compare the total activity present on campus with the possession limits for each specific isotope in order to ensure license compliance.

I. Transportation of Radioactive Materials Off Campus

Limited quantities of radioactive materials may be transported off campus to another facility licensed by the ODH to receive the radioactive material (e.g., to one of the consortium universities or hospitals). Due to the numerous ODH and DOT regulations governing transportation of these materials on public highways, ALL TRANSPORTATION OFF CAMPUS MUST PROCEED THROUGH THE RADIATION SAFETY OFFICE. Transfers will only be arranged from the Radiation Safety Office of The University of Akron campus to the Radiation Safety Office of the other institution. All transfers must comply with all applicable regulations found in 10 CFR 71 and 49 CFR 173.

UA RADIOISOTOPE INVENTORY REPORT – Report all values in mCi

Date: _____

Investigator: _____

$$A = A_o e^{\frac{-.693\ t}{T\ ½}}$$

I-----Activity Placed Into Waste (end of Month)-----I

Isotope	Decay Rate (30.5d)	Starting Activity	Activity Received	Activity Transferred	Liquid Scintvials	Dry Solids	Animal	Bulk Liquids	Release to Sewer	Activity Lost by Decay	Activity End of Month
^{3}H	.00467										
^{14}C	.00001										
^{35}S	.21488										
^{125}I	.29589										
^{32}P	.77237										
////////////	//////////	//////////									
////////////	//////////	//////////									
////////////	//////////	//////////									
////////////	//////////	//////////									
Total Activity:											
Lost By Decay:	//////////////////////////////										
Activity Left After Decay:	//////////////////////////////										

IV. Safety Monitoring Program

The goals of the monitoring program are to assure the safe working conditions for all personnel in restricted and unrestricted areas. Frequent monitoring of laboratories and personnel helps to assure that individuals will not exceed their maximum permissible exposure limits, and that radiation levels remain as low as reasonably achievable (ALARA).

The RSO will maintain all required records of personnel occupational exposure histories and laboratory working conditions.

A. Personnel Film Badge Dosimetry Program

The University of Akron contracts with accredited firms for a monthly radiation dosimetry program. The standard badge given to personnel is a "whole body" badge. Special ring or wrist badges are available for situations in which hand exposures may be excessively high compared to whole body exposures. They are specifically required when handling > 1 mCi of strong beta or gamma emitters. Doses are reported to the RSO monthly by the contracting service. Any individual receiving a dose above specific action levels will be notified as soon as possible.

All individuals handling certain x-ray, gamma ray, or high-energy beta emitting isotopes (e.g., 125-I, 32-P) or high activity sealed sources (e.g., Cs-137, Co-60) must wear a film badge. Individuals working exclusively with low energy beta emitters (e.g., 3-H, 14-C) need not wear a badge. Individuals working exclusively with radiation generating equipment, such as electron microscopes, x-ray diffraction equipment, spectrometers, etc., may be required to wear an appropriate dosimeter. The rules established in Chapter 66 of the OAC will be used to determine which radiation generating equipment operators are required to wear a dosimeter, and the type of dosimeter that is appropriate for their activities. The maximum permissible exposures for personnel are as follows:

Maximum Permissible Dose Limits (Dose in Rem)

Occupational Radiation Workers	**Yearly**
Total Effective Dose	5.0
Deep Dose Equivalent or Committed Dose Equivalent to:	
Eye	15
Other Organ	50

Shallow Dose Equivalent to:	
Skin	50
Each of Extremities	50
Pregnant Women	0.5
Members of the General Public	0.1

The annual occupational dose limits for minors are 10 percent of the annual dose limits specified for adults.

Prior to beginning work in which personal dosimetry is required, the RSO will determine whether the individual requesting the dosimeter has previously been employed at an institution where occupational radiation exposure was monitored. If so, the RSO will have the individual complete a request form authorizing the previous employer(s) to release information regarding the individual's prior accumulated occupational dose.

The RSO will perform monthly reviews of occupational radiation exposures with particular attention to instances in which the investigational levels in the following table are exceeded.

