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SOP-1
PROCEDURES FOR AUTHORIZATION OF PERSONNEL

THE RADIATION SAFETY COMMITTEE (RSC) reviews user applications and research protocols for the use of radiation or radioactivity within the institution from the standpoint of radiological safety. The RSC approves or disapproves the applications, protocols, and proposals based upon user competence, training, and experience to assure regulatory compliance and radiological safety.

PROCEDURES FOR AUTHORIZATION

The applicant must:
- Complete Form DHS-027 "Application for Authorization to Use Radioactive Materials or Radiation Generating Devices,"
- Schedule the appropriate Radiation Safety Training with Laboratory Services, and,
- Successfully complete the Radiation Safety Training and examination.

The **Radiation Protection Specialist (RPS)** will:
- Review the applicant's Form DHS-027, and, if minimum requirements are met,
- Present the new application(s) for authorization at the next meeting of the RSC, and,
- Permanently maintain Authorization Records.

REGULAR AUTHORIZATION FOR RADIOACTIVE MATERIALS AND DEVICES

The RSC grants Regular Authorization (RA) to permanent faculty members that:
- Document adequate previous training and experience with radioisotopes,
- Successfully complete the Radiation Safety Training and examination, and,
- Indicate proficiencies in
  - The safe handling of radioactive materials or devices,
  - Regulatory compliance,
  - The proposed research areas, and,
  - The handling of radioactive materials or any radiation generating devices.

TEMPORARY AUTHORIZATION FOR RADIOACTIVE MATERIALS AND DEVICES

The RSC grants Temporary Authorization (TA) to any applicant that meet the following criteria:

- The applicant is a student of the University
- The applicant is not a permanent employee of the University
- The applicant successfully completes the Radiation Safety Training and examination
- The RSC determines the applicant has not had adequate training or experience in the areas of radiation safety, handling radioactive material or operation of radiation generating devices for Regular Authorization.

Temporary Authorization (TA) is:
- Valid for a one-year period,
- Renewable annually, and
- Requires all work under the supervision of faculty member with Regular Authorization.

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TEMPORARY RADIATION PROTECTION SPECIALIST AUTHORIZATION

The Radiation Protection Specialist (RPS) may authorize individuals to work with radioactive materials and/or radiation producing devices pending approval of the RSC at the next scheduled committee meeting.

SOP-2
LOCATION CLASSIFICATION

Classification of locations for the safe use and handling of radioactive material or radiation generating devices will be accomplished in a three step process.

1. The Principal Investigator (PI) will complete **Section "A" of Form DHS-030 APPLICATION FOR RADIOISOTOPE USE IN A LOCATION**. The PI will submit Form DHS-030, along with the proposed experimental procedure, describing the use or handling of radioactive material, to the Radiation Protection Specialist (RPS), for review.
2. The RPS will complete **Section "B"** of Form **DHS-030**, and conduct a Site Safety Audit based upon the proposed protocol and the proposed use location.

   The Audit will cover the following items:
   1. The radioisotope as well as the proposed amounts to be handled and stored in the area, and,
   2. The necessary controls to reasonably protect personnel and equipment, including:
      a) Personnel Protective Equipment requirements,
      b) Personnel and/or area monitoring requirements,
      c) Laboratory Survey requirements, and,
      d) Compliance with State Laws and University Policies and Regulations.

3. The RPS can approve the protocol as submitted, approve with modifications, or disapprove the protocol(s).
   1. If the application is disapproved by the RPS, the PI may submit the application to the Radiation Safety Committee (RSC) for further review at its next scheduled meeting.
   2. The RSC can approve the protocol as submitted, approve with modifications, or disapprove the protocol(s). The decision of the RSC is FINAL.
   3. Approved locations will be summarized on Form **DHS-035 Laboratory Classification and Survey Summary.**

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SOP-3
PROCEDURES FOR THE PROCUREMENT OF RADIOACTIVE MATERIALS AND RADIATION GENERATING DEVICES

The Principal Investigator (PI) is the only authorized user permitted to submit requests to purchase radioactive materials and radiation generating devices. The PI must be an authorized user with Regular Authorization.

PROCEDURES FOR THE PROCUREMENT OF RADIOACTIVE MATERIALS

The PI will submit a completed Form DHS-26, "Radioactive Material Purchase Application" together with an attached quotation from the vendor to Laboratory Services (LS).

- If the request is approved after evaluation by the LS, the Radiation Protection Specialist (RPS) will obtain a Purchase Order and will place the order with the vendor specified on the Purchase Order.
- The PI will be notified of the status of the procurement request.
- If the procurement request is denied for any reason, the PI will be notified in writing of the reasons for denial, and all application forms will be returned.
- All radioactive materials will be delivered to Laboratory Services for inspection, radiation surveys, leak testing, inventory control, and storage until arrangements for delivery have been scheduled by the RPS.
- When the radioactive material is ready to be released from the RPS, the PI will be notified and DHS Form 29, "Approval for Use of Radioactive Materials" will be completed.
- Radioactive materials are delivered directly to the location of use by the RPS.

PROCEDURES FOR THE PROCUREMENT OF RADIATION GENERATING DEVICES

- All purchases of radiation generating devices or devices containing x-ray tubes require prior consultation with and approval from the RPS before devices can be delivered to campus.
- The RPS has the authority to deny any request if the location does not have suitable shielding, which must be validated prior to installation of the equipment.
- Devices purchased without prior authorization from the RPS can be deemed inoperable until authorization is obtained.

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SOP-4
REGISTRATION OF X-RAY DEVICES

All ionizing radiation producing devices must be registered with the Mississippi State Department of Health in accordance with Subchapter 2 of the Regulations for Control of Radiation in Mississippi.

- The registrations of x-ray equipment and other ionizing radiation producing devices will be maintained in Laboratory Services.

