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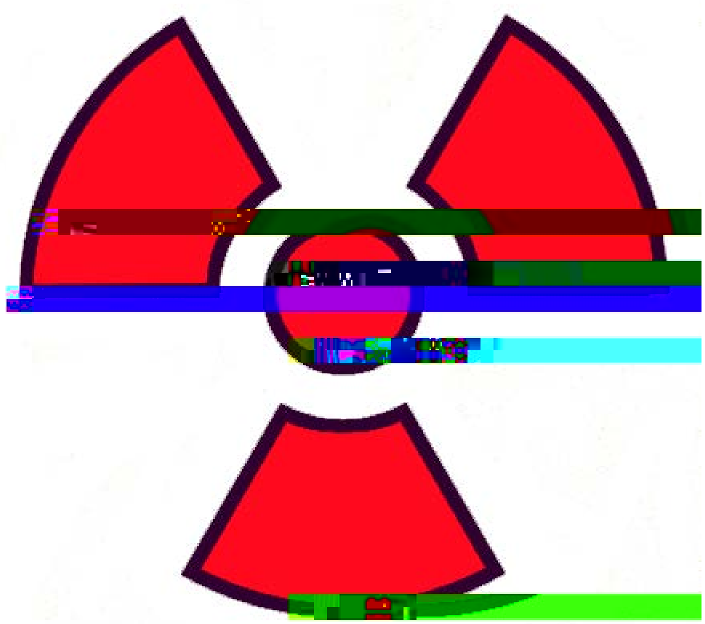
The University of Georgia



INTRODUCTION TO THE 2003 RADIATION SAFETY MANUAL

This Radiation Safety Manual has been revised in its entirety. The purpose of the revision is to update the manual for regulatory compliance, clarify existing policies, improve efficiency, and to provide clear instructions for the performance of radiation safety activities.

Note that individual chapters are identified by a revision number and date in the header of

2) One half of the membership of the Committee will constitute a quorum.

3) A Committee member who cannot attend a meeting may send a qualified representative to represent him/her. A representative is not eligible to vote but written proxies are acceptable for voting.

4) A Committee member who does not attend at least two quarterly meetings in a calendar year may be removed from the Committee and replaced on recommendation of the Chairman. A representative does not count as an attendee

2.0 RESPONSIBILITY AND AUTHORITY OF THE RADIATION SAFETY OFFICER AND RADIATION SAFETY STAFF

2.1 Appointment of the Radiation Safety Officer

1) The Radiation Safety Officer shall be a person qualified by training and experience to give guidance and assistance in the safe use of ionizing radiation.

2) The Radiation Safety Officer is designated by the President of the University to carry out the policies of the Radiation Safety Committee, ensure that federal and state laws and regulations as well as University regulations are complied with, and to advise the Committee in matters of radiation safety.

3) When a new Radiation Safety Officer is being selected for hire, the Committee shall evaluate the candidate's qualifications and make their recommendation to the University President and the Associate Vice President for the Environmental Safety Division.

4) Qualifications of the Radiation Safety Officer should include:

- A minimum of a BS degree from an accredited college or university.
- A minimum of 5 years work experience in radiation safety or applied health physics. This experience should include both supervisory or managerial experience and the direct performance of radiation safety tasks.
- Certification or eligibility for certification by the National Registry of Radiation Protection Technologists (NRRPT) or by the American Board of Health Physics (CHP) is desirable.

2.2 Duties of the Radiation Safety Officer and Staff

1) The Radiation Safety Officer and staff are available to assist and advise Authorized Users of ionizing radiation on the University campus, and to ensure that all ionizing radiation is used in accordance with the policies approved by the Radiation Safety Committee.

2) The Radiation Safety Officer shall ensure

materials in such a manner that:

- Personnel exposure to ionizing radiation will be kept As Low As Reasonably Achievable (ALARA).
- The Authorized User will be in compliance with the policies set forth in this manual and the radiation safety program.
- No state or federal regulations will be violated.

When a radioactive materials use application has been approved, the Radiation Safety Officer or designee will provide the applicant with a written authorization. This written authorization will normally be mater [(.)-6.6( )-6(p.5(.6(n c).6(w)13.-22.2(r)-17(am)(y)09 Tw (,)Tj 4.435 0 T accident.

- Certification of at least one worker in the authorized use location as an Advanced Radiation Worker by successful completion of required training as provided by Radiation Safety.

3) To make available appropriate radiation safety procedures and policies to be observed in the authorized use location.

4) To see that radiological surveys are made and records kept as required by the Radiation Safety Officer and this manual.

5) To keep an up-to-date inventory of all radioactive materials in their possession.

6) To ensure that security of radioactive materials is adequate to prevent unauthorized access.

7) To properly prepare and store radioactive waste material for disposal as described in this manual.

8) To post prope-sSoadeq8t.6(s.c1T)-11858.8(d)10.5(es)-2(c)-2(r)-6(i)2.6(bed)]TJ -0p(unaut)-6.6(hor)

4) The post-doctoral researcher must be approved by the department head who will notify Radiation Safety, in writing, of the arrangement and assume overall responsibility for the laboratory.

5) The arrangement must be approved by the Chairman of the Radiation Safety Committee and by a representative of Radiation Safety.

6) If the Authorized User does not choose one of the options listed above, the Chairman of the Radiation Safety Committee should be notified. If approved by the [illegible]

3.8 Termination of Permits

An Authorized User who plans to leave the University, or terminate his/her permit for any reason, must notify Radiation Safety and arrange for the disposition of their radioactive materials by proper disposal or by transfer to another Authorized User. Authorized users who are tenants in space leased from the University may be subject to additional binding restrictions specified in the lease.

1) To dispose of the material:
   - Properly package and label the materials as described in this manual and notify Radiation Safety of the need for a waste pickup.
   - Disposal of large sealed sources or other radioactive materials requiring special handling and extra expense must be funded by the researcher or his department.
2) To transfer the material to another Authorized User:
   - Follow the requirements for radioactive materials transfers as described in this manual.
   - If the radioactivity is in such a quantity or form so as to require special funding for disposal, a letter from the department head must be enclosed specifying that such funding will be made available when the source is no longer needed.
3) A member of the Radiation Safety staff will inspect the laboratory to determine if it is free of radioactive materials and/or contamination.
4) In the event that an Authorized User abandons radioactive material upon leaving staff

Research Foundation, Inc.

3.9 Retirement of Authorized Users

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In 1928, the International Commission on Radiation Protection (ICRP) was established. This group defined the roentgen as the unit of radiation dose. In 1934, a "tolerance dose" of 0.2 roentgens per day (60 roentgens per year) was agreed upon as the recommended limit for radiation exposure.

In 1936, the recommended limit was reduced to 0.1 roentgen per day (30 roentgens per year). In 1950, the National Council on Radiation Protection and Measurement (NCRP) and the ICRP introduced the concept of "permissible dose" and set the permissible exposure at 0.3 roentgen per week (15 roentgens per year). In 1956, the permissible dose was reduced to 0.1 roentgen per week (5 roentgens per year). This was not due to any observed ill effects at previous limits, but was based on the desire to be conservative and reduce the possibility of any long-range effects. At the present time, the limit for occupational exposure remains 5 roentgens per year or the equivalent. No ill effects have been noted at this exposure level.

1.2 Rad

The roentgen was not an ideal unit of radiation dose. It was defined as the amount of x or gamma radiation which produces ions carrying one electrostatic unit of charge of either sign in one cubic centimeter of dry air at standard temperature and pressure. Thus, the roentgen was defined as a given amount of ionization in air and applied only to x and gamma radiation. It did not indicate directly the damage within a biological system. It was soon realized that a given amount of ionization in air could result in different amounts of damage in an object being irradiated. Results of experiments using low energy x-rays could not be compared with those using high energy x-rays or gamma rays. This led to much confusion in the literature on radiation effects.

This resulted in establishment of the rad. A rad is 100 ergs of energy per gram, absorbed by any material from any type of ionizing radiation.

1.3 Rem

e

Below are some examples of Quality Factors for different types of radiation.

Radiation	Q. F.
x-ray	1
gamma ray	1
beta particle	1
alpha particle	20
slow neutron	2.5
fast neutron	20
heavy ions	20

1.5 International Units

It should be mentioned here that there are also international (SI) units of dose. Applied health physicists in general feel that these new units are unnecessary and will cause much confusion, especially in record keeping. The new units have not, at this time, been widely accepted for use in the United States. While we will continue to use the roentgen, the rad, and the rem, the following conversions can be made if desired:

Gray = 100 rad
Sievert = 100 rem

2.0 EFFECTS OF RADIATION EXPOSURE

2.1 Acute Exposure Effects

Radiation in large doses causes observable damage. The following list gives some typical effects of radiation exposure by X or gamma rays given to the total body at a high dose rate over a short period of time.

0 - 25 rem - No observable effects on the health of the individual. At 25 rem, a physician could probably see some changes in blood cells.

50-100 rem - Possible nausea and blood count depression. Recovery within days to weeks with no lasting ill effects.

500 rem - Nausea, weakness, anemia, internal bleeding, temporary sterility, susceptibility to infection, loss of hair. This is the LD^{50-30}. Half of the persons so exposed die within 30 days (without medical treatment). The other 50% recover with few lasting ill effects. Recovery takes months to years. Death is usually due to damage to the blood-forming stem cells in bone marrow.

1000 rem - Death within days to weeks, usually from damage to the gastrointestinal system.

10,000 rem - Death within hours to days from damage to the nervous system.

100,000 rem - Essentially instantaneous death from damage to the nervous system.

The above effects are observable within a short time after the exposure. They have been observed in persons exposed before the harmful effects of radiation were known, in take the straight-line model and apply it to low-level radiation exposure. For instance:

persons x rem = person-rem
1,000,000,000 x 0.001 = 1,000,000

This implies that one billion persons exposed to one-thousandth of a rem each (one millirem) would develop 200-400 fatal cancers. Since 400 cancers among one billion persons would be impossible to detect among the millions of cancers naturally occurring, it has been impossible to prove or disprove the straight-line model for low-level radiation. However, some persons have pointed out that if the straight-line model were correct for low-

Job or Other Risk	Days of Life Expectancy Lost
Manufacturing	43
Agriculture	277
Construction	302

5 rem (5000 mrem)

- Limit for one year of occupational exposure.
- Not expected to cause any ill effects over a lifetime.
- Epidemiological studies cannot detect any harmful effects at this level.

3 rem (3000 mrem)

- Maximum received in one year by the general population from natural radiation in the most radioactive areas of earth.
- No demonstrated ill e 1 Tf 0.457 0 Td 72.6(.6(i)2.s)-1.9.07.

CHAPTER 3 RADIATION EXPOSURE LIMITS

1.0. ALARA POLICY

It is the policy of the University of Georgia that exposure to ionizing radiation will be as low as reasonably achievable, consistent with the teaching, research, and service missions of the institution.

2.0 MONITORING OF EXTERNAL RADIATION EXPOSURE

Each radiation worker at the University of Georgia with the potential to exceed 10% of any annual exposure limit

6) Persons with internal radioiodine exposures in excess of 10% of the applicable limit will be counseled by a Radiation Safety staff member.