Exposure Investigational Levels (mrem/month)

	Level I	Level II
Deep Dose Equivalent	20	200
Lens Dose Equivalent	60	600
Shallow Dose Equivalent	1,000	2,000

All reported exposures in excess of Level I will be conveyed to the individual as soon as they are detected. The RSO will attempt to determine the cause of the exposure and try to eliminate it. All reported exposures in excess of Level II will be immediately conveyed to the individual, the authorized investigator, and the Chairman of the RSC as soon as they are detected. If deemed necessary, a special meeting of the Radiation Safety Committee will be scheduled. All concerned will attempt to determine the cause of the exposure and take corrective measures. Corrective measures may include revision of laboratory procedures, construction of additional shields, implementation of additional ALARA measures, and/or suspension of the use of radioisotopes by the individual.

All individuals have the right to examine their exposure reports at any reasonable time in the Radiation Safety Office. Future employers of the individual have the right to obtain a copy of their exposure history.

B. Bioassay Programs

The bioassay program is designed to assure that no radioactive material has been inhaled, absorbed, or ingested during the handling of specific radioisotopes under certain conditions. Appropriate clinical action will be taken if certain levels of radioactive materials are detected.

Bioassays are performed on an "as needed" basis, and are only required under certain circumstances. The University's policy is to minimize as much as possible those situations requiring bioassays.

U. S. N. R. C. Regulatory Guides 8.20 and 8.32 stipulate that individuals handling specific quantities of tritium (3-H), 125-I or 131-I labeled compounds must be bioassayed. Other specific radioisotopes may also require bioassay procedures in accordance with Regulatory Guide 8.9.

3-H

All workers involved in the processing of 3-H under conditions sufficiently close to or exceeding those shown on page 26, must participate in the bioassay program. It is anticipated that seldom, if ever, will the activities in the table be exceeded.

Experiments involving 3-H nucleotide precursors at levels exceeding the table shall be performed in a radiological fume hood and investigators will wear lab coats throughout the experiment. The RSO shall be notified at least eight (8) hours before such an experiment.

Urinalysis will be performed within 48 hours following the use of designated quantities of 3-H compounds. Duplicate 1 ml samples of urine will be collected and counted by liquid scintillation using an appropriate cocktail. If routine use of designated quantities of isotopes are planned, urinalysis will be performed bi-weekly until one month after use of 3-H at designated levels has ceased.

If 3-H excretion rates exceed 50 uCi/liter, the following steps will be taken by the RSO, or authorized designee:

1. Notify the Radiation Safety Committee Chairperson, Department Chairperson, and Authorized Investigator in charge of the area.

2. Refer the individual to the Nuclear Medicine Department of Akron City Hospital.

3. Investigate the operation and the area it was performed in to determine the cause of the exposure.

4. Report the incident to the ODH.

5. Implement corrective procedures necessary to reduce further exposures. These may include removing the individual from further work with excessive quantities of 3-H or prohibiting use of excessive quantities of 3-H in that work area.

6. Perform urinalysis on a weekly basis until excretion rates of less than 5 uCi/liter are seen for two (2) consecutive weeks.

   In the event that activities of 5 – 50 uCi/liter are observed, the urinalysis procedure will be repeated within 48 hours. If levels are still above 5 uCi/liter, steps 3 through 6 will be implemented.

125-I/131-I

The activity levels above which bioassay shall be required for 125-I or 131-I are shown on page 27. The thyroid burden for each individual will be determined by scanning each participant with a survey meter equipped with an appropriate scintillation probe. The meter will be calibrated against a known standard enclosed in a Lucite neck phantom to simulate tissue equivalency and thyroid position. Readings will be taken from the neck over the thyroid and compared with control readings taken from the individual's thigh. These values will be used to estimate the individual's thyroid burden.

Bioassays will be performed at the following frequencies:

1. **Initial** – Pre-operational baseline reading performed within two (2) weeks prior to beginning work with radioactive iodine.