- Individuals and/or departments obtaining ionizing radiation producing devices will be required to make application for registration of such devices through Laboratory Services (LS). Within five working days of receipt of an ionizing radiation device, the Radiation Protection Specialist (RPS) will be notified. The use in any manner of such equipment will be prohibited until authorization to use it is given in writing by the RPS.

- Devices in this category include, but are not limited to:
  - X-ray generating units
  - X-ray diffraction units
  - Electron microscopes
  - Electron capture detectors

- All persons utilizing ionizing radiation producing devices will be approved by the RPS.

- Personnel monitoring devices, including TLD ring badges, are required of all individuals using x-ray generating devices.

- All x-ray generators or diffractometers will be inspected annually for radiation leakage by the RPS using the procedures given in SOP-7. The results of these surveys will be recorded on Form DHS-31, "Radiation Generating Device Survey Record." Copies of this form will be maintained on file in LS.

- The person designated in charge of an instrument producing ionizing radiation, is solely responsible for the safe use and operation of these devices. The RPS, with the approval of the Research and Environmental Compliance Officer, will have the authority to require cessation of a known unsafe practice.

- An ionizing radiation device cannot be sold or disposed of by any individual or department without the written consent of LS.

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SOP-5
PROCEDURES FOR RECEIVING AND OPENING INCOMING PACKAGES

- All packages containing radioactive material received at the University of Mississippi Main Campus must be inspected and surveyed for contamination within 3 hours of receipt.
- Records for incoming package surveys are maintained in Laboratory Services (LS).
- **In the event that an incoming package is improperly delivered to another University location, please contact Laboratory Services immediately at 5433. Do not open the package.*

Procedures for Package Surveys by the Radiation Protection Specialist (RPS)

1. Confirm that the arrival of the shipment was expected, and determine if the package was properly labelled, marked and packaged.
2. Verify that the package is not open, wet, leaking or displays any degradation of its integrity.
3. Obtain a calibrated beta-gamma portable survey instrument that has a beta-gamma probe.
4. Measure the radiation level, in mR/hr on contact with the outside accessible surfaces of the shipping container. The surface contact radiation level should not exceed 200 mR/hr. Record readings.
5. Measure radiation levels at a distance of three feet (1 meter) from the surfaces of the shipping container. Radiation level should not exceed 10 mrR/hr at three feet from any surface of the package. Record readings.

Procedures for Wipe Test

1. Obtain wipes or swabs and scintillation vials, deionized water, and protective gloves.
2. With protective gloves, dampen a smear or swab with two to four drops of deionized water, and wipe the innermost container of the package over its entire surface or 100 cm^2 whichever is less. Return the innermost container to the interior of the package.
3. Place the wipe or swab into the labeled scintillation vial.
4. Refer to the Procedures for Wipe Testing section of SOP-3, for the appropriate counting protocol. Record results.
5. If the results indicate the presence of removable activity in excess of the limits given in the table below, the RPS must immediately notify the carrier and the Mississippi Division of Radiological Health.

Table 3 Wipe Test Limits for Removable External Radioactive Contamination

Radioactive Contamination	Bq/cm^2	$\mu Ci/cm^2$	dpm/cm^2
Beta and gamma emitters and low toxicity alpha emitters	0.4	10^{-5}	22
All other alpha emitting radionuclides	0.04	10^{-6}	2.2

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SOP-6
PROCEDURES FOR PERFORMING RADIATION SURVEYS

- Radiation surveys are to be performed annually on all operational radiation generating devices.
- Radiation surveys should be performed on new radiation generating devices following installation, and on any existing device following a repair.
- Additional radiation surveys may be deemed necessary when a location meets or exceeds the criteria for Radiation Area or High Radiation Area as specified in the regulations.
- If any radiation survey exceeds general area background radiation levels by a factor of two, the radiation generating device will be declared unsafe and removed from service. The device shall remain posted as inoperable until repairs or modifications are made that allow the device to operate at the levels as specified in the regulations.

- This SOP is only applicable to radiation generating devices that are regulated within the scope of the licenses issued to Laboratory Services (LS). This SOP does not apply to the diagnostic or healing devices maintained at Student Health.

Procedure for Radiation Surveys of Operational Radiation Generating Devices:

1. Perform surveys on all approved radiation generating devices.
2. Obtain the necessary calibrated radiation detecting instrument, Form DHS-31, “Radiation Generating Devices Survey Record”, and appropriate personnel dosimetry.
3. Measure and record the general area background radiation reading by holding the energized detector probe at waist level with the detector instrument sound amplifier ON.
    a. When using Analog Devices, record the one minute and record the highest meter deflection observed.
    b. When using Digital Devices, obtain the average level over a one to two minute interval.
4. Survey the exterior of the device with the energized detector.
5. Record probe position and highest meter deflection for at least five planar positions surrounding the radiation generating device. If any one or more planar meter deflections exceed the general area background radiation level, the generating device shows evidence of x-ray leakage.
6. The test of the operational interlocks is to be performed with the assistance of the Principal Investigator (PI). Operational interlocks must demonstrate that the power to the device is interrupted upon activation of the interlocks. Failure of the interlocks to correctly interrupt power upon activation constitutes a failure of the instrument functions and it is inoperable until repaired.

7. Verify that the warning mechanism (lights, alarm, etc.) is automatically activated when penetrating radiation is being produced by the device during operation.
8. Notify the PI in writing if a device fails any of the survey criteria or requires repair.
9. Maintain all survey records in the Radiation Devices Survey Record binder located in LS.

Procedures for Performing General Area Radiation Surveys:

1. Obtain the appropriate survey instrument, laboratory diagram and personnel dosimetry from the Radiation Protection Specialist (RPS). Ensure the detecting probe and instrument are fully operational, functional, and in calibration.
2. Permanent records of all radiation surveys, including negative results must be maintained. The records must include:
    - Date and Time
    - Surveyor name/ title
    - Instrument (Model number, serial number, calibration date.
    - Location
    - Background radiation level
    - Device
    - Reason for the survey
    - Areas Surveyed
3. General area surveys are to be performed with the energized detector probe at waist level. Surface scans should be performed slowly approximately 1 inch from the surface.
    Note: <u>The probe of the survey meter should never make contact with any surface areas during surveys.</u>
4. All radiation survey results will be maintained in the Site Radiation Survey binder located in LS.