7) The Authorized User and Radiation Safety will evaluate the probable causes of the exposure and changes in procedures, work habits, or equipment will be recommended as appropriate.

8) A written summary of the investigation results, including potential correc(ent)-6.6(i)2h0.7(t)2o5(udi)2.

4) A written summary of the investigation results, including potential corrective actions, should be provided to the Radiation Safety Committee.

4.4 Airborne Radioactivity Exposure

Any intentional exposure

1) A pregnant radiation worker must make her own decision regarding whether or not to declare her pregnancy in accordance with Regulatory Guide 8.13.

2) The declaration of pregnancy must be submitted in writing to the appropriate Authorized User (or work group supervisor) and to Radiation Safety. An example declaration form is provided in the appendix to this chapter.

3) Once pregnancy is declared in writing, the declaration will remain in effect for a period of one year from the date of submission, unless it is revoked in writing.

4) The radiation exposure to the embryo/fetus of a declared pregnant woman shall not exceed 500 mrem during the entire term of the pregnancy.

5) The radiation exposure to the embryo/fetus of a declared pregnant woman should not exceed an

CHAPTER 4 FACILITIES AND EQUIPMENT CONScTaHD(E)-5((A)05(T)-15(cTaHCO)-4(N

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radiological use facilities and equipmen

2.0 PRECAUTIONS

Proper facilities and equipment are an ess
program. Facilities and equipment that are
maintained may cause unsafe conditions w
personnel exposure or a loss of radiologic

3.0 LABORATORY CLASSIFICATION

University of Georgia laboratory facilities s
unsealed radioactive materials in accordan
classification scheme. In the event that a c
approved by the RSC, appropriate docume
classification scheme is referenced in *NUR*
about Materials Licenses: Program-Specif

Table 3.1
Radiotoxicity Table of Representative Radioisotopes

Radiotoxicity Group	Radioisotopes
Very High (group 1)	Pb-210, Po-210, Ra-223, Ra-226, Ra-228, Ac-227, Th-227, Th-228, Th-230, Pa-231, U-230, U-232, U-233, U-234, Np-237, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Am-243, Cm-242, Cm-243, Cm-244, Cm-245, Cm-246, Cf-249, Cf-250, Cf-252
High (group 2)	Na-22, Cl-36, Ca-45, Sc-46, Mn-54, Co-56, Co-60, Sr-89, Sr-90, Y-91, Zr-95, Ru-106, Ag-110m, Cd-115m, In-114m, Sb-124, Sb-125, Te-127m, Te-129m, I-124, I-125, I-126, I-131, Cs-134, Cs-137, Ba-140, Ce-144, Eu-152, Eu-154, Tb-160, Tm-170, Hf-181, Ta-182, Ir-192, Tl-204, Bi-207, Bi-210, At-211, Pb-212, Ra-224, Ac-228, Pa-230, Th-234, U-236, Bk-249
Moderate (group 3)	Be-7, C-14, F-18, Na-24, C1-38, Si-31, P-32, P-33, S-35, Ar-41, K-42, K-43, Ca-47, Sc-47, Sc-48, V-48, Cr-51, Mn-52, Mn-56, Fe-52, Fe-55, Fe-59, Co-57, Co-58, Ni-63, Ni-65, Cu-64, Zn-65, Zn-69m, Ga-72, As-73, As-74, As-76, As-77, Se-75, Br-82, Kr-85m, Kr-87, Rb-86, Sr-85, Sr-91, Y-90, Y-92, Y-93, Zr-97, Nb-93m, Nb-95, Mo-99, Tc-96, Tc-97m, Tc-97, Tc-99, Ru-97, Ru-103, Ru-105, Rh-105, Pd-103, Pd-109, Ag-105, Ag-111, Cd-109, Cd-115, In-115m, Sn-113, Sn-125, Sb-122, Te-125m, Te-127, Te-129, Te-131m, Te-132, I-130, I-132, I-133, I-134, I-135, Xe-135, Cs-131, Cs-136, Ba-131, La-140, Ce-141, Ce-143, Pr-142, Pr-143, Nd-147, Nd-149, Pm-147, Pm-149, Sm-151, Sm-153, Eu-152, Eu-155, Gd-153, Gd-159, Dy-165, Dy-166, Ho-

Table 3.3
Modifying Factors

Operation Description	Modifying Factor
Storage (stock solutions)	X 100
Simple wet operations	X 10
Normal operations	X 1
Complex wet operations with risk of spills and simple dry operations	X 0.1
Dry and dusty operations	X 0.01

4.0

8.0 GENERAL CONSIDERATIONS

- Bench top or open work areas may be used for handling small quantities of solid materials in a form not likely to become airborne or dispersed, and for small quantities of liquids of such low volatility as not to cause airborne contamination or toxicity problems.
- Trays and/or absorbent surface covers (secondary containment) to catch and retain spilled liquids should be used in all appropriate radioisotope work locations.
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CHAPTER 5 PROCUREMENT AND TRANSFER OF RADIOACTIVE MATERIALS

1.0 PROCUREMENT POLICY

The University policy is that all orders for radioactive materials must be placed through the [illegible] sers at o will generally be granted approval for direct delivery.

2.0 PRECAUTIONS / PREREQUISITES

- Prior to ordering radioactive materials, Authorized Users must be approved by the RSC for the type and quantity of radioactive materials desired.
- Individuals performing transportation, shipment, or

request form should be completed as provided in the Administrative Policies and Procedures Manual, with the Authorized Users desired final delivery point. Also, the words "deliver to UGA Radiation Safety Laboi the vendor or disposed of as waste. The Authorized User will be notified that the shipment has arrived, that it is contaminated and that a replacement should be ordered. Vendor notification exceed 1000 dpm/100cm^2. If results exceed 1000 dpm/100cm^2 notify the RSO or designee. Do not proceed with opening the package.

6) If no external contamination is indicated, open the package and carefully remove the packing material until the final source container is reached. Again, check for any obvious signs of leakage and take appropriate precautions.

7) Packages that contain volatile radioactive materials (I-125/131, S-35, H-3, etc.) in quantities greater than limited quantity shipments should be opened in a fume

verification purposes.

- The University's radioactive materials license with the state of Georgia requires the performance of a physical verification of radioactive material inventory every six months. Records in support of this inventory verification will be requested by Radiation Safety on a biannual basis.

4.4 Removal of Radioactive Materials from the Inventory of Authorized Users

- When all of the radioactive material assigned to an authorization tracking number (B number) has been used up or disposed of as waste, the *Inventory of Radioisotopes* form (or approved equivalent) must be completed and returned to Radiation Safety. The radioactive materials tracked by the B number on the returned *Inventory of Radioisotopes* form will be removed from the inventory of the respective AU in the database system by the Radiation Safety staff.
- *Inventory of Radioisotopes* forms must be returned promptly in order for the inventory database to be accurate. Additional radioactive materials orders will not be processed (B numbers will not be issued) if the inventory database indicates that a requested order would result in the AU’s radioactive material inventory exceeding their possession limit.
- Authorized Users should be aware that radioactive materials are not removed from the inventory database as a result of radioactive decay. Inventory paperwork must be processed as described in this chapter in order for the database to be accurate.
- In the event that a B number is obtained for an order and the order is not completed (not purchased), Radiation Safety should be contacted. After verification that the order has not been procured, the radioactive materials tracked by that B number will be removed from the Authorized Users inventory.
- AU’s are encouraged to dispose of radioisotopes that have exceeded a reasonable shelf life as recommended by the manufacturer. Ionization due to radioactivity can

CHAPTER 6 RADIOLOGICAL SURVEYS

1.0 INTRODUCTION

1.1 Purpose and Scope

This chapter describes the methodology for performance of radiation and contamination surveys of areas where radioactive materials are used, stored, or suspected to be present. Specific survey requirements for radioactive materials shipments, leak rate testing of radioactive sources, and x-ray equipment are not described in this chapter.

The primary purpose of radiation surveys is to identify the magnitude (or verify the absence) of dose rates so

information. The following general information is applicable to most types of portable radiation monitoring instrumentation used in UGA laboratories.

1) Pre-operational checks:

- Verify that the instrument has a current and up to date calibration label (instrument calibration services are available from Radiation Safety).
- Inspect the instrument for physical damage.
- Check the batteries, for instruments equipped with a battery test function.
- Verify that the instrument is operational by checking for detection of normal background radiation. This should be done in a low background area away from sources of radiation. If routinely performed in the same location, consistent, reproducible results are an indication of a properly performing instrument.
- Instruments which are not capable of detecting background levels should be response tested with a radiation source of known quantity. Response check sources may be available from Radiation Safety for this purpose.

2) Selection of audible and response settings on portable instruments is left up to the discretion of the surveyor, however, the following settings are recommended:

- Audible on - Normally used.
- Audible Off - Recommended when the instrument higher scales are used, and at the discretion of the survey technician.
- Fast Response - Recommended when surveying with audible off, using the instrument high range scales, or for contamination surveys.
- Slow response - Normally used for dose rate readings on the low scales.

3.2 Wipe Test Count

levels and longer counting times enable a lower MDA value to be reached. Calculate the MDA by use of the formula:

$$\text{MDA in dpm} = \frac{2.71 + 4.66\sqrt{\text{bkg cpm x count time}}}{(\text{efficiency})\ (\text{count time})}$$

7) If high levels of contamination are detected take appropriate precautions to control or prevent the spread of contamination. Notify the Authorized User and/or Radiation Safety for assistance.

8) Direct scan surveys are not required to be documented as a part of your monthly radiological survey. Direct scan surveys for release of potentially contaminated items or components to unrestricted use (see section 7.2) do require documentation. When appropriate, direct scan surveys may be documented on a Radiological Survey Form (RSF) by identifying the items or locations surveyed and recording the results. “ND” may be used to indicate no detectable contamination. If contamination is identified, the levels found and units measured must be recorded. Refer to the RSF and the instructions provided by Radiation Safety for additional information.

5.0 TRANSFERABLE CONTAMINATION SURVEYS (WIPE TESTS)

Transferable contamination surveys are performed by wiping a known surface area (typically 100 cm^2) with a collection medium. The concentration of radioactivity on the collection medium is then analyzed. This is an important survey technique because transferable contamination can be spread from one location to another and is a potential inhalation, ingestion, or absorption hazard. Also, transferable contamination measurements are required to be performed and documented to maintain compliance with state and federal regulations.

In addition to the standard wipe testing technique described in section 5.1, there are two optional techniques that may be used for special applications as described in sections 5.2 and 5.3. If you do not fully understand the limitations of these optional survey techniques, contact Radiation Safety for assistance.

5.1 Survey Technique - 100 cm^2 Wipe Tests

1) 100 cm^2 wipe tests may be performed using filter papers or commercially available wipes or smears with an approximate diameter of 1” as the collection medium.

2) Wipe the collection medium over the surface of the area being surveyed using moderate pressure such that 100 cm^2 is wiped (typically a 16”-18” lazy S pattern).

3) Analyze the wipes using counting equipment as described in your laboratory standard protocols and section 3.2 of this chapter.

   - If using a LSC, add an appropriate amount of biodegradable scintillation fluid and count the sample for a minimum of 1 minute (see sections 3.2 and 5.2 for special counting considerations if analyzing exclusively for P-32)
   - If using a gamma counter or counter scaler, follow the standard counting protocol for the instrument

4) Subtract the background count rate (cpm) from the gross count rate (cpm) to obtain a result in net cpm. Multiply the net cpm by the conversion factor of 3 to convert the result to dpm/100 cm^2.

