Radiation Safety Office
California State University Long Beach
www.csulb.edu/cnsm/radiation

RADIATION SAFETY MANUAL HIGHLIGHTS

This document has been designed to serve as a "pocket" version of the CSULB Radiation Safety Manual (RSM). The list of key requirements outlined in this document may also refer to other specific CSULB procedures not contained in the RSM proper. Copies of the complete detailed procedures are available through the Radiation Safety Office.

Regulation of Radioactive Materials

The CSULB Radiation Safety Officer (RSO) and Radiation Safety Committee (RSC), in conjunction with CSULB administration, exercises control over all licensed radioactive material possessed by or used at CSULB. The exact requirements appear in each Authorized User's Ionizing Radiation Use Authorization (IRUA), which in turn sets limits and conditions as required by Title 17 of the California Code of Regulations, the University Radioactive Materials License, and the Code of Federal Regulations 10 CFR part 20. The CSULB Radioactive Materials License is issued by California's Radiologic Health Branch (RHB). The RHB inspectors audit our program regularly and they may arrive unannounced. They have the right to inspect all labs, ask questions of PIs and students etc. without prior notification or permission.

Acquisition and Transfer of Radioactive Materials

RSO/RSC authorization is required prior to ***each order*** of radioactive material. ***Each transfer*** of radioactive material between Users must be specifically approved IN WRITING by the RSO and ***recorded in the white Radiation Notebook on the appropriate "Stock Bottle Log" sheet***.

Custody of Radiation Sources

Users and their project workers are required to employ the following measures while in possession of radioactive materials:

1. Personal Safety

Storage and use of radioactive material must be such that personal radiation exposure and radioactive contamination are kept **As Low As Reasonably Achievable (ALARA)** by using the principles of time, distance, shielding, and good laboratory practice.

2. Security

Storage and use of radioactive materials must be in a manner that prevents unauthorized access. Radioisotope storage units (like refrigerators/freezers) must be kept locked when located in general access areas (such as classrooms). Labs where isotope is used or stored must be locked at all times.

3. Inventory

Each User is required to keep track of her/his radioactive material. Written inventory summaries are forwarded to the RSO each quarter. Each stock-bottle of radioactive chemicals has its own "Stock Bottle Log" sheet, kept in the white Radiation Notebook. Whoever takes ANY isotope out of the stock-bottle for any purpose (including transfers to other Users) must immediately record the amount taken on the log-sheet.

Radiation Safety Training

The radiation safety training and experience requirements for those affected by a User program are as follows:

1. Authorized Users

Users must have 40 hours relevant training and experience as required by state law. The User qualifications are reviewed by the RSC. An IRUA is granted only if applicant is qualified.

2. Radioisotope Project Workers

Each person (including unpaid students and volunteers) who actually handles radioactive material (including simply washing trace contamination from labware) must be given documented training described below.

a) *General Safety Training* (live or online CNSM Safety Training).

b) General radiation safety training as outlined in *"Minimum Training for Radioisotope Lab Personnel"* coupled with issue of a personal copy of this *"Manual Highlights"* document and the *"Reproductive Health Policy"*.

c) Radiation Safety Training in the form of reading the *CSULB Radiation Safety Manual* (available online).

d) *Project-specific safety training* for the actual manipulations conducted. This level of training is provided by the Authorized User or a skilled designee approved by the User.

3. Project Workers Who Do Not Handle Radioisotope

These are people who have routine unescorted access to radioisotope areas. Persons who do not use isotopes but work alone in a laboratory where isotopes are used or stored must receive a brief, documented radiation training session covering applicable topics referenced in *"Minimum Training for Radioisotope Lab Personnel"* (Radiation Safety Memo #10). This training is usually provided by the User, but any Radiation Worker may give this training.

4. Ancillary Personnel

(visitors, custodians, contractors, salespersons etc) who can be observed by a trained project worker while they are in the radioisotope area need no formal radiation safety training. When such persons are left alone in a radioactive materials area, they must given enough instruction to keep them safe. If they don't seem to understand, ***don't leave them alone***--you're responsible for their safety. If in doubt, call the RSO.

5. Refresher Training for Radioactive Material Users

Continuing education for IRUA holders and project workers is provided through periodic mandatory refresher training sessions, sponsored by the RSO/RSC. In addition, Users will conduct "Lab Meetings" for project workers.