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SOP-7
PROCEDURES FOR LEAK TESTING SEALED SOURCES

Sealed source must be tested for leakage or contamination at intervals not to exceed six months. Records of leak test results on all sealed sources are maintained in Laboratory Services (LS).

Procedures for Leak Testing of Sealed Sources:

Personnel must wear a TLD ring and whole body badge when leak testing Disc, Wand, and Planchet Sources, as well as when testing the Troxler Neutron Moisture Gauge. Care and speed are essential when handling Sealed Sources.

1. Obtain wipes or swabs, Deionized water, small zippered plastic bags or scintillation vials, tweezers or grip tongs, protective gloves.
2. Label the outer cover of the cap of the scintillation vial with the UMRAC# before wiping the sealed source.
3. Dampen a smear or swab with two to four drops of deionized water.
    a) For Sealed Sources - Wearing gloves, carefully remove the source from its container and quickly wipe the entire surface of the source with the dampened smear or swab. Whenever possible, use remote handling devices, such as grip tongs or tweezers to minimize exposure to the extremities. Return the source to its container and proper shielded position.
    b) For Electron Capture Detectors - Rub the swab vigorously at the top of the detector cap, or, if the detector is installed in a machine, at the outlet tube.
4. Fold the wipe over and place in the plastic bag or place the wipe/swab in the labeled scintillation vial.
5. Use the counting system shown in Table 1 of this SOP for the specified radionuclide. The protocols for the system to be used are found in SOP-6, “Contamination Surveys. If a wipe was used, allow the smear to dry before counting.
6. Transfer all data to the individual sealed source Leak Test Record binder maintained in LS.
7. Evaluate the results of the leak test surveys. Any leak test that exceeds the limit of 0.005 microcuries is evidence that the source is leaking.
    - The leaking sealed source must be immediately withdrawn from use, decontaminated, repaired or disposed of as radioactive waste.
    - The Radiation Protection Specialist (RPS) will file a report with the State within five calendar days of the determination that the source is leaking.
8. All non-leaking sources will be returned to their storage locations.

Table 1

Counters and Standards for Leak Test of Sealed Sources

Radiation Emitted	Counting System	Standard
Beta <= 2.0 MeV	Liquid Scintillation Counter	Internal
Gamma, w/Auger or EC	Liquid Scintillation Counter	Internal
Gamma	Na (Tl) I Detector	Ext. w/ same E
Alpha	Liquid Scintillation Counter	Internal
Alpha	Internal Proportional	Ext. w/ same E
X-ray	Liquid Scintillation Counter	Internal

Procedures for Leak Testing of the Troxler Neutron Moisture Gauges:

- Follow steps 1, 2, 3 and 3a above. Then,
  - Remove the top cover and the electronic assembly as described in the instrument manual.
  - After the electronic assembly has been placed beside the gauge, the source holder can be seen attached to the bottom of the gauge base.
  - The top of the source holder is covered with a yellow “Radioactive Material” label.
  - Wipe the visible edges of the yellow “Radioactive Material” label with the smear or a swab.
- Continue following steps 4 through 8 above

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SOP-8
CONTAMINATION SURVEYS

Contamination surveys are to be performed in all Active Locations approved for radionuclide research that involve the handling or use of unsealed radioactive material and the generation of radioactive waste. The Radiation Protection Specialist (RPS) will conduct monthly surveys in all Active Locations. Records will be maintained by Laboratory Services in accordance with the regulations of the Mississippi State Department of Health, Division of Radiological Health.

Survey Frequency:
When using unsealed radioactive materials, contamination surveys will be conducted by the Principal Investigator (Pl), or an appointed designee, according to the frequencies listed below:

Radiation Type	Isotopes	Survey Frequency
Beta (<200 keV)	H-3, C-14, S-35	Weekly (Wipes)
Beta (>200 keV)	P-32, P-33	Daily (Area), Weekly (Wipes)
Gamma	I-125, I-131	Daily (Area), Weekly (Wipes)

Contamination surveys do not need to be performed during periods when no radioactive materials are used.

Action Levels:

Radiation Type	Action Level
Beta, x-ray (<200 keV)	2200 dpm
Beta (>200 keV)	220 dpm
Alpha	22 dpm

In accordance with the ALARA concept, an item or location exceeding twice background must be cleaned until background levels are obtained for both fixed and removable contamination. The contaminated location must be resurveyed and the results must be documented.

Survey Methods:

Contamination surveys can be performed using a variety of methods. The two most common methods are "area" and "wipe" surveys.

Area (meter) survey:
- Measures both fixed and removable contamination, and,
- Performed with an appropriate portable radiation survey meter.

Wipe survey:

- Measures only removable contamination, and,
- Is performed using “wipes” counted on a liquid scintillation counter or a gamma counter.
  - Wipe tests are the most versatile and most sensitive method of detecting low-level contamination in the laboratory.

The area supervisor or a designee must complete contamination surveys of the active work area at the end of each week during which operations involving the use or handling of loose radioactive material occurs.

Recording Survey Results:

The PI must maintain permanent records of all contamination surveys, including negative results. The records must include:

- Date of survey,
- Type of instrument used,
- Name of person conducting the survey,
- Survey results - must be keyed to locations on the area drawing, and,
- If contamination is found, the results of retesting after decontamination.