5) Wipe test results sho

6.0 RADIATION SURVEYS

Radiation surveys are performed to measure the dose rates (radiation fields) produced by sources of radiation, or to confirm the absence of these dose rates. Unless specifically exempted, radiation dose rate measurements are required to be performed and documented to maintain compliance with state and federal regulations.

The performance of radiation dose rate surveys is <u>not</u> required in authorized use locations where the radioactive materials are limited exclusively to milliCi quantities of isotopes that emit primarily beta radiation with energies below 250 keV (H-3, C-14, S-35, and P-33). The exclusive use of I-125 immunoassay kits with <25 microCi per kit is also exempted.

10) Perform a representative number of wipe tests in accordance with your professional judgment with consideration given to the type, quantity, and locations of radioactive materials use that has occurred since the last survey. A total of 10 to 20 wipe test locations are generally appropriate for a typical radioisotope use laboratory. No more than 5 wipe test locations would be appropriate for a location used exclusively for sample counting, such as a LSC room where no other radioisotope work is performed.

Recommended wipe test locations include the following:

- areas normally used for radioisotope work (countertops, hoods, sinks, etc.)
- adjacent areas with the potential to have become contaminated
- floor locations in high traffic areas (hallways, doorways) and in areas adjacent to locations where radioisotopes are commonly handled (in front of hoods, sinks, benchtops, etc.)
- items frequently handled when moving from radioisotope use/storage areas to unrestricted areas (doorknobs, freezer handles, etc.)
- exterior surfaces of radioactive waste containers
- boundaries between restricted and unrestricted areas.

11) You may use large area wipes to supplement 100 cm^2 wipe tests during the performance of monthly surveys. To use this option you must follow the requirements of section 5.3 of this chapter.

12) When performing wipe surveys, it is recommended that you survey areas with the least potential for contamination first and work your way to areas with the greatest potential for contamination last. This reduces the potential for cross contamination of wipes and survey locations.

13) Wipe test locations may be identified on the map by using circled numbers, or as otherwise described on the RSF.

14) Analyze the wipe samples in an appropriate counter, document the results, and compare the wipe test results to the ALARA action levels of Table 5.1 of this chapter.

15) If the ALARA action levels for transferable contamination are exceeded, take the following actions:

- If unrestricted area contamination levels exceed 200 dpm/100cm^2 but are less than 1000 dpm/100cm^2; perform decontamination, re-survey, and document the results on the survey form. In the comments section of the survey form indicate that the affected areas were decontaminated and resurveyed.
- If unrestricted area contamination levels exceed 1000 dpm/100cm^2; prevent personnel access to the affected area and promptly contact Radiation Safety for assistance.
- If restricted area contamination levels exceed 1000 dpm/100cm^2 but are less than 10,000 dpm/100cm^2; perform decontamination, re-survey, and document the results on the survey form. In the comments section of the survey form indicate that the affected areas were decontaminated and resurveyed.

Table 7.2
Unrestricted Release Limits

Direct Scan Limit	Transferable Contamination Limit
<2 times background not to exceed 0.05 mrem/hr	<200 dpm/100cm^2 (<66 cpm/wipe)

- If the survey results exceed the specified values; decontaminate in accordance with section 7.1, re-survey, and document results
- If the results are below the limits specified in Table 7.2 the material is suitable for release to unrestricted use
- If the material meets the criteria where a documented survey is required as described in item 2 above, provide a copy of the survey to the Radiation Safety Officer or designee for approval prior to release for unrestricted use. Keep a copy of the survey for your records.
- Destroy or deface any radiological markings prior to releasing items for unrestricted use.

4) Liquids, bulk material, and components with inaccessible surfaces with the potential for contamination require special survey techniques or analysis. Contact the RSO or designee for release of these materials to unrestricted use.

7.3 Other Survey Requirements

The frequency of radiological surveys in the work place must be adequate to ensure that personnel exposure to radiation and radioactive materials is ALARA. Documentation of these surveys on a RSF is not required. Specific instances when monitoring is needed include, but are not limited to, the following:

- monitoring of conditions during work with radioisotopes
- surveys of work areas after handling radioisotopes
- personnel contamination monitoring (direct scans of hands, clothing, shoes) after working with any unsealed radioactive materials and prior to exiting the laboratory
- direct scans of lab coats, furniture, and other routinely used and potentially contaminated items
- surveys of laboratory equipment after being used with radioisotopes
- radiation surveys of storage areas and waste containers after adding radioactive materials to those locations, to verify that dose rates are within limits
- surveys to ensure that unrestricted areas (i.e. office or break areas) are free from radiological hazards
- surveys in support of radioactive material shipments or transfers
- surveys of waste containers prior to pickup by the Radiation Safety Staff

- monitoring in support of any suspected spill of radioactive materials.

7.4 Use of the Radiological Survey Form

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CHAPTER 7 RADIOLOGICAL POSTINGS

1.0 GENERAL POSTING INFORMATION

1.1 Regulatory Documents and Notices

- Current copies of the University of Georgia Radioactive Materials Licenses, Parts 19 and 20 of Title 10 of the Code of Federal Regulations, this Radiation Safety Manual, and other radiation safety program documents may be examined at the Radiation Safety Office, Environmental Safety Division.
- In the event that the Georgia Department of Natural Resources issues a notice of

8) Posting of doors should be such that the postings remain visible when doors are open or closed.

9)

radiation exposure in excess of 100 millirem in any one hour at 30 centimeters refrigerators, fume hoods, cabinets, etc.) require posting if radiological hazards lie within.

3) Radiological tags or labels should be used to label items with internal or potential internal contamination.

4) In addition to the standard radioactive material markings, labeling of containers of radioactive material should include the isotope, quantity, and assay date.

5) Items that do not contain radioactive material, are not contaminated, or are not likely to become contaminated or to contain radioactive material should not be posted with radiological markings even if they are used for radiological work. For example, a balance that is kept clean and free of contamination that is used to weigh radioactive materials contained in Petri dishes need not be labeled. A mechanical pipette device dedicated for use with liquid radioisotopes would be appropriate to label (or to keep in a labeled stand or enclosure) due to the potential for internal and external contamination of the device.

6) Packaged radioactive material should have the label or tag visible through the package or affixed to the outside.

7) Labeling for sealed sources should include the isotope, quantity, and assay date. Sources which are too small to be labeled with all of the stated information should be labeled, at a minimum, with the words “Caution, Radioactive Material” and the standard radiation symbol.

8) Radiological warning tape, consisting of yellow and magenta striping with the standard radiation symbol, and/or “Caution, Radioactive Material” tape, should be used as a demarcation of the boundaries of small work areas. An example is a designated area on a bench top covered with absorbent paper and used for radioisotope work. Dedicated radiological work surfaces should not be used for non-radiological work. All items within the boundaries of this type of posted area should be considered potentially contaminated until proven otherwise by a radiological survey.

9) Instrumentation or equipment that contains radioactive materials shall be labeled with the words “Caution, this instrument contains Radioactive Materials” or an RSO approved equivalent.

4.0 POSTING AND LABELING OF RADIOACTIVE WASTE CONTAINERS

- When a waste container is in use, post the container with a “Caution Radioactive Material” label/tag.
- Waste container labels should include the isotope(s) and estimated maximum quantity (i.e. mCi amount).
- Waste containers that are empty should be labeled as such.
- Complete the appropriate paperwork for each waste container in accordance with Chapter 10, Radioactive Waste Handling and Disposal.
- The use of a labeled shielding enclosure for a waste container does NOT eliminate the need to label the waste container within.

5.0 EXEMPTIONS TO POSTING REQUIREMENTS

The following items/locations are not required to be posted in accordance with this procedure.

1) Industrial products that contain exempt quantities of radioactive materials, including; smoke detectors, self illuminated signs, etc.

2)

CHAPTER 8 RESPONSE TO RADIOLOGICAL INCIDENTS

1.0 PRECAUTIONS / LIMITATIONS

- **In situations where personal safety is, or may become, in jeopardy, no radiation safety requirement shall be considered as limiting any action necessary to protect personal health and safety**.

- **In the event of a fire or release of hazardous materials; warn personnel in the affected area, evacuate the area, call (9) 911, and follow the directions of emergency response personnel.**

- The Radiation Safety Officer and staff may be your training and qualifications. /C2_0 1 Tf 3.261 -1.207 Td <0078>Tj /TT0 1 Tf 0.4
  Do not attempt to move the victim unless there are significant hazards in the immediate location. Utilize appropriate precautions for blood borne pathogen control (i.e. use gloves, etc.)

2) Notify the Authorized User or designee. Follow the guidance of the laboratory safety plan for the handling of personnel injuries including notification to emergency response personnel, if appropriate.

3) Notify the RSO of any actual or suspected personnel contamination involving an injury. Follow the directions provided by the RSO. If Radiation Safety personnel arrive on the scene, provide them with all appropriate assistance and information.

4) If immediate medical treatment and transport by ambulance is indicated, the

Radiation Safety staff or any individual with radiation safety training should take measures to control the spread of contamination. **Do not interfere with patient care in the course of radiation safety activities.** When emergency response personnel arrive on the scene; offer to assist them by performing monitoring, removing the victims potentially contaminated lab coat or gloves (PPE), or other appropriate actions. Do not attempt decontamination or removal of PPE of injured personnel without the consent of medical professionals. A person with a contaminated injury will be taken to St. Mary's Hospital for treatment

5) An AU, Advanced Radiation Worker, or Radiation Worker with a portable monitoring instrument should continuously accompany the patient until a representative of the Radiation Safety staff arrives or all radiological concerns are resolved.

6) If immediate medical treatment is not indicated, the Radiation Safety staff should perform personnel contamination monitoring of the individual(s) involved. If the Radiation Safety staff cannot arrive promptly, any trained individual (AU, ARW, RW) should scan the individual(s) involved for contamination with a portable instrument in accordance with section 4.2 of this procedure.

7) If the individual is cleared of radiological contamination take any additional precautions needed to secure the area of radiological hazards. Document survey information on a Radiological Survey Form (RSF) or take notes for future reference to report the incident. Documentation should include the individuals name, social security number, date/time, location, and general circumstances of the event. Perform and document follow up surveys, as appropriate, to ensure that no spread of contamination occurred.

3.0 RESPONSE TO A SPILL OF RADIOACTIVE MATERIAL

3.1 Major Spills

A spill is considered a major spill if it involves millicurie quantities of radioisotopes, includes materials with the potential to produce significant airborne radioactivity (mist, dust, fumes), covers a large area (more than a few square feet of area), or if the spill is not easily contained or controlled. Any malfunctions of radiation producing devices (irradiators, large quantity sealed sources, X-ray devices) with the potential to result in high radiation levels should be treated in the same manner as a major spill.

Respond to a major spill as follows:

1) Take no actions which could result in injury or unnecessary contamination to yourself or others.

2) Stop work. If necessary secure any immediate safety hazards.

3) Warn other individuals in the area. All personnel should leave the immediate area but take appropriate measures not to spread contamination. Potentially contaminated individuals should gather in a location nearby for monitoring prior to being released.