2. **Routine** – Performed at the frequencies listed in NRC 8.20, Regulatory Position 4. Initially, bioassays will be performed within 72 hours following entry of an individual into an area where bioassays are required, but waiting at least six (6) hours for distribution of a major portion of the iodine to the thyroid. For individuals who are continually using radioactive iodine, bioassays will be performed at a minimum of every two (2) weeks thereafter. For individuals who use radioactive iodine on an infrequent basis (less than every two (2) weeks), bioassays will be performed within

72 hours (but no sooner than 6) of the end of the work period. After a 3-month measurement period, the frequency of bioassays for continual users can be reduced to monthly or quarterly periods if criteria outlined in NRC 8.20 are met.

3. **Post-operational** – A bioassay will be performed within two (2) weeks of the last possible exposure of radioactive iodine when the individual is terminating all potential exposure.

4. **Diagnostic –** Follow-up bioassays will be performed within two (2) weeks of any measurement exceeding levels given as action points in NRC 8.20 regulatory position 5-1, and within one (1) week for levels exceeding those given in 5-2.

5. **Emergency** – Bioassays will be performed after any incident that causes thyroid uptakes to exceed the burdens listed below. These are to be carried out within 2-3 hours after exposure (when the time of exposure is known) so that any prescribed blocking agent would be effective.

   Whenever the thyroid burden is found to exceed 0.12 uCi of 125-I or 0.04 uCi of 131-I, the following steps will be taken by the RSO, or authorized designee:

   a. Conduct an investigation of the operations involved to determine the cause of the exposure, and evaluate the potential for further exposure.

   b. Implement corrective action to eliminate or reduce the potential for further exposures.

   c. Repeat bioassays within two (2) weeks to confirm the presence of radioactive iodine and estimate the effective biological half- life.

   d. Notify the ODH.

   If the thyroid burden is found to exceed 0.5 uCi of 125-I or 0.14 uCi of 131-I, the following actions will be taken immediately by the RSO, or authorized designee:

   a. Notify the Radiation Safety Committee Chairperson, the Department Chairperson, and authorized investigator responsible for the area when and where the exposure occurred.

b. Refer the individual to the Nuclear Medicine section of Akron City Hospital.

c. Conduct an investigation of the operations involved to determine the cause of the exposure, and evaluate the potential for further exposure.

d. Notify the ODH.

e. Implement corrective action to eliminate or reduce the potential for further exposures.

f. Carry out repeated measurements at one-week intervals until the thyroid burden is less than 0.12 uCi of 125-I or 0.14 uCi of 131-I.

g. Evaluate the possibility of longer-term compartments containing 125-I or 131-I to ensure that appreciable exposures to these compartments do not go undetected.

Activity Levels or Concentrations Above Which Bioassay For 3-H Is Necessary

TYPES OF OPERATIONS	HTO[a], TRITIATED COMPOUNDS AND GASES [b]
Processes in open room or bench with possible escape of tritium from process vessels	10 mCi
Processes with possible escape of tritium carried out within a fume hood of adequate design, face velocity, and performance reliability	100 mCi
Processes carried out within glove boxes that are ordinarily closed but with possible release of tritium from process vessels and occasional exposure to contaminated box and leakage	1 Ci

Quantities (< 10 Kg) of substances containing tritium that are present during operations may be considered to be either the amount processed by an individual at any one time (when accidental intake is more likely) or the amount of activity that entered into the process (throughout) during any one month (when routine handling of repeated batches is the more likely source of exposure).

1. ([a]) HTO is a symbol for a water molecule in which a tritium atom (T) is present in place of a normal hydrogen atom (H).

2. ([b]) This refers to gas in sealed process vessels and assumes that adequate air monitoring has established that there is no tritium leakage or that no significant amount of tritium gas can be converted to HTO before intake.