Procedures for Wipe Testing:

1. Obtain the survey list and/or map from the RPS. A survey diagram is posted in every Active Laboratory for reference.
2. Test each location specified on the survey map at least once. The smear test is performed by using wet or dry filter paper or swab, and then gently rubbing the filter paper or swab over an area of approximately 100 sq.cm. with sufficient force to remove loose material from the surface without destroying the filter paper or swab.
3. Place each completed smear inside the scintillation vial labeled for the position tested. Scintillation fluid must be added to each vial prior to counting (typically 50- 100% of the vial volume for optimum efficiency).
4. When ready to obtain counting data for the completed survey, place the vials containing the smears in appropriate racks inside the liquid scintillation counter, with a background scintillation vial as the first vial. The background vial should contain liquid scintillation fluid with a clean sample.
5. Obtain counting data by selecting the appropriate counting protocol, or by selecting the Direct **D**isintegrations **P**er **M**inute (DPM) option and selecting the appropriate lower and upper regions for the isotopes to be counted. If the appropriate selections are made in the counting protocol, the data will give the **C**ounts **P**er **M**inute (CPM), DPM, activity per unit area or volume and the efficiency of each sample counted.
6. After the counting interval is complete, check the dates printed on the data sheet and identify the positions of all locations surveyed.

7. Record the results.
   - Check each location for removable activity in excess of the established Action Level listed for the laboratory.
   - If any location exceeds the Action Level, immediately notify the RPS. If the Action Level is exceeded by a factor of 10 or greater, all lab activity should safely be terminated as soon as possible.
   - Activity in the area may continue only after written approval from the RPS.

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SOP-9
RADIOACTIVE LIQUID WASTE

- The Radiation Protection Specialist (RPS) is responsible for the collection and disposal of all radioactive waste and associated materials.
- Separate procedures must be followed for the disposal of bulk fluids, liquids contained in scintillation vials, sharps and other materials that pose a puncture hazard to personnel, and samples with visible residues.
- Wastes which are not correctly identified by the user/generator will be returned.
- Only Non-Flammable Scintillation Fluid may be used in laboratories.
- Any sewer/sink disposal of Radioactive Waste by laboratory personnel is strictly prohibited.

Procedures for Generators of Liquid Radioactive Waste:

1. Liquid waste must be collected in the plastic containers provided by Laboratory Services (LS). The "Radioactive Materials" tag attached to the container must be completed, including:
   - Material I.D. (Radioisotope),
   - Principal investigator (PI) or an appointed designee, and,
   - Current Date
2. Form DHS-014, "Request for Disposal of Radioactive Materials" must be completed, submitted to the RPS (Campus mail, hand delivered, fax 5480), and approved prior to waste collection.
3. The radioactive liquid waste description must include the following information:
   - Chemical components of the waste,
   - Relative amounts of any chemicals present in the waste, identified +/- 1% of the total volume.
4. Liquid radioactive waste must be segregated by radionuclide
5. Use separate waste containers for Organic Waste and Aqueous waste.

Procedures for Generators of Liquid Waste with Scintillation Vials:

Liquid Scintillation Vials (LSV) are to be placed in a sturdy receptacle with 2 liners provided by LS.

1. The following criteria must be followed for the collection of LSVs:
   - The average specific activity of waste generated must be less than 0.05 µCi/ml (1.85 MBq/ml).
   - The vials are to be tightly capped and there should be no leaking vials within the lot.
   - There must be no visible solids or residues (tissue parts, animal parts, etc.) contained in the vials.

2. Liquid radioactive wastes which do not meet the criteria above are to be packaged as follows:
    - The contents of any vials or similar glass or plastic containers are to be emptied into an appropriately marked liquid container which has a leak proof, screw-on cap.
        - Do not mix nuclides without prior approval from the RPS.
        - Each container should be labeled with a tag showing the isotope, activity and volume with the completed waste form and activity analysis attached.
    - Empty vials and other empty glass or plastic containers are to be tightly capped and discarded into a double polyethylene bagged step-pedal type waste container.
        - When the bag is approximately 75% full, seal the bags with tape and label the outer bag with the radioisotope, activity and weight with the completed waste form attached.
    - Puncture hazards such as broken glass, aluminum crimp seals, syringes, syringe needles, pipettes, pipette tips, and other sharp objects contaminated with radioactive material are to be segregated by nuclide and chemical compatibility and discarded into appropriately labeled puncture and leak proof containers.
        - When the container is full, the sealed puncture and leak proof containers are to be labeled with the radioisotope, activity and weight with the completed waste form attached.
    - After properly packaging the material for disposal, contact LS to arrange for pickup.

Procedures to be followed by the RPS:

Wastes which are not properly identified by the user/generator will not be collected for disposal.

1. Inspect the packaging of the liquid waste offered for disposal in accordance with the criteria and packaging requirements listed above. Ensure that each package is dated and labeled with the radioisotope and the PI's name. Add the waste Control # to the package and form.
2. Review the completed Form DHS-014, "Request for Disposal of Radioactive Materials". Ensure the form is signed and complete, with all necessary information provided.
3. During the transfer of waste that can contaminate any nearby materials, especially gamma emitters or high energy beta emitters, use a properly shielded waste transport container.
4. Transport the collected wastes to the Radioactive Waste Facility while awaiting analysis and/or disposal.

5. All “Request for Disposal of Radioactive Materials” forms are maintained in LS.
6. Notify the Laboratory Safety Specialist whenever any collected Radioactive Waste meets the EPA criteria of a Mixed Low Level Radioactive Waste.
7. Every bulk liquid waste container must be sampled prior to disposal, as required by the current regulations and vendor requirements.

Procedures for Sampling Liquid Radioactive Waste

Aqueous and Non-Aqueous Liquid Waste Containing Beta emitters, with $E_{max} \leq 2.0$ MeV:

1. Obtain a 1.0 ml graduated pipette, pipette control, a scintillation vial.
2. Pipette 1.0 ml of the radioactive liquid to be assayed into the scintillation vial using the pipette control. Add an appropriate amount of scintillation fluid to the vial (typically enough to fill the vial to 50 to 100% of its rated capacity), cap and label the vial.
3. Count the sample with a suitable LSC program for the radionuclides to be assayed.
4. Collect the data as the information becomes available.