4) Isolate the area to prevent the spill from spreading.

A minor spill should be handled as follows:

1) Stop work. If necessary secure any immediate safety hazards.

2) Warn other individuals in the area to stay out of the spill location. Notify the AU and/or Advanced Radworker, they should perform/direct further activities.

3) If assistance is needed, promptly notify the Radiation Safety staff.

4) Isolate the area to prevent the spill from spreading. Cover liquid spills with absorbent materials.

5)

passes when wiping and use a new surface of the towel for each wipe. An inward spiraling circular motion is often effective. The method used should prevent spreading the contamination.

7) Dispose of all waste properly. Wet contaminated towels should be placed in a dry radioactive waste container with sufficient absorbent material to prevent any visible liquid from developing.

8) Perform follow up surveys and continue decontamination efforts if needed.

9) Perform personnel contamination monitoring after each decon effort.

10) If three attempts at decontamination are unsuccessful, you should use different decontamination agents or methods. Contact the Radiation Safety staff for assistance as needed.

11) Decontamination is considered comple(ont)-6.6(a)104T(ont)-6.6(a)104T(ont)-6.6(a)105.9583(f)-6.7oc

2) SLOWLY scan (approximately 2 inches per second) with the detector of the instrument at a distance of approximately 1/2 inch from the surface being monitored.

3) Monitor your hands first to ensure that you do not spread contamination.

4) Survey all other areas of the body and clothing with the potential for contamination. This should include, but is not limited to, the front of the torso, elbows, arms, face, and shoes (top and bottom).

5) If an audible increase in the count rate is heard, or if the meter reading increases, hold the detector still over that location for 5 to 10 seconds and determine if the reading is higher than the background level.

6) If contamination is indicated as in item 5 above, it is best to stay where you are to prevent the spread of contamination and have someone assist you in notifying the RSO or a member of the Radiation Safety staff. While waiting for assistance, avoid unnecessary contact between areas of suspected contamination and "clean" surfaces.

7) If no contamination is detected, evaluate the situation to determine if additional work area surveys or monitoring of other personnel is indicated.

4.3 Response to Personnel Contamination Events

1) If contamination of skin is confirmed, always notify the RSO or a member of the Radiation Safety staff.

2) Before beginning decontamination, attempt to determine the location and approximate size of the contaminated area. Record the maximum reading found with the instrument at a distance of ½" (near contact) from the contaminated area. For fastest results simply write down the instrument reading and the scale used. In the event that the instrument reading is off-scale at contact, attempt to obtain and record an on-scale reading at a measured distance away. A pencil, pen, or piece of paper may be used to "measure" the distance since this will provide a reference to be measured at a later time. Also note the time (or best estimate) of the initial contamination occurrence. This information is needed to assist in calculating an accurate assessment of the amount of radiation exposure to the skin.

Example:	Time	9:15am
	Approximate size/location	2 square inches, right forearm
	Instrument contact reading	3.5
	Instrument scale	x 0.1 (mr/hr)

3) Simple skin contamination can usually be removed by washing the affected area with soft soap and lukewarm water. Make sure that you do not spread the contamination to other areas of the body during the decontamination process.

4) Dry the area by patting lightly with a disposable towel. Re-survey the affected area immediately following decontamination. If necessary, repeat decontamination by soap and water.

5) When there is no detectable contamination remaining, record the time of the survey.

6) If three consecutive decontamination attempts using soft soap and water are not successful, additional measures such as an industrial grade hand cleaners may be used.

7) Do not abrade the skin, use harsh chemicals, or attempt decontamination of injuries, the eyes, or body orifices without the assistance of medical professionals and the RSO or designee. However, if no medical complications are apparent, injuries, eyes, or body orifices may be flushed with lukewarm water or saline solution to promptly remove any hazardous materials or radioactive contamination from the affected area. Use precautions not to spread the contamination and capture any rinse water in a suitable container. The rinsate may require analysis in support of a radiation exposure assessment.

8) Any facial contamination, contamination involving breaks in the skin, or contamination with the potential for skin absorption or internal contamination will require a determination by the RSO of the need for a bioassay.

9) If necessary, restrict and control access to any work locations where contamination events have occurred until follow up surveys can be completed.

10) The Radiation Safety staff should perform a preliminary evaluation of incidents to determine the potential causes and to take measures to ensure that no additional personnel contamination events occur as a result of existing conditions or circumstances.

5.0 FOLLOW UP ACTIONS FOR RADIOLOGICAL INCIDENTS

- Document radiological surveys on a Radiological Survey Form or an RSO approved equivalent.
- A *Radiological Improvement Program Report* (RIPR), or an RSO approved equivalent, should be used for reporting and tracking of significant radiological incidents.
- RSC and DNR notification of incidents will be performed by Radiation Safety in accordance with regulatory requirements and as described in Chapter 11, *Radiological Improvement Program*.
- A critique should be conducted for significant incidents. At a minimum, participants of the critique should include the individuals involved in the incident, the AU, and the RSO or designee. The critique should focus on determining why the event occurred with the goal of determining the appropriate path forward to prevent future occurrences.

CHAPTER 9 LABORATORY PROCEDURES

1.0 RADIATION SAFETY TRAINING

1.1 Radiation Worker Training

All individuals who work with radioactive materials at the University are considered to be Radiation Workers (Radworkers). Individuals who routinely occupy or frequently work in locations where radioactive materials are used or stored may also be considered Radworkers. All Radworkers must receive documented training in radiation safety. A standard form for use in recording Radworker training is available from Radiation Safety. It is the responsibility of the Authorized User to ensure that this training has been completed. Radworker training should be completed prior to the performance of any tasks using radioactive materials or involving radiation exposure. The minimum requirements for Radworker training shall include:

x Reading this Manual.

x General rules of radiation safety.

x Specific rules for the authorized uses and use locations.

x

2.0 RADIOLOGICAL WORK PLANNING

- Plan the layout of the laboratory in relation to your radiological work. When practical, locate all radiological use and storage areas in the same part of your laboratory. The exception to this is to allow adequate distance from radiation sources to reduce personnel exposure.
- Use the smallest reasonable quantity of radioactive material for the desired purpose.
- When a choice of radionulides is available, use the least hazardous radioisotope for the planned experiment.
- Do not order more radioactive material than needed for the anticipated use. Handling of excess material may increase personnel exposure. Also, regardless of half life, all compounds containing radioactivity undergo decomposition as a result of radiation effects.
- Prior t

12) Use remote handling tools in the form of work stands, tongs, tweezers, etc. to reduce exposure to the extremities (hands & fingers) and whole body when appropriate.

5.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

Personal protective equipment is clothing and equipment that is worn for the purpose of reducing exposure to workplace hazards.

1)

6.0 PERSONNEL CONTAMINATION MONITORING

Personnel contamination monitoring is the only practical method to ensure that your skin or personal clothing is not contaminated with radioactive material. Neglecting to perform monitoring can result in the spread of contamination and increases the risk of inhalation, ingestion, or absorption of radioactive material. Personnel contamination monitoring is commonly referred to as “frisking” in the field of radiation protection.

The following requirements apply to personnel contamination monitoring.

1) Personnel contamination monitoring is required prior to exiting a radiological use laboratory after handling unsealed radioactive materials.

2) Personnel contamination monitoring should be performed upon the completion of any single operation involving the handling of unsealed radioactive materials.

3) The minimum standard for personnel contamination monitoring consists of a slow scan with the probe of a portable monitoring instrument, checking the hands, shoes, and any other areas of the body or clothing with the potential to have become contaminated during the operation conducted.

4) After a spill or unplanned contamination event, a “whole body frisk” should be performed. A whole body frisk is a scan of the entire body/clothing for

2) Radiation Workers without dosimetry may perform limited tasks approved and

10.0 SPECIFIC RADIOLOGICAL HAZARDS

10.1 Internal Hazards

Contamination occurs when an unsealed radioactive material (liquid or dispersible solid) is in an undesirable location. The primary hazard of contamination is inhalation, ingestion, or absorption of radioactive material into the body. All dispersible radioactive materials may cause contamination and are therefore considered internal hazards. Internal hazards are controlled by surveys and monitoring, engineering controls, and personal protective equipment (PPE).

10.2 External Hazards

Radiation is energy, in the form of particles or waves, emitted from radioactive materials. An external radiation hazard occurs only when the amount of radiation emitted is powerful enough to reach and interact with the human body. External hazards are controlled by the
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5) Training for users of radioactive iodine should include observing Radworkers experienced in radioiodine procedures, practicing procedures with non-radioactive materials, and demonstrating proper work practices to an experienced radioiodine worker prior to un-supervised performance.

6) Double disposable gloves (wear 2 pair) are required for radioiodine work.

7) Only small quantities of radioiodine may be handled on an open bench, such as RIA kits that contain $\leq$ 25 microcuries. See section 4.1 of Chapter 3 for additional information about fume hood requirements.

8) Use syringes and needle guides for removal of radioiodine through the septum of shipment vials. Charcoal traps are also available. Follow the vendor's instructions for the use of these products. If the package insert instructions are not available, refer to vendor catalogs, websites, or call the vendor by telephone for technical information.

9) Containers of radioactive iodine must be kept tightly sealed at all times to prevent airborne radioactivity. Ziplock style plastic bags should be used to contain small contaminated items. Remember to seal and label the bags.

10) Fume hoods should be used to reduce the risk of inhalation. The sash of the hood should be kept at the lowest practical level during work.

11) Monitoring must be performed at frequent intervals to detect and prevent the spread of contamination. A conventional GM probe is very inefficient for the detection of I-125, which emits low energy radiation (electron capture X-rays). A scintillation detector designed for detecting I-125 is the best choice of detector for a portable monitoring instrument. I-131 emits a combination of beta and gamma radiation and is easily detected with portable instruments equipped with conventional GM detectors.

12) Contamination surveys should include wipe tests analyzed by liquid scintillation counting or by use of a low energy gamma counter.

13) In addition to contamination surveys, radiation dose rate surveys should be performed in radioiodine laboratories, except for laboratories where only small quantity RIA kits are used. Radiation dose rates should be measured at 1 foot from use areas, storage locations, and waste containers as described in Chapter 6, *Radiological Surveys.*

14) Individuals working with radioactive iodine must have thyroid bioassays in accordance with the requirements of Chapter 3, *Radiation Exposure Limits*. Notify the Radiation Safety staff to schedule a thyroid bioassay.

15) Any individual who has had skin contamination due to radioactive iodine or has reason to suspect that they may have inhaled, ingested, or absorbed radioiodine should promptly notify the Radiation Safety staff to schedule a thyroid bioassay.

10.4 Phosphorus-32

1) Phosphorus-32 (P-32) is primarily an external hazard, but it is also an internal hazard. P-

should also be protected from beta radiation by the use of safety glasses or other protective measures.

2) P-32 has a radiological half life of 14.3 days.

3) Extremity dosimetry (ring badge) is required for persons performing direct handling of P-32 in individual quantities $\geq$1 millicurie.

4) P-32 should never be directly shielded with dense materials such as lead, due to the Bremsstrahlung effect. Bremsstrahlung radiation is the production of X-rays as a result of charged particle interaction with a dense material. After the high energy beta radiation has been attenuated by a low density shielding material (plastic, acrylic, etc.), it may be shielded with lead or other high density materials without generating Bremsstrahlung radiation.

