Appendix B: Recommended Procedures

Appendix B provides recommended procedures for tasks frequently performed in the laboratory. These procedures outline acceptable methods for meeting radiation safety requirements. The procedures are generic in nature, allowing for the diversity of research facilities, on campus.

Contamination Survey Procedures

Surveys are performed to monitor for the presence of contamination. Minimum survey frequencies are specified on the radiation permit. The surveys should be sufficiently extensive to allow confidence that there is no contamination. Common places to check for contamination are: bench tops, tools and equipment, floors, telephones, door handles and drawer pulls, and computer keyboards.

Types of Contamination

Removable contamination can be readily transferred from one surface to another. Removable contamination may present an internal and external hazard because it can be picked up on the skin and ingested. **Fixed contamination** cannot be readily removed and generally does not present a significant hazard unless the material comes loose or is present large enough amounts to be an external hazard.

Types of Surveys

There are two types of survey methods used: 1) a direct (or meter) survey; and 2) a wipe (or smear) survey.

Direct surveys, using a Geiger-Mueller (GM) detector or scintillation probe, can identify gross contamination (total contamination consisting of both fixed and removable contamination) but will detect only certain radioisotopes.

Wipe surveys, using "wipes" such as cotton swabs or filter papers counted on a liquid scintillation counter or gamma counter can identify removable contamination only but will detect most radioisotopes used at the university. Wipe surveys are the most versatile and sensitive method of detecting low-level removable contamination in the laboratory.

Survey Instrumentation

The portable **Geiger-Mueller (GM) survey meter** is best used for P-32, a high-energy beta emitter, and other high-energy beta and gamma emitters, such as Co-60, Zn-65, Cs-137, and U-238. A GM meter can also be used to identify areas heavily contaminated with lower energy beta emitters, such as C-14 or S-35, for which the GM meter has a relatively low efficiency.

GM meters should not be used to survey for I-125 contamination because they detect I-125 only when there are very high levels of contamination.

The portable thin crystal **NaI scintillation survey meter** should be used to locate I-125 contamination and to conduct surveys around low-energy X-ray sources such as X-ray diffractometers and electron microscopes.

The **liquid scintillation counter**, used for counting wipe tests, is the most versatile counting instrument because it has a high counting efficiency for a wide range of radionuclides. Most LSCs provide a printout of sample results that may be used as survey record.

Gamma counters are not portable and are used to count swipes of photon emitters such as Cr-51 or I-125.

How to Perform a Meter Survey

Prior to performing any survey, clean gloves should be worn. This prevents the possibility of personal contamination or cross-contamination.

Perform an instrument check. To check the operation of a survey instrument, do the following:

1. Calibration check:
   Check the calibration label on the instrument and ensure the instrument is within the calibration period. If the calibration due date has passed, contact DRS to have the instrument re-calibrated and find another instrument to use.
   .
2. Battery check:
   Turn the switch on the survey meter to "BATTERY," or flip the battery switch to "ON." The needle on the meter face should move to a position within or beyond the indicated area on the meter face scale. Replace batteries if needed before using the survey meter.

3. Speaker check:
   If there is an audio switch on the survey meter, turn it to "ON." Set the survey meter to a scale of "X1." The survey meter should chirp or click. If the speaker does not function, the survey meter can be used, but the surveyor will need to check the reading on the survey meter face frequently.

4. Background check:
   Go to an area with an expected low background rate. Note the count rate when the survey meter is switched to the "X1" scale. The background rate for a GM meter should be less than 100 counts per minute; the background reading for a NaI meter should be less than 400 counts per minute. If background readings exceed these levels, investigate the area for unknown sources of radiation or detector contamination. Do not use the survey meter if it does not register a background rate.

5. Instrument response check:
   Hold the supplied check source (often a thorium lantern mantle) up to the probe window. Note the counting rate. The survey meter should respond to the check source, thus providing positive indication that the instrument is functioning properly.

Do not cover the probe surface with parafilm or other protective coating. Parafilm and similar materials will shield the low energy betas from C-14, P-33, and S-35 and may prevent the meter from detecting contamination.

Hold the probe window approximately 1 cm from the surface to be surveyed and move the probe over the surface at about 1 cm/second.

Check the most common sites for contamination, such as survey meter handle, soap/towel dispensers, drawer handles, refrigerator/freezer handles, chair edges, writing utensils, survey record books, floors, radio dials, telephone receiver/keypad, microwave oven touch pads/handles, doorknobs, light switches, and non-radioactive trash containers.

Record survey results in a survey log (see Appendix E). Obtain several background readings and record the highest result. Next, complete the survey. If survey results are equivalent to the background, log the result as '≤ BKG'.A surface may be considered contaminated if the result is greater than the background count rate. If contamination is found, record the result and indicate the action taken. Once corrective actions have been taken, perform another survey of the area until the contamination is within the range of highest background results.