Aqueous and Non-Aqueous Liquid Wastes Containing Beta Emitters, with $E_{max} \geq 2.0$ MeV:

1. Obtain a 100 lambda λ (100 µL) micropipette and control, a 1-inch planchet, a scintillation vial containing 1 to 10ml of the sample to be assayed.
2. Measure 100 lambda (100 µL) of the assay liquid onto the center of the planchet. Evaporate the liquid under a heat lamp in the hood of an approved Radioisotope Lab.
3. The uncovered planchet, background, and an appropriate standard are to be counted in an appropriate proportional counter at the center of the alpha-beta plateau for approximately five to ten minutes each.
4. Collect the data as the information becomes available.

Aqueous and Non-Aqueous Liquid Wastes Containing Gamma Emitters that cannot be counted by LSC:

1. Obtain a 1.0 ml graduated pipette, pipette control, a scintillation vial.
2. Pipette 1.0 ml of the radioactive liquid to be assayed into the scintillation vial using the pipette control. Add an appropriate amount of scintillation fluid to the vial (typically enough to fill the vial to 50 to 100% of its rated capacity), cap and label the vial.
3. The uncovered planchet, background standard, and an appropriate standard are to be counted with a three inch Na (Tl) I Scintillation Detector for a period long enough to give good statistics (about 4 minutes) each at the appropriate gamma plateau and discriminator setting for the nuclide of interest.
4. Collect the data as the information becomes available.

Aqueous and Non-Aqueous Liquid Waste Containing Alpha Emitters:

Note: Alpha emitters can be counted using a LSC as shown in the procedure given in SOP-7, if the radioisotope meets the requirements given in that section. If the radioisotope cannot be counted in a LSC, the following procedure can be used.

1. Obtain a 1.0 ml graduated pipette, pipette control, a scintillation vial.
2. Pipette 1.0 ml of the radioactive liquid to be assayed into the scintillation vial using the pipette control. Add an appropriate amount of scintillation fluid to the vial (typically enough to fill the vial to 50 to 100% of its rated capacity), cap and label the vial.
3. The uncovered planchet, background standard, and an appropriate standard are to be counted in a proportional counter at the center of the alpha plateau, for a period long enough to give good statistics (about five minutes each).
4. Collect the data as the information becomes available.

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SOP-10
PROCEDURES FOR SANITARY SEWER DISPOSAL OF RADIOACTIVE MATERIALS

- The Radiation Protection Specialist (RPS) is responsible for the collection and disposal of all aqueous liquid radioactive waste.
- The Radiation Safety Manual does not permit Lab Supervisors to perform independent sanitary sewer disposals.
- All aqueous liquid radioactive waste is disposed of in a dedicated sink clearly marked with "Caution Radioactive Material" tape, located in the Radiation Storage Facility.

Requirements for Liquid Waste Submitted for Disposal:

- The liquid waste must be assayed for the level of radioactivity. Copies of the results must remain with the waste container through the final disposal.
  - For unknown waste activities, SOP-9 Radioactive Liquid Waste: Procedures for Sampling Liquid Radioactive Waste will be followed and results recorded on Form DHS 33 "Alpha/Beta/Gamma Counting Record."
- The liquid waste must be readily soluble, or readily dispersible biological material in water.
- The liquid waste should not contain any element or compound that exceeds the EPA Toxicity Characteristic Leaching Procedure (TCLP) limits for wastewater.
- Liquid waste containing alpha emitters will not under any circumstances be disposed of into the sewage system.
- The liquid waste disposed of via the sewage system will be recorded on the Sewer Disposal of Aqueous Radioactive Waste spreadsheet.

Procedures to be Followed by the RPS:

Only liquid radioactive wastes that have been accepted by the RPS and meet ALL of the requirements as listed above can be processed for disposal.

1. Proper PPE must always be worn when preparing for a sanitary sewer disposal (lab coat, gloves, safety glasses, and dosimetry).
2. Waste container to be disposed of should be moved to the far left side of the work bench and placed in metal tray with absorbent. (Ensure that jugs are not leaking and/or punctured)
3. To ensure pipes are clear and flushed, allow water to run 2-3 minutes prior to beginning disposal. Check that pipe is not leaking and metal tray lined with absorbent is under sink.
4. Check power and operability of Variable Speed Peristaltic pump BEFORE inserting tubing into waste containers. Tubing should be primed each day of use by running water through the tubing to ensure connections are snug and not leaking.
5. Once tubing has been primed, slowly remove cap of jug. (Never stand directly over open containers of liquid waste. Appropriate PPE must be worn when handling waste with inhalation hazards).
6. With peristaltic pump OFF, insert tube with yellow indicator tape into the liquid, placing it at the bottom of the container. The tube with white indicator tape should be placed directly over drain.

7. The peristaltic pump is set at a speed of 80 and should always remain in a metal tray lined with absorbent.
8. Turn peristaltic pump ON and allow liquid waste to pump into sink drain with running water. Allow water to run 5-10 minutes after disposal.
9. Empty containers will be crushed and placed in radioactive waste bags and processed as solid waste.
10. Document liquid waste disposed of including:
    - o Name of Person Conducting Disposal
    - o Date Received
    - o Date/ Time of Disposal
    - o Control Number
    - o Activity
    - o Volume
11. Calculate and record the total quantity of radioactive material that is released into the sanitary sewer. If more than one radionuclide is disposed of, the fraction of the limit must be determined.
    - To determine the fraction of the limit, divide the actual monthly average concentration of each radionuclide released into the sewer by the concentration of that radionuclide listed below (MAC). The sum of the fraction cannot exceed unity (100%).
12. Wipes will be performed at the end of any week liquid waste was disposed and results documented.