5) Plexiglass, acrylic, or Lucite plastic of 3/8" minimum thickness is recommended for shielding of P-32.

6) Never work directly over an open container of P-32, since the walls of the container (plastic, glass) provide some shielding for the beta radiation.

7) Do not handle containers of P-32 any longer than necessary. Use tongs, work stands, and associated devices to limit direct handling.

8) P-32 is not a significant absorption hazard, but like all unsealed materials may be ingested.

9) The high energy beta associated with P-32 is easily detected with a portable monitoring instrument using a thin window GM detector (efficiency >30%). Work area surveys for contamination may be performed by direct scans and wipe testing as described in Chapter 6, *Radiological Surveys*.

10) In addition to contamination surveys, radiation dose rate surveys should be performed in P-32 laboratories. Radiation dose rates should be measured at 1 foot from use areas, storage locations, and waste containers as described in Chapter 6,

close proximity (1/2") to the surface being scanned. Contamination surveys should focus on wipe scanning for contamination must be done slowly (1 to 2 inches per second) in a close proximity (1/2") to the surface being scanned. Contamination surveys should focus on wipe testing with the wipes counted in a liquid scintillation counter.

10.9 Other Radioisotopes

The previous information covers the significant hazards associated with some of the commonly used research radioisotopes at UGA. For specific information about the hazards of other radioisotopes, contact Radiation Safety and review any vendor supplied information. You should always be aware of the primary hazards (internal, external, or both) and methods of detecting the radioisotopes that you are using.

10.10 Sealed Sources

1) Sealed radioactive sources are primarily an external radiation hazard. However, sealed sources must be used, handled, and stored in such a manner as to prevent the source from becoming an internal (contamination) hazard.
2) No sealed source may be opened or modified in any way. Sources may not be machined, drilled, cut, or altered.
3) Avoid handling the active surface of sources. Use tweezers, tongs, or other remote handling devices when working with sources that have the potential to produce significant personnel exposure. However, when using remote handling devices, take precautions not to scratch or damage the surface of the source.
4) Do not clean sealed sources with abrasives, chemicals, etc. Avoid other potentially damaging conditions such as temperature extremes, mechanical shock, etc.
5) Sealed sources must be labeled and posted as with any radioactive materials. They are also subject to the same security requirements.
6) Radioactive sources in electronic devices (i.e. gas chromatographs) must not be removed from the detector cells. Do not open or attempt to clean detector cells in these devices.
7) Sealed sources shall be leak tested at a frequency specified by the Radiation Safety Office. A leak testing kit will normally be sent to the Authorized User by the Radiation Safety staff at appropriate intervals.

11.0 USEFUL FORMULAS, CONVERSION FACTORS, AND TABLES

Radioactive Decay

This formula may be used to determine the actual activity of a radioactive source by calculating the correction for radioactive decay. Activity can be in units of curies, dpm, etc.

Elapsed time and half life must be in the same units (i.e. hours, days, years).

Decay Formula

$A = A_o e^{-0.693\, t / T½}$

Where:
A = Activity
A = Original Activity
e = base of natural log
t = elapsed time
T½ = half life

"Rules of Thumb" for Radioactive Decay

- After 7 half lives the activity of any radioisotope is reduced to <1% of the original value.
- For radioisotopes with half lives >6 days, the change in activity in a single 24 hour period is <10%.

Inverse Square Law (Point Source)

The inverse square law may be used to calculate the dose rate at a known distance from a radiation source (point source), when another dose rate and distance are known. For example, if a radiation source is generating a known dose rate at 1 foot, you could use this formula to calculate the dose rate at 3 feet.

$$(I_1)\,(D_1)^2 = (I_2)\,(D_2)^2$$

Where:
I_1 = dose rate at 1st distance (initial dose rate)
D_1 = 1st distance (initial)
I_2 = dose rate at 2nd distance (new dose rate)
D_2 = 2nd distance (new distance)

Gamma Exposure Rate Calculation

This formula may be used to calculate the dose rate at one foot from a radioactive source, when the activity of the source in curies and the isotope are known. This formula is effective only for gamma radiation dose rates.

$$I_{1ft} = 6CEN$$

Where:
I = the gamma dose rate in Rem/hr at one foot
C = the source activity in curies
E = the gamma energy in MeV
N = the photon yield

- Accuracy is approximately 20% for gamma energies from 0.05 to 3 MeV.
- If N is not given, assume 100% photon yield (N=1).

Unit Conversion

Based on a given set of units, you may convert to a desired unit by means of a conversion factor. The conversion factors shown here are ratios of two equivalent physical quantities expressed in different units. When expressed as a fraction, the value of a conversion factor is 1.

Conversion factors in the form of fractions may be built as shown in the following example:

1 millicurie (mCi) of a radioisotope has been diluted in a gallon of solution. What is the activsng8/5/03

1.0 RADIOACTIVE WASTE REDUCTION

1.1 Limiting Waste Production

Whenever practical, limit the production of radioactive waste. Some ways to limit waste production include:

- Training personnel in proper ha

2.0 DRY SOLID RADIOACTIVE WASTE HANDLING

2.1 Segregation of Dry Solid Waste

Segregate dry solid radioactive waste according the following categories:

1) Long lived waste (half life >120 days)
2) Short lived waste (half life <120 days)
3) Long lived mixed waste
4) Short lived mixed waste
5) Sealed radioactive sources

Long lived waste will normally be stored by Radiation Safety pending disposal via a commercial radioactive waste disposal vendor. Please limit the production of this type of waste since commercial disposal is expensive. Long lived dry waste may be mechanically compacted to achieve volume reduction or incinerated by a licensed vendor. Non-compactable materials and materials that cannot be incinerated should not be put into containers of long lived dry radioactive waste. Non-compactable and non-incinerable materials include, but are not limited to, metal objects, aerosol cans, and lead shielding materials.

Short lived waste will normally be held for radioactive decay by Radiation Safety. Following decay for a time period of 10 radioactive half-lives, the waste will be monitored for the presence of residual radioactivity. If no residual radioactivity is detected the waste will be disposed of as non-radioactive. Containers used to store short lived waste will be returned to the Authorized User after disposal of the contents.

Mixed waste is any combination of a hazardous waste and a radioactive waste. Handling and disposal of mixed waste is expensive. A hazardous waste is any material listed as hazardous by the EPA (refer to the MSDS for this information). Consult with the Environmental Safety Division prior to generating mixed waste. If the estimated cost of disposal of a quantity of long-lived dry mixed waste exceeds the average cost of disposal of a similar quantity of long-lived dry radioactive waste by more than 10%, this will trigger a review by the Radiation Safety Committee. The RSC may then require the Authorized User who generated the waste to arrange for funding to pay for all or part of the disposal costs beyond the average disposal cost for a drum of long-lived dry waste. Short lived mixed waste will be held for radioactive decay and disposed of as hazardous waste.

Safety Committee. The RSC may then require the Authorized User who generated the waste to arrange for funding to pay for all or part of the disposal costs beyond the average disposal cost for a drum of long-lived dry waste.

The above listed categories should be additionally sub-divided into separate containers when appropriate. For example, different types of hazardous (mixed) waste should not be combined into one container.

Note: Dry radioactive waste materials that are in process will be referred to as **dry active waste (DAW)**. "In process" means that the materials have not officially been classified as radioactive waste for purposes of transportation and final disposal. Treatment options, such as decay in storage, compaction, and incineration, may be used prior to the final classification of this material as low level radioactive waste.

2.2 Dry Active Waste (DAW) Containers

1) The standard container for DAW is a 30 gallon fiber drum with a reinforced metal lock-rim closure lid.

2) Alternative approved containers include 5 gallon plastic pails with secure screw top lids and 10 to 20 gallon capacity all fiber drums. All fiber drums are preferred for use with long lived DAW because they are completely incinerable, although they may be used any time a smaller container is more practical. Smaller containers should be used only in laboratories that generate small quantities of DAW, so that the need for waste pick-ups will not be excessive.

3) Other special use containers may be approved by the RSO/RSC on a case by case basis.

4) Authorized provons7(c)-2(al)2SO/tthat generate

)-6.9(al)DkDD mcsD0.026 Tw [(D)-2k

10) All DAW containers must be lined with a removable polyethylene liner bag (or bags) to achieve a minimum thickness of 4 mil. Liner bags should not have radioactive materials markings and should not be closed or labeled with radiological warning tape.

11) Used waste containers that are no longer needed must be turned over to Radiation Safety for disposal or reuse on campus.

2.3 DAW Packaging

1) No free standing (visible) liquids of any kind may be placed in a DAW container.

2) Small amounts of liquid may be added to absorbent materials and then placed in the container. Ensure that a sufficient quantity of absorbent material is used when absorbing liquids for disposal as DAW.

3) Empty liquid containers may be placed in the dry waste container, but they must not contain any free standing liquid. Empty liquid containers should have the lids removed prior to disposal to prevent moisture condensation during storage.

4) Empty scintillation vials that were used for analysis of H-3 or C-14 may be disposed of in regular (non-radioactive) trash. Empty scintillation vials that were used for analysis of other isotopes may be disposed of in regular (non-radioactive) trash, IF the count rate of the samples did not exceed 500 cpm. This value is based on the fact that only a small percentage of the original activity in the scintillation cocktail will remain on the surface of the empty vial as contamination. If the counting results exceed this value the empty vials must be rinsed with water. According to industry standards a triple rinse will remove >90% of the residual activity. The rinsed vials may then be disposed of as non-radioactive.

5) Items that have a high moisture content require special handling. When appropriate, dry these items under low heat in a fume hood prior to disposal. If this is not practical, you must surround these items with a sufficient quantity of absorbent materials to eliminate all free standing liquid

necessary decontaminate) the outside of the container and dispose of as non-radioactive.

10) Lead (Pb) shielding materials must not be placed into a dry waste container. Lead waste is considered hazardous waste. If suspected to be contaminated, lead shielding should be surveyed for contamination in accordance with Chapter 6, *Radiological Surveys*. Contact Radiation Safety for specific information regarding disposal or decontamination of contaminated lead. Do not attempt to decontaminate lead by cutting, heating, or abrasive methods due to the risk of inhalation and ingestion of this hazardous material.

11) The maximum acceptable weight limit for an individual DAW container is 50 pounds.

12) Sealed radioactive sources shall not be put in DAW containers without specific approval from Radiation Safety.

13) DAW containers used for short lived waste will be returned to the Authorized User after disposal of waste. In order to facilitate the return of used containers, label the container with the name of the Authorized User and ensure that liner bags are used in such a manner that the container does not become contaminated. Since containers will be held for radioactive decay, extra containers should be purchased for use while full containers are

materials or have only

3.0 ANIMAL CARCASSES AND BIOHAZARDOUS WASTE

Note: Refer to the University's Biosafety Manual for specific information about biohazardous waste.

1) Notify Radiation Safety prior to initiating any new projects resulting in the generation of animal carcasses or biohazardous waste contaminated with radioactive materials.