How to Perform a Wipe Survey

Prior to performing any survey, clean gloves should be worn. This reduces the likelihood of personal contamination or cross-contamination.

Removable contamination is best identified by a wipe survey, which is performed by rubbing a filter paper (approximately 45 mm in diameter) or cotton swab over the survey area with moderate pressure. The paper or swab may be wetted with ethanol or water to increase the collection efficiency. Usually an area of 100 square centimeters (4 in. X 4 in.) is surveyed. To monitor a larger area, take additional swipes.

If surveying for low-energy beta emitting isotopes such as H-3, C-14, P-33, and S-35, analyze the wipe using liquid scintillation counting.

If surveying for high-energy beta emitters (e.g., P-32), wipe samples may be counted using either liquid scintillation counting or a GM meter.

If monitoring for low-energy gamma emitters (e.g., I-125), wipe samples should be counted with a thin crystal NaI scintillation meter.

The *net sample count rate* is determined by subtracting the background count rate from the gross count rate.

Sample activity is determined by dividing the net sample count rate by the instrument's efficiency for the isotope in question.

Survey results must be documented on a survey log (see Appendix E) or similar form. Results may be reported as *gross count rate, net count rate*, or in units of *activity* (usually *disintegrations per minute*). Ensure that the survey log accurately reflects how results are being reported. Similar to a meter survey, if the result(s) is (are) above the highest background sample the contamination will need to be cleaned. Re-survey to confirm effectiveness of the cleanup of contamination. If the contamination cannot be effectively removed contact DRS.

Personnel Dosimetry

The use and type of personnel dosimetry is determined by the activities and functions the individual performs. By regulation, any person who receives or is likely to receive more than 10 percent of the maximum permissible dose or who enters a high radiation area must be provided with and must wear personnel monitoring devices.

To enroll in dosimetry services, complete a *Dosimetry Request Form* (see Appendix E) and return it to DRS. Upon receipt, DRS personnel initiate the request process with the dosimetry services vendor. The turnaround time is typically one week for a rush order. Therefore, ensure dosimetry requests are made in advance of the need to work with radioactive materials. Note that dosimetry is not issued for individuals working with weak beta-emitting radionuclides such as H-3, C-14, P-33, and S-35.

Whole body dosimeters, or badges, monitor exposure to the whole body and should be worn between the neck and the waist, usually on the front of the body.

Finger ring dosimeters monitor radiation exposure to the hands and fingers. These dosimeters may be worn on any finger and should normally face the palm side of the hand. Finger rings must be worn under gloves to prevent them from becoming contaminated.

Every person with assigned dosimeters must wear the badges and/or ring dosimeters when working with sources of ionizing radiation.

The dosimeter reading is the legal record of an individual's occupational radiation exposure. Therefore, dosimeters shall be worn only by the individual to whom it is assigned, shall not be tampered with or experimentally irradiated, and shall not be used to measure radiation exposure received as a medical patient.

When not being worn, dosimeters must be stored in a location where they will not be exposed to radiation.

Dosimeters are collected monthly or quarterly by DRS personnel and sent to a vendor for processing. Dosimeters must be made available for this exchange to occur.

If a dosimeter is lost, discontinue radiation-related activities and contact DRS. Individuals who have lost a dosimeter must provide information to DRS personnel so that an assessment of their radiation exposure can be performed. DRS will order a replacement dosimeter.

Declaration of Pregnancy

The increased sensitivity of rapidly dividing cells makes the human embryo and fetus particularly susceptible to injury from exposure to ionizing radiation. For this reason, regulations require that exposure to the fetus during the gestation period not exceed 500 millirem (5 mSv). Recommended reading for pregnant female radiation workers is provided in Appendix E.

Any radiation worker who is pregnant or believes that she may be pregnant should contact DRS and review the recommended reading in Appendix E. All inquiries will be confidential. The individual must complete a *Declaration of Pregnancy Form* (see Appendix E). If a written declaration of pregnancy is not submitted, then the worker's dose continues to be controlled under the normal dose limits for radiation workers.

For the type of radiation work performed at the University of Illinois, it is rarely necessary to recommend reassignment or changes to job duties to reduce exposure.

Radioactive Waste Contents Tags Procedure

Radioisotope users are requested to complete waste content tags prior to requesting a pickup of radioactive waste by DRS. Each bag of dry waste or carboy of liquid waste should have a tag attached to it.

Instructions on filling out the tags:

Please print legibly and press hard.

LAB SUPERVISOR: Enter the name of the Radiation Permit Holder.

PERMIT NO.: The Radiation Permit Number.

LOCATION: The building and room number where the radioisotope laboratory is located.

PHONE NO.: The Principal Investigator's office phone number.

DATE SEALED: The date that the container was finally closed after filling.

DRY/LIQUID WASTERADIOACTIVE SHARPS: Indicate whether the waste is in solid, liquid, or sharps disposal container form. If the waste is liquid waste, specify the volume in liters. If the waste is in sharps disposal container form, specify the size of the container on the Cont. # line.