Activity Levels Above Which Bioassay For 125-I Is Necessary

Types of Operations	Radioactivity Handled in Unsealed Form Which Requires Bioassay*	
	Volatile or Dispersible	Bound to Nonvolatile Agents
Processes in open room or bench, with possible escape of iodine from process vessels	0.01 mCi	0.1 mCi
Processes with possible escape of iodine carried out within a fume hood of adequate design, face velocity, and performance reliability	0.1 mCi	1 mCi
Processes carried out within glove boxes, ordinarily closed, but with possible release of iodine from processes and occasional exposure to contaminated box and leakage	1 mCi	10 mCi

***** - The radioactivity present may be considered the amount in process by a worker at any one time. The quantities shown in the right-hand column may be used when the radioactive iodine is always chemically bound and will remain nonvolatile, and diluted to concentrations less than 0.1µ Ci/mg of nonvolatile agent. Certain compounds where radioiodine is normally bound are known to release radioiodine when the material is in process, and the left-hand column may be applicable. For investigators who use 125-I in radioimmunoassay (RIA) kits, the quantities of 125-I are very small and in less volatile forms; therefore, the bioassay requirements may be found in the right-hand column.

C. Laboratory Monitoring Program

1. Survey Methods

All areas in which radioactive materials are either used or stored must be monitored by authorized investigator or user. All routine and special monitoring records shall be retained in a designated monitoring notebook. Notebooks must be kept in a secure location and made available for inspection by the RSO, RSC, or ODH.

The Radiation Safety Office also performs independent monitoring of all areas where unsealed forms of radioactive materials are used or stored on a monthly basis.

Monitoring for weak beta emitters, such as 3-H, 14-C, or 35-S, will consist of wipe tests. Monitoring for high-energy beta, x-ray or gamma radiation will consist of wipe tests and surveys performed with an appropriately calibrated meter.

The Radiation Safety Office maintains an inventory of calibrated rate and dose survey meters to be distributed to investigators as needed. Surveys will be used to verify that the radiation levels in all areas accessible to personnel are such that a major portion of the body could not receive exposures exceeding the following:

a. Unrestricted Area
Normal background radiation levels
(e.g., halls, offices, non-radiation labs)

b. Restricted Type C Area
2.0 mRem/hour
(e.g., typical radioisotope laboratory)

c. Restricted Type B Radiation Areas
5.0 mRem/hour
(e.g., ASEC 9B-E radioactive material and waste storage area)

Wipe tests are performed to detect removable surface contamination. Areas of approximately 100 cm^2 are wiped with filter paper disks moistened in 50-70% ethanol, and subsequently evaluated by appropriate counting instruments. Samples should be counted on a multichannel program to determine the quantity and type of radioisotopes present. Counting standards or DPM programs must be used to quantify results.

All contamination in excess of 200 dpm/100 cm^2 must be promptly removed. For contamination in excess of 2,000 dpm, a contamination zone shall be established around the area until the contamination is removed. Contamination in excess of 20,000 dpm will initiate immediate termination of all activities in the contaminated area. The area will be immediately decontaminated by the laboratory personnel under the supervision of the RSO.

All contaminated areas shall be promptly decontaminated with appropriate cleaning agents such as soap and water, D-Con, RadiacWash, or I-Bind. All contaminated materials will be processed through the corresponding routine waste streams. The contaminated area will be re-monitored by survey and/or wipe tests as appropriate to verify decontamination.

Records of decontamination activities shall be retained with other monitoring records in a designated monitoring notebook. Notebooks must be available for inspection by the RSO, RSC, or the ODH.

2. Survey Frequency

No area utilizing unsealed forms of radioactive material(s) may be monitored less frequently than on a monthly basis, and must be monitored after each experiment or use of material.

Radioactive materials held in long-term storage in the Radiation Safety Office's radioactive materials and waste storage facility (ASEC 9B-E) will be monitored on a no less than semiannual basis.

Sealed sources, not exempted from tests for leakage and/or contamination, will be wipe tested in accordance with manufacturers guidelines and evaluated using appropriate instrumentation and standards at intervals not to exceed six (6) months.

All investigators and users are responsible for monitoring their own areas of operation. Many projects are of such a nature that monitoring instruments must be on hand at all times. The RSO maintains an inventory of calibrated survey and rate meters to be distributed to those laboratories needing such equipment.