Program Inspections

Each User program is subject to up to ***four formal RSO audits per year***. The inspection consists of an ***unannounced*** review of records, inspection of the facility/equipment, measurement of radiation fields/contamination, and interviews with the User and project personnel. The RSO inspection findings are documented and a copy is provided to the User. If points of non compliance are encountered, the User must take appropriate action and forward a written notice of correction to the RSO.

Radiation Dosimetry

The RSO/RSC dictates the dosimetry requirements (badges and rings) for each program. ***Dosimeters will not be issued to people using ^{3}H, ^{14}C, and ^{35}S (low-energy emitters)***. Use of dosimeters as stated on the IRUA is required. Personal dosimeters may NEVER be loaned to another individual. According to 10 CFR 20, radiation workers are allowed to receive a maximum annual dose of:

- 5 Rem (0.05 Sv) to the whole body (Deep Dose Equivalent)
- 15 Rem (0.15 Sv) to the lens of the eye (Lens Dose Equivalent)
- 50 Rem (0.5 Sv) to the extremities or skin (Shallow Dose Equivalent)

Surveys - Radiation Levels/Contamination

1. Experiment Surveys

An ***appropriate contamination/exposure survey (five sample points minimum) must be performed immediately after each experiment*** to demonstrate the absence of contamination. The ***meter survey and/or instrument print-out data must be immediately logged in the User's white Radiation Notebook.*** *Don't forget to write down which areas you surveyed*. Sample data must be expressed in DPM/100cm2 and be labeled on an accompanying map. Contaminated areas should be cleaned until the surveys show no more removable contamination; the repeat surveys must be documented. Instruments/areas allowed to be contaminated (e.g. tip of pipettor, hot spot on benchcote etc.) and/or sites with non-removable contamination must be labeled as described below. Survey procedures are as follows (see the white Rad Notebook, or lab "How To Do Contamination Survey" poster for details):

- **^{3}H**: No meter use; wipe 5 areas and count in the LSC, put printout in the white Rad Notebook.
- **^{32}P, ^{54}Mn, ^{60}Co**: survey slowly with the pancake GM probe, then log results in the white Rad Notebook.
- **^{35}S, ^{14}C**: find hot spots with the pancake GM probe; do not log these results! Wipe 5 areas and count in the LSC; put printouts in the white Rad Notebook.
- **^{125}I**: survey slowly with the cylindrical gamma probe, then log results in the white Rad Notebook.

- **^{109}Cd**: find hot spots with the cylindrical gamma probe; do not log these results! Wipe 5 areas and count in the gamma counter, put printout in the white Rad Notebook.

2. Monthly Surveys

Lab personnel must assist the PI in ensuring that ONE MONTHLY SURVEY is performed EACH MONTH for each room where isotopes were used. Only ONE person in each lab need perform this survey. Refer to the above survey instructions; the LSC must be used if 3H, 35S, 14C, 33P or 109Cd has been used even ONCE during the month. ***Five areas must be surveyed that are not normally checked during experiment surveys.*** **THIS SURVEY DOCUMENTATION MUST BE GIVEN TO THE RADIATION SAFETY OFFICE BY THE 20TH OF EACH MONTH.** California's Radiologic Health Branch has cited us in the past for missing *one* lab's monthly survey out of three years of surveys from 17 different labs.

LSC and Gamma Counter Use

You must wear gloves and a lab coat whenever you use the liquid scintillation counter/gamma counter. Even if you don't think that your samples contain radioactivity (i.e. lab wipes), the counter itself may be contaminated. Remember to sign the log, and write your name and the isotope identity (or "wipes" if appropriate) on the first vial in the rack. Unidentified vials will be removed from the counter and all primary investigators will be notified. Do not change the parameters of an existing program. You can customize your own program. Contact the Radiation Safety Office for details. If you must count for long periods, post a note on the LSC the day before.