Monthly Average Concentrations (MAC) for Sewer Disposal

Radioisotope	Activity
Hydrogen-3	1E-2 µCi/mL
Carbon-14	3E-4 µCi/mL
Iodine-125	2E-5 µCi/mL
Iodine-131	1E-5 µCi/ml
Phosphorus-32	9E-5 µCi/ml
Sulfur-35	1E-3 µCi/ml

Annual Average Limits for Sewer Disposal

Carbon-14	1 curie (37 gigabecquerels)
Hydrogen-3	5 curies (185 gigabequerels)
All radioactive Materials Combined	1 curie (37 gigabecquerels)

*NRC Table 3 of appendix B to part 20

Analysis of Sewage Treatment Plant Sludge for Radioactivity:

1. The Sewage Treatment Plant Sludge pile is analyzed quarterly by the RPS, when liquid disposal has occurred during that quarter. When the sludge bed is full and dry, at least 3 samples will be collected from different parts of the sludge bed.
   - 1 gram of dried sludge is added to each 20 ml scintillation vial.
2. Tissue solubilizer is added to the samples to homogenize the sample. The sample will be monitored and vortexed until the sample is uniformly homogeneous.
3. An appropriate amount of scintillation fluid is added and the vial is vortexed until the mixture is homogeneous.
4. The vials will be dark adjusted and then counted for at least 60 minutes using a protocol with the appropriate settings for the isotopes disposed of via the sewer (typically H-3 and C-14) during that quarter.
5. The results of the assay will be recorded.

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SOP-11
RADIOACTIVE SOLID WASTE

- The Radiation Protection Specialist (RPS) is responsible for the collection and disposal of all radioactive waste and associated materials.
- Wastes which are not correctly identified by the user/generator will be returned.
- Any Dumpster disposal of Radioactive Waste by laboratory personnel is strictly prohibited.
- The weight limit for a solid waste bag is 25 pounds.

Procedures for Generators of Solid Waste:

1. Solid radioactive wastes must be collected in the yellow Radioactive Waste bags provided by Laboratory Services (LS). Bags should be securely closed with zip ties. The "Radioactive Materials" tag attached to the container must be completed, including:
    - Material I.D. (Radioisotope),
    - Principal investigator (PI) or an appointed designee, and,
    - Current Date
2. Form DHS-014, "Request for Disposal of Radioactive Materials" must be completed, submitted to the RPS (Campus mail, hand delivered, fax 5480), and approved prior to waste collection.
3. The radioactive liquid waste description must include the following information: Chemical components of the waste, and, Relative amounts of any chemicals present in the waste, identified +/- 1% of the total volume.
4. Radioactive-Biological Waste which is pathogenic or infectious must be autoclaved or disinfected prior to disposal.
5. Solid radioactive waste must be segregated by radionuclide and chemical compatibility (if applicable)
    - Use separate waste containers for Organic (burnable) Waste and Inorganic (Metals, Glass, etc.) waste.
    - Solid waste containers offered for disposal must not contain standing fluids.
    - Solid waste plastic bags are to be filled no more than 75% full to allow for adequate closure.
    - Sharp objects, puncture hazards, and broken glass are to be packaged separately from burnable and other non-burnable wastes, segregated by nuclide, and contained in a puncture and leak proof sealable container.
6. Containers offered for disposal must be clearly labeled with a "Caution - Radioactive Material" tag, including generator name, radionuclide and date.
7. After properly packaging the material for disposal, contact LS to arrange for pickup.

Procedures to be followed by the RPS:

1. Inspect the packaging of the solid waste offered for disposal in accordance with the criteria and packaging requirements listed above.
    - Ensure that each package is dated, and labeled with the radioisotope and the PI's name.

- Add the waste Control # to the package and form.

2. Review the completed Form DHS-014, “Request for Disposal of Radioactive Materials”. Ensure the form is signed and complete, with all necessary information provided.
3. During the transfer of waste that can contaminate any nearby materials, especially gamma emitters or high energy beta emitters, use a properly shielded waste transport container.
4. Transport the collected wastes to the Radioactive Waste Facility while awaiting analysis and/or disposal.
5. All “Request for Disposal of Radioactive Materials” forms are maintained in LS.
6. Notify the Laboratory Safety Specialist whenever any collected Radioactive Waste meet the EPA criteria of a Mixed Low Level Radioactive Waste.

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SOP-12
DECAY IN STORAGE PROCEDURES

Properly packaged Solid and Liquid Radioactive Wastes, may be held for decay in storage in accordance with the Regulations for Control of Radiation in Mississippi.

- All radioactive waste held for decay in storage will be held for a minimum of 10 half-lives. Only wastes with a half-life of <120 days will be held for decay in storage.

- Before disposal as normal waste, the radioactive waste, which was held for decay in storage, shall be surveyed to determine that the radiation level of the waste cannot be distinguished from background with a typical low-level laboratory survey instrument.

- All radiation labels will be removed or obliterated before waste is disposed of as normal waste.

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SOP-13
PROCEDURES FOR PERSONNEL DECONTAMINATION

- The Radiation Protection Specialist (RPS) must be notified immediately of any incident involving personnel contamination regardless of the radionuclide or activity.
- Radiation surveys should be performed to locate contamination on the body. A background reading should be obtained prior to performing surveys.
- Form DHS-129 "Personnel Contamination Report," must be completed and submitted to the RPS. Records will be maintained at Laboratory Services (LS).
- All personnel who have undergone decontamination procedures are required to report to the Student Health Service for a checkup by a physician before returning to normal activities.
- Save all materials used, including water, for disposal as radioactive waste.

Procedures for Skin Contamination:

1. Notify RPS immediately whenever any case of skin or body contamination occurs.
2. Record all required information on Form DHS-129 "Personnel Contamination Report."
    - Name of the Individual Requiring Decontamination
    - Date of the Incident
    - Location of the Incident
    - The time the contamination was discovered
    - Isotope(s) involved
    - Exposure and Decontamination Time
    - Surveyor Name and Instrument Used
    - Location(s) of Contamination
        - Including approximate size
        - Activity
    - Initial survey meter reading.
3. Remove and collect any contaminated clothing.
4. Wash skin using mild soap and warm water for 2-3 minutes. Do not scrub skin or use hot water. *If an individual has visible breaks in the skin, do not perform decontamination – immediately escort the person to Student Health Services.
5. Measure and record the count rate after the initial attempt at decontamination. Survey and repeat decontamination until the count rate cannot be reduced any further.
6. If the skin becomes irritated, or the individual feels ill, discontinue decontamination, and immediately escort the person to Student Health Services.
7. When decontamination efforts are not immediately successful, often a substantial reduction in count rate is achieved during the next 24 hours with periodic washings with soap and water, combined with normal flaking of the skin.