3. Pregnant Workers

A declared pregnant woman means a woman who has voluntarily informed her employer, in writing, of her pregnancy and the estimated date of conception. To ensure the health and safety of a developing fetus, the following steps shall be taken in the protection of a declared pregnant workers.

a. Regulatory Guide 8.13 contains information that shall be presented, both orally and in writing, to the pregnant worker.

b. Reduced embryo/fetus dose limits outlined in 3701:1-38-12 will be implemented until the declared pregnant woman withdraws the declaration in writing or is no longer pregnant.

4. Air and Ventilation Monitoring

The RSO shall conduct investigations of air and ventilation quality as part of the laboratory-monitoring program. The purpose of the investigations is to detect defective ventilation equipment (hoods, unit ventilators, general exhaust) and evaluate concentrations of potential airborne radioactive contaminants. Areas of particular concern are those laboratories utilizing volatile radioactive materials or operations producing dusts or aerosols.

Ventilation checks shall be performed using an air velocity instrument, such as a TSI Model 8346 VELOCICALC. Breathing zone air sampling shall be performed during all operations deemed necessary by the RSO. Sampling shall be performed with air sampling instruments calibrated with an appropriate instrument, such as a mini-buck calibrator.

5. Laboratory Audits

The RSO and the RSC shall conduct an annual audit of all laboratories for the purpose of evaluating compliance with license conditions. Two main items of concern are the verification of monthly inventory reports, and the inspection of wipe test and survey records.

Copies of the RSC audit report will be provided to all RSC members. The RSC will review the findings following each audit and recommend appropriate ways to address any noted problems or deficiencies. The findings of the RSO audit will also be shared with the RSC.

V. Radioactive Waste Disposal

The term "radioactive waste" includes all wastes that contain, or are contaminated with, any radioactive material. This includes liquids, solids, animal carcasses, infectious materials, excreta, used scintillation counting liquids, etc. Waste and trash, which are not radioactive, should never be thrown in with radioactive waste, as the cost for disposing of radioactive waste is very high. All wastes must be classified and disposed according to the following categories.

A. Liquids

1. Organic Based – must be collected in linear polyethylene jugs supplied by the Radiation Safety Office. Liquid wastes are not to be stored in any other containers unless specifically approved by the RSO.

2. Aqueous Based – certain amounts of radioactive materials may be released into the sanitary sewer systems if the activities present are below the amounts outlined in OAC 3701:1-38-19, and the chemical and physical form are shown to be readily soluble and dispersible. Because these amounts are based on the total volume of effluent released by the institution, and monthly and annual limits, all released must be approved by the Radiation Safety Office and recorded on the individual's monthly inventory sheet.

Daily Allowable Releases to the Sanitary Sewer

^{3}H	6.489 mCi/day/building*
^{14}C	1.369 mCi/day/building*
^{32}P	1.027 mCi/day/building*
^{35}S, ^{125}I, and remaining radioisotopes	0.342 mCi/day/building*

* - Release amounts are based on the two buildings (Auburn Science & Engineering Center and Knight Chemical Laboratory) that are currently authorized to release material to the sanitary sewer. Figures are subject to modification by the RSO.

The most important criteria to remember is that "the material must be readily soluble in water or is a biological material that is readily dispersible in water". Investigators must be prepared to provide solubility data to the ODH on any materials they release.

The release to the sanitary sewer of radioactive materials in quantities exceeding the limits given above must be approved by the RSO in advance. Liquid waste not released to the sanitary sewer is to be collected and disposed of in the same manner as organic based liquid waste.

B. Dry Solids

Dry solid wastes must be free of all residual liquids. Solid wastes must be collected in the special waste containers supplied by the Radiation Safety Office. Needles, scalpels, and any other sharp objects must first be placed in puncture-resistant **"sharps"** containers to prevent injury to personnel handling bags of solid waste.

C. Animal

Animal carcasses and excreta containing radioactive material must be placed in plastic bags and then frozen prior to disposal. Large animals, such as dogs, must be cut into smaller pieces before freezing to facilitate placement of the carcass into a standard 30-gallon drum.