2) Animal carcasses and biohazardous waste may be disposed of as if it were not radioactive IF the disposal is documented and approved by Radiation Safety, the disposal method is appropriate for the physical and biohazardous properties of the material, and the material consists of one or more of the following:

   - Animal tissue that does not contain more than 0.05 µCi of H-3 or C-14 per gram.
   - Waste that contains radioisotopes in concentrations that do not exceed the appropriate effluent limit specified in 10 CFR 20 Appendix B, Table 2.
   - Waste that contains short lived radioisotopes that has been held for radioactive decay for a minimum duration of 10 half lives and when monitored with an appropriate portable instrument shows no detectable activity.

3) Animal carcasses and biohazardous waste must be properly labeled and safely stored pending disposal.

4) Any radioactive biohazardous waste will NOT be picked up for storage or disposal by Radiation Safety unless the Authorized User has verified that the waste has been deactivated, decontaminated, or sterilized.

5) Waste that has been deactivated, decontaminated, or sterilized should not be labeled as biohazardous. Radioactive waste in bags or containers with biohazard labels will not be picked up for disposal by Radiation Safety.

4.0

by conventional sample counting equipment. These very low levels of radioactivity are considered safe for release. See section 5.3 for additional information.

Disposal of waste by radioactive decay is performed by the Radiation Safety staff. Although some radioactive decay does occur while waste is being accumulated in authorized use locations, the tracking, storage, monitoring, and disposal of waste via the radioactive decay process is performed in a designated facility by Radiation Safety.

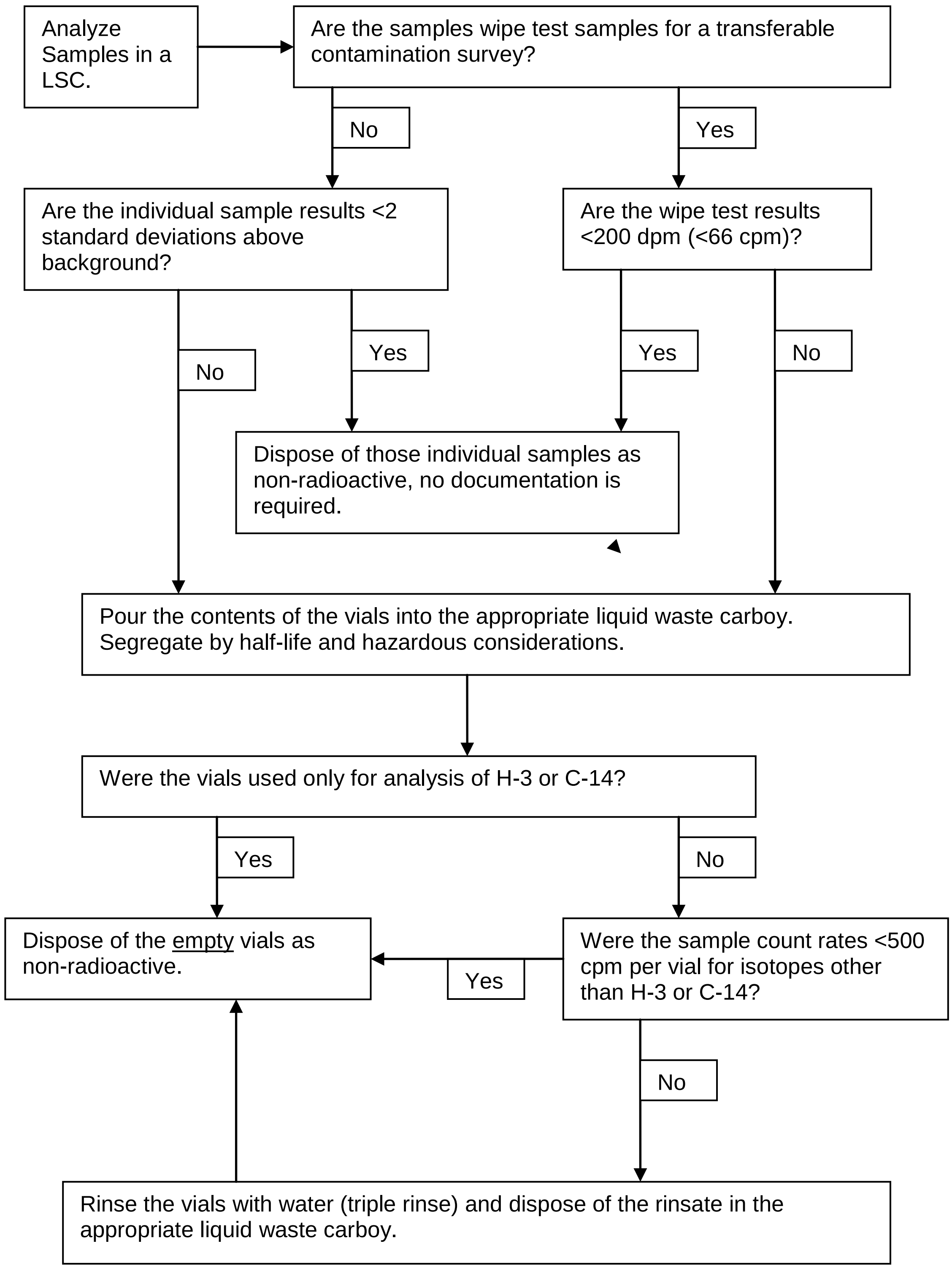
Sewer disposal involves the discharge of carefully measured and tracked quantities of radioactive liquids into the sanitary sewer system. These disposals may only be performed in accordance with specific regulatory limits on both the concentration of radioactivity in a liquid and the total amount of radioactivity that the University may release on a monthly and annual basis. Due to the large volume of water in a municipal sanitary sewerage system, these disposals become diluted and therefore do not contribute significantly to environmental radioactivity levels. The vast majority of sewer disposal at UGA is performed by the Radiation Safety staff. Short lived radioisotopes are typically held for radioactive decay prior to disposal. Specific approval for sewer disposal may be granted to Authorized Users by the RSC on an individual basis. Adding or terminating sewer disposal approval is handled via the Radioactive Materials Permit amendment process.

Radioactive waste disposal by off-site shipment to an approved waste disposal vendor is performed exclusively at UGA by the Radiation Safety staff. Such shipments are strictly regulated and expensive operations.

4.2 Disposal of Used Liquid Scintillation Counting Fluid

1) LSC fluid should be verified biodegradable by checking the manufacturer's specifications prior to purchase.

Flow Chart for Disposal of Used Liquid Scintillation Fluid & Vials



µCi/ml. Therefore it would be appropriate to count a 2 ml sample for 1 minute for H-3 at this background level (or less) because the ALARA action level for release of H-3 is 2 E -4 µCi/ml. If the calculated MDA is less than the action level, the variable parameters of counting time and background are suitable for the release analysis.

3) If a counting instrument's background is high (i.e. >50 cpm), the sample counting time may have to be increased in accordance with an MDA calculation. A high background should be investigated, possible causes include contamination of the counting instrument or the placement of radiation sources (waste containers, stored isotopes, etc.) nearby.

4) Liquids that contain significant quantities of known quenching agents that are likely to contain radioactive material should be considered radioactive waste and not evaluated for release. Analyze samples of these liquids for pick-up by Radiation Safety as described in section 5.4. Coloring agents, non-homogenous samples, and certain chemicals will interfere with liquid scintillation counting. To ensure accurate counting, samples should have visible clarity (lack of coloration) and homogeneity.

5.2 Procedure for Sampling and Analysis of Liquids

1) Sampling must be representative. Liquids should be uniformly mixed (shaken, stirred, etc.) prior to sampling.

2) Collect and pipette a sample of the liquid waste into a sample counting vial. The standard sample volume to use is 1 milliliter. When performing sample analysis for release evaluations the sample volume must be adequate to ensure that the required minimum detectable activity (see section 5.1) is met.

3) Add the appropriate amount of scintillation fluid for use with your liquid scintillation counting instrument to the vial (i.e. 7, 10, or 20 ml of scintillation fluid).

4) If you are analyzing samples exclusively for P-32 and would like to perform Cerenkov counting, contact Radiation Safety for assistance. Cerenkov counting cannot be used for liquid release analysis and the counting efficiencies must be adjusted on the *Sewer Disposal Log* and *Liquid Radioactivity Analysis* forms.

5) If you are using a gamma counter follow the standard counting protocols for that instrument.

6) Set-up the instrument to count in the spectrum of the isotope known or suspected to be present. Multiple isotopes must have distinct energy spectrums to permit differentiation. Segregate liquids by radioisotope to facilitate analysis.

7) If a liquid waste carboy contains multiple isotopes that are not easily differentiated by analysis, the sample should be analyzed by full spectrum counting. The analysis sheet should list all the isotopes in the container and the total activity.

8)

automatically provided by the electronic application.

5.3 Evaluation of Liquids for Release

If you generate liquids that contain very low concentrations of certain radioisotopes you may evaluate these liquids for release in accordance with the regulations for liquid effluents. Each individual radioisotope has its own release limit. The action levels provided only include those n - 2 (e d 2

Table 5.3 may only be approved by the RSO on a case by case basis.

Liquid Release Evaluation Procedure

1) The *Liquid Release Evaluation* form must be completed in an electronic format to ensure consistent performance and eliminate the need to check for mathematical errors. The electronic format must be approved by the RSO and obtained from Radiation Safety. After the electronic form is completed, it must be printed and signed. A signed copy is required as a record of disposal.

Sewer Disposal Procedure

1) The *Sewer Disposal Log* should be completed in an electronic format for increased efficiency. The electronic format must be approved by the RSO and obtained from Radiation Safety.

2) If the electronic format *Sewer Disposal Log* is un-available or is not being used for any reason, sample analysis may still be performed and documented on the form. Radioactivity calculations will have to be performed manually. Contact Radiation Safety for assistance if needed.

3) Collect a representative 1 ml sample of the liquid as described in section 5.2.

4) Count a background sample and the prepared liquid waste sample for a minimum of 1 minute in an appropriate counter.

5) Enter the required data on the *Sewer Disposal Log.* The electronic version of the form will perform the required mathematical calculations automatically.

6) If the sample results exceed the limits in your sewer discharge permit (either the µCi/ml or total µCi), do not proceed with sewer discharge. Delete the entry from your *Sewer Disposal Log* and use the *Liquid Radioactivity Analysis* form to document the analysis. Complete all the information on the *Liquid Radioactivity Analysis* form as described in section 5.4. Use the *Liquid Radioactivity Analysis* form to label the container and schedule a waste pick-up with Radiation Safety.

7) When all sewer disposals for the month are completed, the electronic form must be printed and signed. A signed copy is required as a record of disposal. Laboratory copies may be maintained in either electronic or hard-copy format.

8) Send the completed *Sewer Disposal Log* to Radiation Safety in conjunction with your monthly radiological survey. If no sewer disposal is performed for the current month this should be noted in the space provided on the *Radiological Survey Form*.

9) Sewer disposal shall be performed only at designated locations in posted Radioactive Materials Areas.

10) Discharge liquid waste slowly to minimize splashing with water running to be sure that the
ForSend t

Is the liquid likely to contain exclusively very low concentrations of the radioisotopes H-3, C-14, S-35, P-33, and/or P-32 that would be suitable for release in accordance with the ALARA Action Levels provided in Table 5.3?