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SOP-14
PROCEDURES FOR DECLASSIFICATION OF EQUIPMENT AND WORK AREAS

- Notify the Radiation Protection Specialist (RPS) in writing of the intent to declassify any equipment or any location authorized for radioisotope use.
- Radiation surveys and/or wipe tests will be collected and a detailed contamination survey of the area of interest will be completed in accordance with SOP-6, “Procedures for Performing Radiation Surveys”.
- The RPS will schedule a declassification survey after surveys and wipes have been performed by the Supervisor.
- Consult the RPS for proper transport and storage of all sources of ionizing radiation PRIOR TO REMOVAL.
- Surveys and maintenance of records performed for declassification are the responsibility of the lab supervisor.
- The RPS will retain copies on file in Laboratory Services (LS) in the binder labeled “Declassification of Rooms and Equipment.”

Procedures for Declassification of Equipment:

1. Equipment which is to be released from restricted use in a radioisotope use location must be thoroughly cleaned and inspected by the area supervisor.
2. The area supervisor will conduct a surface contamination and radiation level survey of the equipment in accordance with SOP 3, “Procedures of for Performing Radiation Surveys.”
3. Upon satisfactory completion of the supervisor’s survey(s), the supervisor will notify the RPS that the equipment is ready for declassification, providing the RPS with:
    a. Name and Department of Lab Supervisor submitting request
    b. Equipment Name
    c. Model and serial number of the item (if applicable)
    d. UM I.D. number of the item (if applicable)
    e. Current location of the item
4. Loose surface contamination levels must fall below the applicable levels contained in Table 1 below, and the radiation level must be at or below background in order for the item to be declared declassified.

Table 1

Radiation Type	Activity Level (dpm/100cm²)
Alpha	22
X-ray, Beta or gamma	220

5. The results of the surveys will be recorded on Form DHS-65, “Declassification of Rooms and Equipment Used with Radioactive Material.” The survey and wipe results will be maintained including diagram of surveys collected.

6. If the equipment being declassified meets the criteria specified in Table 1, all radiation symbols, associated labels and laboratory signs should be removed. The equipment should immediately be removed from any authorized location where radioactive materials are used, stored, or handled.

Procedures for the Declassification of Locations:

1. Locations authorized for radioisotope use which are being declassified must have all sources of ionizing radiation removed from the location and transported for storage and/or use in another location with radioisotope authorization.
2. After all sources of ionizing radiation are removed, detailed contamination and radiation surveys of the entire location and its contents are performed by the supervisor.
3. Upon successful completion of the radiation and contamination surveys performed by the supervisor, notify the RPS that the location is ready for declassification.
4. Follow steps 4 through 6 as listed above.

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SOP- 15
PROCEDURES FOR DOSIMETRY

- Personnel will be required to wear an appropriate monitoring device (Dosimeter) when any of the following apply:
  - Working with or around unsealed, high energy beta or any energy gamma emitters
  - Working with or around radiation generating devices
  - All personnel who may be exposed to neutrons are required to have a neutron dosimeter or a combination β, γ, n dosimeter.

- All dosimetry badges are collected and processed on a quarterly basis.

- The Radiation Protection Specialist (RPS) will provide an annual report to each individual monitored under Rule 1.4.18 of the dose received in that monitoring year if:
  a. The individual's occupational dose exceeds 1mSv (100mrem) TEDE or 1 mSv (100 mrem) to any individual organ or tissue; or
  b. The individual requests their annual dose report.

- Any exposure that exceeds the dose limits as specified in the Radiological Safety Manual, will be reported to the Research and Environmental Compliance Officer and to the Division of Radiological Health as specified in Rule 1.4.55 and Rule 1.4.56.

- The Research and Environmental Compliance Officer will take any immediate action deemed appropriate to remedy the situation in consultation with the Mississippi State Department of Health.

- Exposure records on all personnel will be maintained as permanent records.

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ANNUAL REPORT OF RADIATION EXPOSURE OF PERSONNEL

This report is furnished to you in accordance with Rule 1.10.4(2)(a)(b) of the Regulations for Control of Radiation in Mississippi. Please retain the original for your records. Sign, date and return the second copy to this office.

MONITORING PERIOD: _____ to _____

NAME_____ SOC. SEC. #_____

TOTAL DEEP DOSE THIS PERIOD: _____mRem.

TOTAL SHALLOW DOSE THIS PERIOD:_____ mRem.

TOTAL ACCUMULATED DEEP DOSE: _____mRem.

TOTAL ACCUMULATED SHALLOW DOSE:_____ mRem.

BADGE TYPE(S):_____

DATE:_____ _____
Radiation Protection Specialist

By my signature given below, I acknowledge receipt of this radiation exposure report.

DATE:_____ _____
Signature

Form DHS-87

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P.O. Box 1848 | University, MS 38677-1848 | (662) 915-5433 | Fax (662) 915-5480 | http://safety.olemiss.edu

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SOP-16
PROCEDURE FOR I-125/131 THYROID BIOASSAYS

- Thyroid bioassays are required of individuals involved in the use of I-125 and/or I-131. Bioassays are performed to determine if an intake occurred in the thyroid during the handling of the radioactive iodine.
- A baseline bioassay is required on all individuals before beginning work with radioactive iodine.
- Routine bioassays will be performed quarterly by the Radiation Protection Specialist (RPS) per NUREG 8.20. Bioassays will be performed at Laboratory Services (LS) unless otherwise specified by the (RPS).
- Results of bioassays performed will be documented on Form DHS-80 "Bio-Scan Report for I-125/I-131." All records will be maintained in LS.