D. Liquid Scintillation Vials

Currently, either plastic or glass vials can be accepted for disposal. Vials must have a capacity of 20 ml or less and may contain only the following radioisotopes in activities <.05 uCi/m1, H-3, C-14, Na-22, P-32, P-33, S-35, Ca-45, Cr-51, I-125. If an investigator desires to use a radioisotope not previously listed, they must obtain permission from the RSO prior to generating any waste. There are no restrictions on the type of scintillation fluid used at this time. Used vials must be accumulated in plastic bags inside radioactive waste containers approved by the RSO pending their transfer to waste drums in the ASEC 9B-E facility.

E. Short Half-Life

Short half-life isotopes (those with a half-life, 120 days or less) are to be separated from long half-life isotopes, for each category listed above. Long half-life wastes are shipped for disposal, whereas short half-life wastes are decayed on site.

VI. Emergency Procedures

We are all human and occasionally make mistakes. There is no shame in reporting spills or contamination. There is considerable hazard in NOT REPORTING an accident involving radioactive materials. The RSO may de-authorize any individual failing to promptly report any emergencies involving radioactive materials.

A. Low-Level Spill

A low-level spill is one that is confined to a limited area and does not increase the radiation levels in the area beyond 2 mR/hr. It must conform to all of the following criteria.

1. The spill did not contact any part of a person's body.

2. Radiation levels one (1) meter from the center of the spill do not exceed 2 mR/hr for x-ray, gamma, or strong beta emitting isotopes, or 2,000 dpm for alpha or weak beta emitting isotopes.

The authorized investigator supervising the activities in the laboratory where the spill occurred must be notified immediately. The investigator is responsible for assuring that the spilled material is collected and disposed of properly. Decontamination procedures should include the following steps:

1. **NOTIFY**: Immediately notify all other persons in the area that a spill has occurred.

2. **PREVENT THE SPREAD**:

   a. **Liquids** – Cover the spill with absorbent paper.

   b. **Dry Material** – Dampen thoroughly, taking care not to spread the contamination. Water should be used unless chemical reactions would generate an air contaminant, oil should then be used instead.

3. **DECONTAMINATE**: Use disposable gloves. Place all contaminated materials into a plastic bag and dispose of in the radioactive waste container.

4. **SURVEY**: With an appropriate survey meter, check the area around the spill, your hands, feet, and clothing for contamination. Wipes should be taken for weak beta contaminants.

5. **REPORT:** Report the incident to the Radiation Safety Officer and include survey results in the monitoring notebook.

B. Major Hazardous Spill

A major hazardous spill is any spill that is not a low-level spill, and DOES NOT involve contact with any part of a person's body. Procedures for hazardous spills are as follows:

1. **NOTIFY**: Immediately notify all persons to vacate the room.

2. **PREVENT THE SPREAD**

   a. **Liquids** – Cover the spill with absorbent material, but do not attempt to clean it up. Confine the movement of all personnel to prevent the spread of contaminants.

   b. **Dry Material** – Do not attempt to clean it up.

3. **CLOSE THE ROOM**. Switch off all fans and hoods. Do not leave the room until steps are taken to limit the spread of contamination unless immediately warranted by radiologic conditions.

4. **CALL FOR HELP**. THE RADIATION SAFETY OFFICER MUST BE NOTIFIED IMMEDIATELY WHEN A MAJOR HAZARDOUS SPILL OCCURS.

The RSO is responsible for directing the decontamination and assuring that the area is as free of contamination as reasonably achievable when decontamination procedures are completed. The authorized investigator is responsible for promptly executing all decontamination procedures deemed necessary by the RSO.

The RSO and Radiation Safety staff will determine the extent of the spill by monitoring the surrounding area. The contaminated area will be labeled and cordoned off to prevent inadvertent entry into the area. Only authorized personnel may enter the area until the decontamination procedures are completed.

The authorized investigator must complete a Radioactive Contamination Report and submit it to the RSO. An example of this report is included on page 36. A meeting of the Radiation Safety Committee may be convened to determine corrective measures to assure that similar hazardous spills do not occur.

If conditions warrant, the RSO will report the incident to the ODH.