Labeling Requirements for Radioactive Material

1. **All radioactive materials**, including labware, containers, waste bottles, refrigerators and any known/suspected contaminated equipment or work-area **MUST be fully labeled**. Each label must include:

    - Radiation symbol (magenta "propeller" on a yellow background)
    - Radioisotope(s) present
    - Amount of radioisotope present (milli or microCuries -- but Becquerels are O.K. too). You may indicate a maximum amount, like "< 1 mCi" (but don't do this on the waste log!).
    - Date the label was prepared (the date is inextricably linked to the Curie amount)
    - Name of the Professor is mandatory for waste containers and for radioactive materials used/stored in joint-use areas. *Your* name is used in all other cases.

2. **This label information must appear on EACH container/surface** as appropriate. The *ONLY exception* is when "hot" items are confined to a clearly outlined area such as a fume hood or an absorbent paper covered area which is properly labeled (yellow tape, rad sticker, Name, Date, Isotope, Amount).

3. **A yellow/magenta radiation symbol alone is ALWAYS INAPPROPRIATE!** (i.e. a flask with "caution Radioactive" tape and no other labeling). This is considered a label violation when found during audits. Remember: **Name, Date, Isotope, Amount!**

Operational Guidelines and General Work Rules

A set of common sense guidelines appears in the Appendix section of the Manual. ***Do employ these elementary rules:*** Keep the meter ON while working; incorporate ALARA in every operation; use "Double Containment" trays for stored radioactive liquids; wear your labcoat and gloves; wear your dosimeters; keep food and drink out of the lab; keep children out of the lab; do not mouth pipette; use a fume hood as needed.

Emergency Procedures

A step by step guide for notification, evacuation, containment, assessment, and clean up/decontamination procedures is outlined in the appendix of the Manual and posted in each area where isotope is used or stored. The User must be notified of any significant spill. The RSO must be notified if the incident cannot be adequately handled by trained program personnel; if a release of radioactive material outside of the authorized location has occurred or is possible; or if personal contamination or ingestion of radioisotope is known or suspected.

CSULB Radioactive Waste Policy

NO RAD STICKERS/LABELS & NO SHARP ITEMS IN TRASH

NEVER MIX THE FOLLOWING WASTE TYPES!! Each waste type has its own designated container and a corresponding waste log sheet. You MUST log your radwaste in microcurie (µCi) amounts (do not use the symbol "<") on the correct log sheet before you leave the lab. *Each different radioisotope in the waste must be given a separate entry on the log.* Call Radiation Safety Office at 562.985.5623 for a waste pick-up when the container is 4/5 full! *Sum microcuries for EACH nuclide on the log-sheet BEFORE CALLING THE RS OFFICE.*

Dry Solid Short ½ Life (<90 days)

YELLOW LOG SHEET

This includes 32P, 35S, 125I, 51Cr and 203Hg. No liquids, lead or other chemical or biohazardous materials are permitted in this waste. NO SHARP ITEMS ARE PERMITTED (like pasture pipettes or broken glass). Sharp items must be put in a rigid closed container of some type (NOT benchcote!) before placing in the waste drum. *MINIMIZE VOLUME! NO RAD STICKERS/LABELS!*

Dry Solid Long ½ Life (>90 days)

PINK LOG SHEET

This includes all other nuclides including, but not limited to, 3H, 14C, 57Co, 109Cd, 57&60Co. No liquids, lead or other chemical or biohazardous materials are permitted in this waste. NO SHARP ITEMS ARE PERMITTED (like pasture pipettes or broken glass). Sharp items must be put in a rigid closed container of some type (NOT benchcote) before placing in the waste drum. *MINIMIZE VOLUME! NO RAD STICKERS/LABELS!*

Aqueous Liquid (Mixed ½ Lives OK)
GREEN LOG SHEET

This waste consists of water-based solutions (alcohols, acetone, trichloroacetic acid, acetic acid, gel fixing/staining solutions etc.) in a bottle placed in a containment tray. Check with Radiation Safety before adding anything but water-based, biodegradable solutions to this waste-stream! KEEP BOTTLE CLOSED EXCEPT WHEN ADDING WASTE. DO NOT FILL MORE THAN 4/5 FULL – LEAVE SOME SPACE!

LSC Vials (Mixed ½ Lives OK)
BLUE LOG SHEET

This waste consists of tightly-capped scintillation vials containing LSC cocktail plus samples. These vials are usually stored in the original "flats".