Procedures for Obtaining the Efficiency of the Instrument:

A calibrated Ludlum Model 2200 scaler meter with a sodium iodide probe is used to perform the thyroid scan. This meter has an approximate I-125 efficiency of 1.4% in a standard thyroid phantom, a structure of Lucite designed to have similar geometry of a human neck.

1. Set the window to detect emissions for the radionuclide of interest.
2. Hold probe on thigh and count for at least 1 minute. Record Results on Form DHS-80.
3. A standard of known activity will be used to determine instrument efficiency. When assaying for I-131, an I-131 standard (or a standard source of approximately the same energy as I-131, i.e., Ba-133) will be used. For I-125, an I-129 standard source will be used.
4. The standard is placed in a thyroid phantom. The probe is held against the thyroid phantom for 1 minute. The count results are recorded on Form DHS-80.
5. To Determine System Efficiency, the following steps should be followed:
   Standard CPM x Correction Factor- Background CPM = Net Standard CPM
   Standard Activity(µCi) 2.22 x E6 DPM/µCi

$$\frac{\text{Net CPM (0.754 correction factor)} \quad X \quad 100}{\text{Standard Activity (0.77 µCi)} \qquad 2.22E6\ \text{DPM/µCi}} = \_\_\_\_\_\%\text{Efficiency}$$

Procedures for Measuring the Thyroid Gland:

1. Measurements should always be counted on the slow setting and performed in a low-background area.
2. Hold probe on thigh for a count. Record results as background.
3. Hold probe in the center of neck for 1 minute. Record results.
4. Subtract background from thyroid count to obtain net counts.
5. Calculate and record the results on Form DHS-80.

6. In the event that results indicate the limits established have been exceeded, the RPS can restrict the employee's further handling of I-131 or I-125 until the thyroid burden is measured to be below the reporting limits.

Limits for Thyroid Bioassays

1.2 µCi	Evaluation Level (.02 of ALI)
6 µCi	Investigation Level (.1 of ALI)

***The Annual Limit of Intake (ALI) is 60 µCi**

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SOP-17
BIOASSAY OF URINE FOR H-3

For personnel requiring indirect bioassay for H-3, Laboratory Services (LS) will provide a one liter plastic bottle for collection of the urine. A minimum of 500 ml of urine will be required for the assay.

The collected urine will be returned to the Radiation Protection Specialist (RPS) for analysis. The following information is to be listed on the container label:

- Full name
- Social security number
- Date of exposure
- Date of the urine sample
- Work location

Procedure for urine sample by the Radiation Protection Specialist (RPS):

1. Approximately 150 ml of urine with boiling chips added will be transferred to a 250 ml boiling flask equipped with a reflux condenser and a Barrett trap. The urine sample will be distilled with approximately 20 ml of the distillate being collected in the Barrett tap. After the distillate has cooled to room temperature, exactly 5 ml will be transferred to a scintillation vial. Approximately 20 ml of scintillation cocktail will be added.

2. The procedure listed above will be repeated for a second time on the same urine sample, to provide for duplicate analyses.

3. A bio-blank will be prepared containing exactly 5 ml of distilled water and approximately 20 ml of scintillation cocktail.

4. The two sample vials, bio-blank and the six quenched H-3 standards will then be counted in a liquid scintillation counter for 60 minutes using Protocol # 5.

5. The dpm/ml for the urine samples will be converted into μCi/ml and μCi/liter (see SOP-20). The results of the analysis will be reported on "Bioassay of Urine for H-3," form DHS-79. This report will be filed at LS.

6. If the urine is below the level to be considered radioactive, it will be disposed of in the University sanitary sewer system.

7. If the urine is of sufficient activity to be considered radioactive, it will be disposed of as radioactive liquid waste in a sanitary sewer disposal following SOP-10.

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BIOASSAY OF URINE FOR H-3

NAME:_____ DATE EXPOSED:_____

SOC. SEC. #:_____ DATE COLLECTED:_____

DEPARTMENT:_____ DATE ANALYZED:_____

RESULTS OF ANALYSIS

Sample #	Dpm/ml	μCi/ml	μCi/liter

ACTION TO BE TAKEN:_____

_____

_____

_____

Assayer:	Date:
Approved:	
RPS:	Date:

Form DHS-79

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SOP-18
PROCEDURES FOR SHIPPING RADIOACTIVE MATERIALS

- The Radiation Protection Specialist (RPS) is responsible for the shipping of all packages containing radioactive materials.
- A wipe will be performed on the outside of the package to determine the surface contamination level. This will be done according to the procedures given in SOP-6 specified under Procedures for Package Surveys by the RPS, for the type of isotope being shipped.
- For high energy beta emitters and any gamma emitters, a radiation survey will also be made at the surface of the package and 3 feet (1 meter) from the surface of the package. This will be done according to the procedures as referenced above.
- The results of the survey(s) will be recorded on and filed in Laboratory Services (LS).

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SOP-19
USE OF CAUTION SIGNS AND LABELS

The use of caution signs, labels and state postings are used in all radiation areas as specified in 10 CFR Part 20, Subpart J.

- The posting of laboratories and areas containing radioactive materials must be in accordance with 10 CFR Part 20.
- The posting of laboratories in which radiation producing devices are operated will be labeled in a conspicuous manner which cautions individuals that radiation is produced when it is energized in accordance with 10 CFR Part 20.
- The labeling of all radioactive containers will bear a “CAUTION, RADIOACTIVE MATERIAL” label and include the quantity of radioactive material, estimate of radioactivity, date for which the activity was estimated and kind of materials in accordance with the 10 CFR Part 20.
- The Mississippi State Department of Health Form No. 935, "Notice to Employees", the "Emergency Notification" and the "No Smoking, Eating or Drinking" signs must be posted in each area where radioactive materials or radiation producing devices are used.
- All appropriate signage is provided by Laboratory Services.