Use the *Liquid Release Evaluation* form to document the analysis of the liquid and evaluate its suitability for release.

According to the *Liquid Release Evaluation* form, is the liquid suitable for release?

Dispose of the liquid as appropriate for its physical and chemical constituents. Complete the form and send it to Radiation Safety with your monthly reports.

Perform a radiation/contamination survey of the container. Use the completed form to label the container and notify Radiation Safety of the need for a waste pick-up.

x

6.0 WASTE PICK-UPS

Used radioactive materials collected from University laboratories are taken to the UGA Hazardous Materials Treatment Facility (HMTF). There they are classified and placed in one of several channels for disposal. **Used radioactive materials are not officially designated as radioactive waste until they have been received at HMTF and classified**. Channels of disposal include storage for decay, evaporation, solidification, incineration, sewer, and compaction for shipment to a commercial disposal site.

Full radioactive waste containers are not allowed to accumulate in a laboratory. Contact Radiation Safety and schedule waste pick-ups to prevent accumulation of full containers in work locations.

6.1 Preparing for Pick-Up

- Verify that each individual container has either a *DAW Container Log,* a *Liquid Radioactivity Analysis* form, or a *Liquid Release Evaluation* form attached.
- Make sure that the paperwork contains all required information. Complete each section of the forms.
- Perform a contamination survey of the exterior of each container. Contamination levels on containers should be less than 200 dpm/100 cm^2 and must not exceed 1000 dpm/100 cm^2. Contaminated containers should be decontaminated and resurveyed as described in the *Laboratory Procedures* chapter of this manual.
- Perform a radiation dose rate survey of the exterior surface of the waste container. If the contact dose rate exceeds 0.5 mrem/hr, notify Radiation Safety of the dose rate on the container when you request a pick-up. The Radiation Safety staff will verify the radiation dose rates and provide appropriate labeling for the container at the time of pick-up.
- Sign and date the forms in the space provided. Waste container paperwork should only be completed by, or under the supervision of, an Authorized User or Advanced Radworker.

6.2 Scheduling and Performance of Waste Pick-Ups

- Notify Radiation Safety of your need for a waste pick-up. You will need to specify the isotopes, type of material, and number of containers.
- Radioactive materials pick-ups will generally be on the Thursday following your call. The date and time of pick-up will be provided when

7.0 ATTACHMENTS

DAW Container Log (example)

Liquid Release Evaluation (example)

Liquid Radioactivity Analysis (example)

Sewer Disposal Log (example)

1.0 PURPOSE

The purpose of this chapter is to provide guidance in the implementation of the Radiological Improvement Program. This program provides a record of observed radiological deficiencies and opportunities for improvement, a method for reporting these items to management for action, and a means to trend radiological performance. The Radiological Improvement Program may also be used as a self assessment tool, providing a method to encourage continual improvement of the radiation safety program.

2.0 SCOPE

This chapter

5.0 RADIOLOGICAL IMPROVEMENT PROGRAM REPORT

5.1 RIPR Initiation

1) A RIPR may be generated by <u>any</u> person working under the UGA Radiation Safety Program.

2) The RIPR should be initiated promptly after the discovery of any significant radiological occurrence.

3) RIPRs are initiated by completing only section "A" of the form and forwarding the

3) When practical, a root cause analysis should be performed to determine why an incident or deficiency occurred.

4) When completed, the improvement plan will be attached to the RIPR. The RSO should note that the plan is attached by completing the space provided on the RIPR.

5) The target date for completion of the improvement plan shall also be determined and noted on the RIPR in the space provided.

IV shou613.3(3)]TJ 0 T6 0 Td (

6) Category IV RIPRs shall be handled as foll05.6(s)-1. 21p2.6(058lc 0 Tw r /Type / Type / Typo8ea2y2

CHAPTER 12 RADIATION PRODUCING EQUIPMENT

1.0 PURPOSE AND SCOPE

The purpose of this chapter is to provide instruction for the use and control of radiation producing equipment at the University of Georgia. The information in this chapter is based on the requirements set forth by federal agencies and the Georgia Department of Natural Resources and Department of Human Resources. This chapter applies to all personnel working under the UGA radiation safety program.

Radiation producing equipment is defined as exclusively exempt quantities of

d from the requirements of this chapter.

LIMITATIONS

d to human beings except as prescribed by persons
aling arts. Human medical use regulations are outside

n machine in the state of Georgia is prohibited unless the
ered with the Department of Human Resources.
qualified vendors. Contact Radiation Safety for specific information.

- No one is permitted to open or breach the containment of any radioactive sealed source contained in radiation producing equipment. Potentially serious radiological consequences could occur.
- Non-radiological s2(ual)2.6(i)13.5(f)-17.5(i)2.3Dd.6(io).4(g)-14.r914.i922 -1.141 Td3g(nfNc.)007 T a5JC0 T

When x-rays interact with any material, some x-rays may pass completely through the material, some may depart all of their energy within the material, and some will scatter. The scattering effect occurs when x-rays “bounce off” surfaces and results in the majority of exposure to personnel operating radiographic equipment.

3.2 Sealed Source Irradiators

Sealed source irradiators typically consist of a shielded radiation source that can be mechanically m.6(c)-10.6(f)-17.5()-6((s)]TJ ad0(r)-5.9(r)-5-4.34c)-4.3(r(r)-5.9(r)-5-4.34c)-4.d (CID 3un2.6(on responsibility of the individual owner/user to ensure that their equipment is registered with the Department of Human Resources.

5.0 TRAINING

Radiation Safety can provide training in the

5.2 Training of Operators Who Work With Radiation Producing Machines in All Other Applications (Non-Healing Arts)

The registered user must ensure that persons operating his/her radiation machine and

- Patients undergoing procedures in the healing arts are exempt from these exposure limits.
- Radiation exposure rates in unrestricted areas shall be such that, if an individual were continuously present in the area, the exposure to that individual would not exceed 2 mrem in any one hour or 100 mrem in any 7 consecutive days.

7.0 PERSONNEL MONITORING

Radiation monitoring dosimetry is required for all individuals:

- likely to receive 25% of the limits specified in Table 6
- entering high radiation areas
- under 18 years of age in x-ray training schools or employed in occupations that involve exposure to radiographic equipment
- using non-medical x-ray devices who are likely to receive 25 mrem per week.

When using protective aprons, personnel dosimetry shall be worn outside the apron at collar level.

For additional information about procurement and control of personnel dosimetry, see Chapter 9, *Laboratory Procedures*.

8.0 SAFETY REQUIREMENTS FOR RADIATION PRODUCING EQUIPMENT

1) Facilities considerations, including design requirements must comply with the Rules and Regulations for X-Rays, Chapter 290-5-22 and must ensure that the radiation exposure limits for unrestricted areas described in section 6 of this chapter are met. Where appropriate, a qualified expert should be consulted in the design of new facilities or in the modification of existing facilities.

2) Installation, calibration, maintenance, repairs, testing, and radiological monitoring must be performed by qualified personnel. Vendors and associated personnel responsible for these duties must keep documentation adequate to show evidence of compliance with the rules and regulations.

3) Radiation producing equipment shall be tested prior to initial use, after the performance of any modifications, maintenance, or repairs with the potential to affect safety, at any time an abnormal condition is noted, and in accordance with regulatory requirements.

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4) Equipment warning labels and labels that contain information related to the make, model, or manufacturer of radiation producing equipment aba10.6(r)2.6(t)-62.65.9(m)-aintaai ai e

6) A copy of the state of Georgia, Rules and Regulations for X-Rays, chapter 290-5-22 should be in the possession of all registered users (preferably at the work location) and shall be complied with.

7) Radiation producing equipment capable of generating a high radiation area (100 mrem/hr @ 30 cm from the source of radiation) must be kept locked or otherwise controlled to prevent unauthorized access.

8) The useful beam of radiographic equipment shall be limited to the smallest area practicable, consistent with the objectives of the radiological examination or treatment.

9) All interlocks, shutters, dead-man switches, beam limiting devices, collimating devices, filters, primary and secondary barriers, and fail-safe devices shall be used or installed in accordance with regulatory requirements, must be properly maintained, and cannot be modified in any way that would compromise their safety or effectiveness.

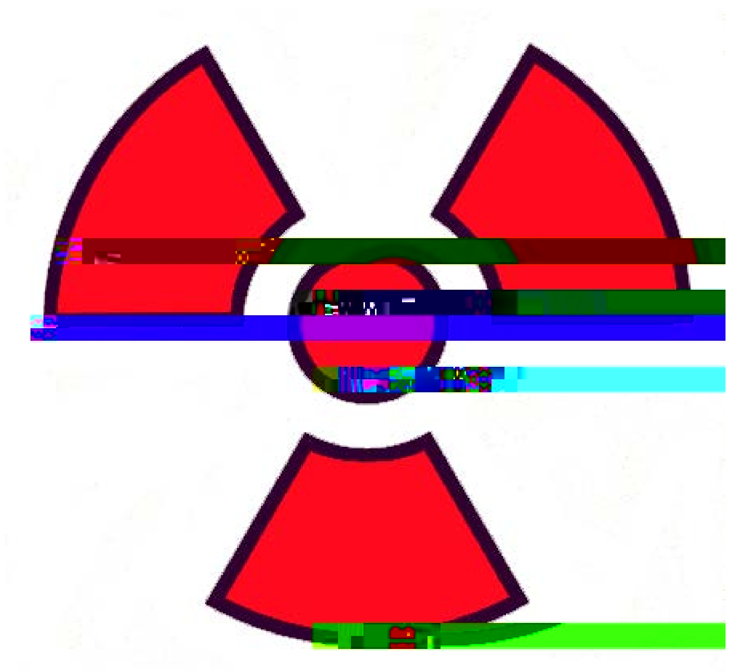
10) X-ray films, intensifying screens, and other image recording devices should be as sensitive as is consistent with the requirements of the examination or procedure being conducted.

11) Particular care should be taken to align the x-ray beam to ensure that only the target area is irradiated and to reduce the need for performing more procedures than necessary.

11)16 orrea302 Tc 0.002 Tw0 Td (,)Tj i.sit32 T55.9(i)2.4-od [2.6 -10.848 -1.20(t32 m)-5.
or efn002 TR(pr)-5.91 tes-6.7(o)1cye(need).9(y)8.-1.152T5(t)arf04j 0 [()-5.9(6(p.5(t)ar).pht)pt32 m

equivalency. Even when using protective clothing, personnel exposure to the primary beam must be avoided.

18) Radiography or teletherapy devices containing sealed radioactive sources must have a durable, legible, and clearly visible label describing the isotope, activity, assay date, manufacturer, and model or serial number of the device. Source assemblies, shields, shutters, etc. are to be properly maintained and cannot be modified in any way that would compromise their effectiveness. The sealed radioactive source of all devices in active use must be leak tested at a minimum frequency of every 6 months.