ISOTOPE/ACTIVITY: Indicate the isotope and an estimate of the activity (in mCi). Use separate lines for multiple isotopes. Activity for liquid organic waste must be determined by liquid scintillation counting. Activities given for dry waste should be as accurate as possible. All activities should be decay-corrected if applicable.

BACKGROUND CPM/CONTAINER CPM: The outside of all containers must be surveyed to ensure that container exteriors are free of removable contamination. Moisten a piece of filter paper or a cotton swab with water or alcohol. Wipe an area of approximately 100 square centimeters/per wipe (4 in. X 4 in. /per wipe) along the outside surface of the bag or container. Multiple wipes may be required for larger containers. Record the background cpm as the count rate from the instrument without radioactive materials present. Record the container cpm as the net count rate (gross cpm – background cpm). The container cpm should be less than two times the background count rate. If it is not, either decontaminate the outside of the bag or place the contaminated bag inside a clean bag and re-survey.

If the bag contains H-3, C-14, or S-35, swipes must evaluated by liquid scintillation counting. Wipes for I-125 should be counted with a NaI detector. Wipes for P-32 should be counted on a GM detector. Other radionuclides should be counted using appropriate instrumentation.

SIGNATURE: TAGS MUST BE SIGNED. The signature verifies that all of the information provided is correct.

DATE: Date that tag was completed.

Attach the completed tag to the container.

After waste has been properly prepared, logon to DRS website at:
http://www.drs.illinois.edu/regwaste/rad/index.aspx

Ensure that laboratory records are properly updated.

NOTE:

It is the responsibility of the laboratory personnel to comply with segregation, collection, packaging, and labeling requirements and to secure all wastes for removal from the laboratory. DRS will not handle any package that does not conform to the requirements of Section 8.0, Radioactive Waste" or which, in their opinion, may present a safety hazard to waste-handling personnel or members of the public. Containers/packages of waste that are not properly packaged and labeled must be promptly corrected.

Records Required in the Radiological Laboratory

DRS personnel periodically audit and survey U of I radiological laboratories. The following are expected to be readily available for inspection:

- Laboratory survey records;
- Radioactive material inventory and use records; and,
- Radioactive waste records (solid and liquid). Sewer disposal records can be kept either in the laboratory logs or in DRS database.

If the forms in Appendix E are used, accurately completed, and maintained, no findings of non-compliance should occur during DRS audits of work with radioactive materials. Printouts from automatic counters such as a liquid scintillation counter may be attached and used as a survey record if the sample numbers correspond to survey locations. Records must be maintained by the PI for as long as the radiation permit is active.

DRS personnel perform independent laboratory contamination surveys and audits of laboratory records. The survey and audit results are sent to the PI via campus mail when completed and approved. The following two pages are the forms that Division of Research Safety personnel use to document the results of these surveys and audits.

EXAMPLE

University of Illinois at Urbana-Champaign
Division of Research Safety
Radiation Safety Section
102 EHSB, 101 S. Gregory St., U MC-225

RADIATION SAFETY SURVEY REPORT

Supervisor:	Permit No:
Office:	Performed by:
Survey Date:	

Labs

Building	Room

Survey Results

Location	Direct (cpm)	Swipe DPM (per 100 cm^2)	Exposure (mR\h)

Instruments used in this survey:
Instrument:
Instrument:
Instrument:

EXAMPLE

Illinois

University of Illinois at Urbana-Champaign

Division of Research Safety
Radiation Safety Section
102 EHSB, 101 S. Gregory St., U MC-225

RADIATION SAFETY AUDIT REPORT

Supervisor:	Permit No:
Office:	Performed by:
Lab(s):	Audit Dates:

Status: Satisfactory, Unsatisfactory, Not Applicable, Not Checked

1. Weekly contamination surveys performed when material in use?	
2. Are calibrated instruments available for contamination surveys?	
3. Are inventory, use and waste records up-to-date?	
4. Are there caution signs and employee notices?	
5. Do lab workers wear protective clothing, gloves, eyewear, footwear, etc?	
6. Is absorbent paper used on the benches?	
7. Are training records available for review?	
8. Are isotope areas and articles labeled?	
9. No mouth pipetting!	
10. No eating, drinking and cosmetic use!	
11. No improper food storage!	
12. Are shielding and handling devices in use?	
13. Is the lab locked or attended?	

Survey instruments calibrated (mfr., model, SN):
None calibrated

GENERAL LABORATORY SAFETY AUDIT

4. Is radioactive waste stored properly and labeled?	
15. Are current emergency posting at the entrance	
16. Are Chemical containers labeled properly?	
17. Are gas bottles properly secured?	
18. Are lab door windows unobstructed?	
19. Is housekeeping satisfactory?	
20. Are emergency shower/eyewash stations tested?	
21. Are emergency/eyewash stations accessible?	

Comments:.