C. Bodily Contamination (External Only)

Radioactive materials in contact with body surfaces (e.g., hands) should be removed promptly using approved decontamination products such as D-Con, RadiacWash, or I-Bind. The area should be scrubbed gently and rinsed with lukewarm water.

DO NOT USE HARSH OR CAUSTIC SOAPS.

DO NOT SCRUB THE AREA WITH AN ABRASIVE TOOL (e.g., scrub brush).

AVOID PROCEDURES THAT MAY BREAK THE SKIN CAUSING POTENTIAL TRANSFER OF MATERIAL INTERNALLY.

The RSO and the authorized investigator must be notified of all accidents involving bodily contamination.

The RSO will determine whether decontamination can proceed on site, or whether the individual should be transferred as a patient to the Nuclear Medicine Department of Akron City Hospital.

If decontamination is carried out on site, the RSO will perform bioassays to determine when the individual is considered decontaminated. The RSOI will perform dose calculations to assess skin exposure. The authorized investigator will complete the Radioactive Contamination Report and submit it to the RSO.

D. Bodily Contamination (Internal)

Ingestion or injection of radioactive materials must be reported to the RSO immediately. The RSO will transfer the individual as a patient to the Nuclear Medicine Department of Akron City Hospital.

RADIO ACTIVE CONTAMINATION REPORT

I. Nature of the Accident (check one) Date of Accident _____

___ Low Level Spill ___ Bodily Contamination (external)

___ Major Spill ___ Bodily Contamination (internal)

II. Location of Accident: _____

III. Describe Accident (Use extra pages if needed)

_____

_____

_____

IV. Describe Decontamination Procedures (Use extra pages if needed)

_____

_____

_____

_____

V. Survey Monitoring Report

Area Surveyed	DPM Before	DPM After
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

VI. Attach Bioassay Report if Necessary.

Report prepared by: _____ Date: _____

RADIATION EMERGENCY INFORMATION

A. Radiation Safety Office – 8:00 a.m. to 5:00 p.m. Ext. 5712
After working hours call University Police Ext. 7123

B. Akron City Hospital
The Nuclear Medicine Department at Akron City Hospital is an appropriate treatment center for cases of radiation ingestion or injury.

C. **Low-Level Spills**

1. **NOTIFY**: Immediately notify all other persons in the area that a spill has occurred.

2. **PREVENT THE SPREAD:**

   a. Liquids – Cover the spill with absorbent paper.
   b. Dry Material – Dampen thoroughly, taking care not to spread the contamination. Water should be used unless chemical reactions would generate an air contaminant, oil should then be used instead.

3. **DECONTAMINATE**: Use disposable gloves. Place all contaminated materials into a plastic bag and dispose of in the radioactive waste container.

4. **SURVEY**: With an appropriate survey meter, check the area around the spill, your hands, feet, and clothing for contamination. Wipes should be taken for weak beta contaminants.

5. **REPORT**: Report the incident to the Radiation Safety Officer and include survey results in the monitoring notebook.

D. **Major Spills**

1. **NOTIFY:** Immediately notify all persons to vacate the room.

2. **PREVENT THE SPREAD:**

   a. **Liquid** – Cover the spill with absorbent material, but do not attempt to clean it up. Confine the movement of all personnel to prevent the spread of contaminants.

   b. **Dry Material** – Do not attempt to clean it up.

3. **CLOSE THE ROOM**: Switch off all fans and hoods. Do not leave the room until steps are taken to limit the spread of contamination unless immediately warranted by radiologic conditions.

4. **Call For Help. The Radiation Safety Officer and the Authorized Investigator Must Be Notified Immediately When A Major Hazardous Spill Occurs.**

E. **Bodily Contamination**

Radioactive materials in contact with body surfaces (e.g., hands) should be removed promptly using approved decontamination products such as D-Con, RadiacWash, or I-Bind. The area should be scrubbed gently and rinsed with lukewarm water.

Do Not Use Harsh Or Caustic Soaps. Do Not Scrub The Area With An Abrasive Tool (e.g., scrub brush). Avoid Procedures That May Break The Skin Causing Potential Transfer Of Material Internally.

The RSO must be notified of all accidents involving bodily contamination.