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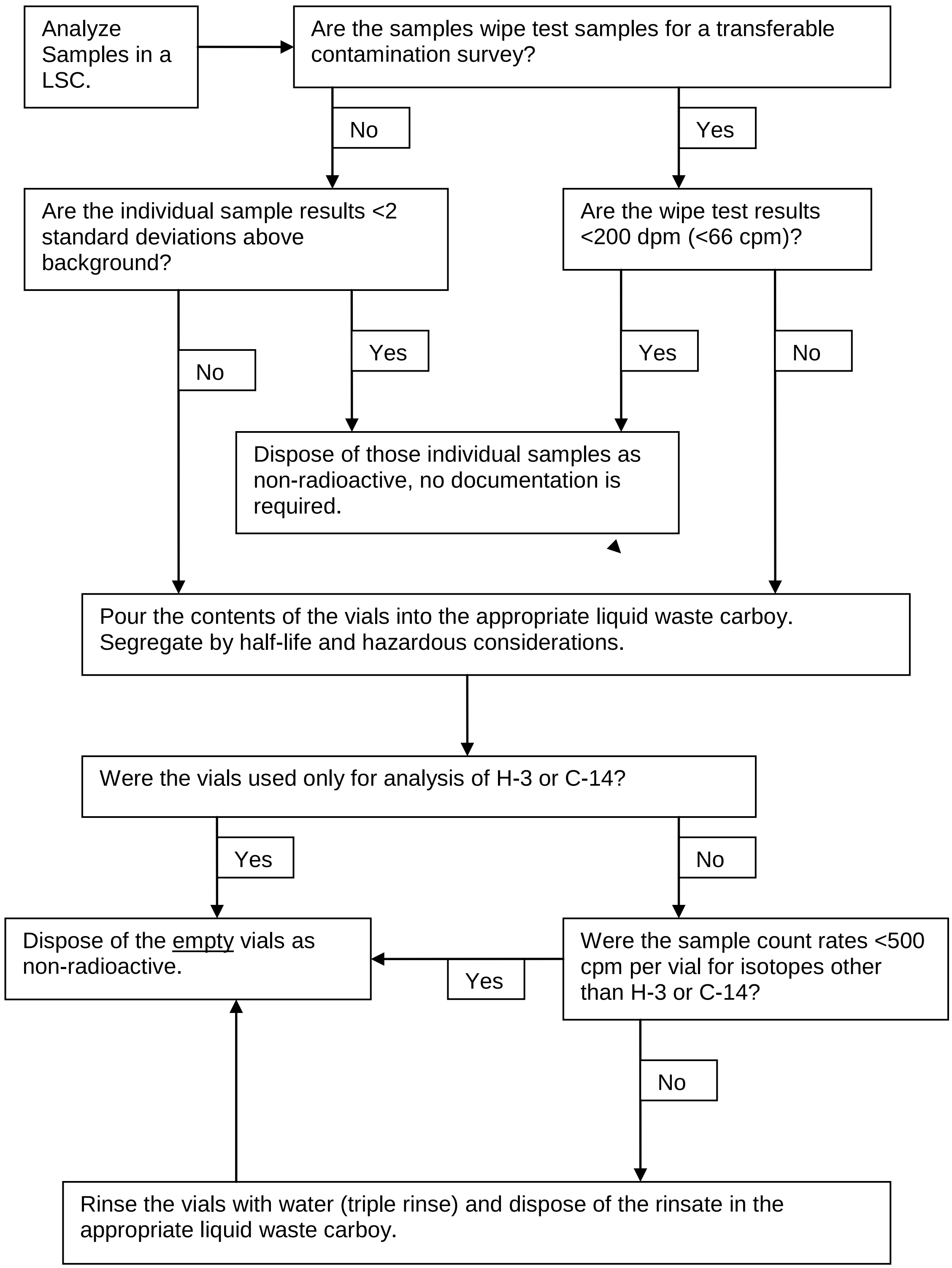
Flow Chart for Disposal of Used Liquid Scintillation Fluid & Vials



Shipment Packaging, Labeling, and Radiological Survey Performed By

Name (print)	Signature	Date

*The shipping container must be marked with a UN2910 label, available from Radiation Safety. In addition, the statement listed below must be included inside the package in a readily visible location. This statement can be added to the packing list or enclosed separately.

This package conforms to the conditions and limitations
specified in 49 CFR 173, 421 for radioactive material,
excepted package -limited quantity of material, UN 2910.

LIQUID RADIOACTIVITY ANALYSIS

Name of Authorized User:

Radioactive Materials Permit Number: | Date of Analysis:

Radioactive Half Life Classification: ☐

Part 1: Liquid Radioactivity Analysis

Volume of liquid in carboy (ml) = | Volume of sample analyzed (ml) =

Isotope	background cpm	sample cpm	counting efficiency	activity dpm/ml	activity µCi/ml	total µCi	total mCi
H-3			0.35	0.00	0.00E+00	0.00E+00	0.00E+00
C-14			0.85	0.00	0.00E+00	0.00E+00	0.00E+00
P-32			0.98	0.00	0.00E+00	0.00E+00	0.00E+00
P-33			0.85	0.00	0.00E+00	0.00E+00	0.00E+00
S-35			0.85	0.00	0.00E+00	0.00E+00	0.00E+00
I-125			0.75	0.00	0.00E+00	0.00E+00	0.00E+00
I-131			0.85	0.00	0.00E+00	0.00E+00	0.00E+00
other				0.00	0.00E+00	0.00E+00	0.00E+00
other				0.00	0.00E+00	0.00E+00	0.00E+00
					0.00E+00		

Part 2: Hazardous Chemical Content

Describe the type and quantity of any EPA listed hazardous chemicals in the space provided below:

Radiation dose rate at contact with exterior of container = mr/hr

dpm/100cm ^{2}

Note: Wipe test results must be <1000 dpm/100cm^2, if the results exceed this level decontaminate and re-wipe the exterior of the container.

Part 4: This Form Completed By:

Print Name	Signature

Isotope	bkg cpm	sample cpm	counting efficiency	activity dpm/ml	release limit (dpm/ml)	limit fr0.00E+00	activity 0.00E+00	total

Radiation Worker Certificate

I, the undersigned, have received training in the following subjects/items:

- I acknowledge that the laboratory where I work is authorized to possess and use certain radioactive materials in accordance with a Radioactive Materials Permit issued by the UGA Radiation Safety Office.
- I understand there are potential health risks associated with exposure to ionizing radiation and radioactive materials.
- I acknowledge that my laboratory's Advanced Radiation Worker (ARW) has been trained in UGA's Radiation Safety Policies and is the recommended person to lead my laboratory in radiation safety techniques and to answer associated questions
- I am aware of the locations where our radioactive materials and radioactive wastes are used and stored.
- I understand that radioactive materials must be kept secure from unauthorized access, loss, theft, or use with malevolent intent.
- I am aware of where my laboratory's Radiation Safety records are kept.
- I understand and can recognize the signs and labels used for Radiation Safety.
- I have been instructed in other appropriate Radiation Safety policies and

____

__________Date_________

____

_________Date____________

____

Initials	Date	gross cpm	bkg cpm	sample volume	disposal volume	activity µ	gross	bkg	sample	disposal	activity	gross	bkg	sample	disposal	activity

AUTHORIZED USER

LOCATION OF RECEIPT:

ISOTOPE

P.O. #

CHEMICAL FORM

VENDOR

RADIOLOGICAL IMPROVEMENT PROGRAM REPORT

Section A	To be completed by the person initiating this report	
Initiated By	Telephone Number	E-Mail Address
Mailing Address		
Date and Time of Report	Location of Occurrence	Date & Time of Occurrence

Descr

Radioactive Material Inventory Summary

Authorized User____________________________ Building____________________ Room_____________

B Number	Isotope	mCi	Chemical Form	Date Received	Storage Location	Date removed from Inventory

RADIATION PRODUCING EQUIPMENT REGISTRATION and DISPOSAL FORM
(one form per individual piece of equipment)

Personal Information (Registered User)

Last Name	First Name		Middle Initial
Facility Address	City	State	Zip Code
Mailing Address	City	State	Zip Code
E-mail Address	Telephone		

Location of Radiation Producing Equipment

Department	Building	Room Number	Telephone Number

Radiation Producing Equipment Information

Equipment Category:	[ ] New Facility [ ] New Purchase [ ] Relocation [ ] Upgrade [ ] Transfer [ ] Sale [ ] Disposal , PO No. for disposal_____________________________________
Equipment type:	[ ] X-ray [ ] Fluoroscope [ ] Irradiator [ ] Other________ ___________________
If X-ray, Indicate Practice:	[ ] Medical [ ] Dental [ ] Veterinary [ ] Research [ ] Education [ ] Industrial [ ] Institution [ ] Other_______________________________________
Facility Category:	[ ] Clinic [ ] Research Laboratory [ ] Mobile [ ] Industrial [ ] Education [ ] Institutional [ ] Other____________________________________
If Mobile:	Van or Trailer ID:__________________________________ State:_________________________ License Tag No.:______________________________ Year:_______________________
Equipment Brand :	
Model Number:	
Serial Number:	
If equipment contains a Sealed Source, list:	Radioisotope____ Radioactivity____ Sealed Source Serial Number____

Alternate Contact:		Telephone:	

Signature of Registered User		Date	

1) Before you begin working with the Radiological Survey Form for the first time, download the document from the ESD website and save it to your local disk.

2) The Building, Room Number, Authorized User and Permit (license) Number sections are self-explanatory. -form can be used for include surveys for release of equipment to unrestricted use, spill follow-up surveys, etc.

4) In the survey diagram section, draw an overhead view diagram of the laboratory surveyed, or draw a sketch of the component or item surveyed. For a monthly routine survey of a laboratory it is recommended that the map be drawn accurately for the first survey and saved as a template for future surveys. Extensive detail is not necessary, however, the location of key components such as fume hoods, sinks, radioactive use benches, radioactive materials storage freezers, radwaste containers, and etc. should be included. With a little practice, drawings may be easily created, saved, or modified.

- The drawing toolbar should be used to create diagrams. Selec7.4d(r)4.9(b4T,)4TJ

- Enter a description of the wipe test location in the column marked Wipe Location to clarify the information provided on the diagram. Location descriptions may be li wiarifionpemihe iupti8.9(i)2“

11) The Sewer Disposal section is provided to record the status of any liquid radioactive waste disposals by designated laboratory drains (excluding releases of liquids below ALARA action levels). Specific authorization is required for sewer disposal. This authorization will be documented in your Radioactive Materials Permit, in the initial document that authorizes radioactive materials use, or in the form of a permit amendment. Select one the three choices by marking an "X" in the appropriate box.

12) Record any additional information in the Comments section.

13) The RSO or designee will complete the Reviewed By and Date section.

14) All sections of the RSF may be computer generated with the exception of the space for signature which <u>must</u> be completed by hand.

15) Never use correction fluid (white-out) on a radiation safety record. Make corrections by drawing a single line through the error, then initial and date the correction.

16) Save a copy of the survey for your records. This may be an electronic file or hard copy. It is highly recommended that you save an electronic version as a template for your monthly surveys.

17) If you are unsure about any part of the form or the survey results, contact Radiation Safety for assistance. If you are using the electronic form for the first time, you may wish to send a draft of the survey to Radiation Safety via e-mail for review prior to submittal as a finished document.

RADIOLOGICAL SURVEY FORM

Building:		Room Number(s):		Authorized User:		Permit Number:	
Purpose:	Routine survey for the month of						

A circled number denotes a wipe test location	All radiation dose rates are in mr/hr	ND denotes no detectable