Organic Liquid (Mixed ½ lives OK)
ORANGE LOG SHEET

RSO approval is required prior to generating this waste! This waste type consists of LSC fluid and flammable concentrations of acetone and other solvents or CHEMICALLY COMPATIBLE organic compounds such as phenol. Accumulate in a container placed in a tray or tub. KEEP CONTAINER CLOSED EXCEPT WHEN ADDING WASTE. DO NOT FILL MORE THAN 4/5 FULL – LEAVE SOME SPACE!

Animal Waste
WHITE LOG SHEET

This waste type consists of carcasses, tissue, blood, excreta etc. *Each project generating such waste and the disposition of the waste must be pre-approved by the RSO!* This material must usually be stored frozen or refrigerated. RSO approval must also be obtained before disposal by project personnel via the designated garbage disposal.

Unusual Items
Sealed sources/foils, uranium, thorium and consumer products (smoke detectors, anti-static devices, radium dials, etc) may not be put in any of the above waste containers. CALL THE R.S. OFFICE!

PLEASE NOTE: You must complete the attached worksheet and bring it with you when you arrange to take the Radiation Safety Test.

RADIATION SAFETY TRAINING WORKSHEET

NAME: _____ DATE: _____

Working With Stock Bottle, Making Secondary Stocks

Your Lab Supervisor has ordered and received 2,000 µCi of sulfur-35 in 1 ml buffer on 1/7/2015. You have been appropriately trained to handle concentrated stocks and have been tasked with producing a secondary "working stock" of the solution to use in subsequent experiments. You have been provided a "Radioisotope Stock Bottle Log", a "Secondary Radioisotope Stock Bottle Log", decay chart along with the Nuclide Safety Data Sheet for 35S.

1. Using the information provided above and below, completely fill out both Stock bottle log sheets;
    - Date of secondary stock preparation is 01/14/2015
    - Stock will contain 500 µCi in a final volume of 5ml water-based buffer.
2. Two weeks later, you plan to begin experiments with the secondary stock. On 1/28/2015 you need 100 µCi of isotope for your experiment. Fill out the secondary log sheet based on this information. Make sure to take decay into account.
    - What volume of the secondary stock will you need to remove to have 100 µCi?

Conducting an Experiment

You begin the experiment you planned in your lab. The meter is on and you are checking your gloves and working carefully. Using a disposable pipette tip and a pipettor, you withdraw the volume you calculated above containing 100 µCi of ^{35}S from the secondary stock bottle and place it into a disposable beaker containing a water-based solution. The final volume is 25 ml. Your beaker has a radioactive sticker on it.

1. How many µCi 35S per ml do you have in your solution?

2. When you finish your experiment, will you have aqueous radioactive waste or organic radioactive waste?

3. Where in the white Rad Notebook do you make sure there is record of the fact that you just took 100 µCi of ^{35}S out of the secondary stock bottle?

4. You put a radioactive sticker on the beaker - what did you write on the sticker?

You continue working. You add 75 ml of water to your solution. Using a disposable pipette, you put one ml of your final solution into a scintillation vial and count it in the LSC. You finish with your experiment and clean up. You pour off the solution into the radioactive waste bottle, and throw your disposables away as appropriate. You think that probably about 1 ml of your solution stuck to the sides of the beaker. You put your scintillation vial with the other waste scintillation vials from previous experiments. You immediately do a post-experimental survey.

1. What was the final concentration of your solution in µCi per ml?

2. How many µCi did you put into the scintillation vial?

3. What number did you write down in the “microcuries of waste” column on the Scintillation Vial Waste Logsheet?

4. Which waste log will you fill out for your radioactive dry-solid waste, “short-life radioactive waste” or “long-life radioactive waste”?

5. For the experiment, list each item you will throw away into the Radioactive Dry Solid trash, and how many microcuries (or fraction thereof, if any at all) of 35S you think each item is contaminated with:

6. When you log this waste onto the Radioactive Dry Solid Logsheet, will you list one number only (the total microcuries for all items) or list the microcurie amount item by item?

7. What did you do to the sticker on the beaker before you threw it away?

8. How many microcuries of radioactive liquid waste do you have?

9. Describe how you will perform and record your experiment survey.

10. The 10cm x 10cm area swipes you collected yield the following data in CPM:

Sample	CPM	DPM/100cm^2
Negative control	35	
RAM work surface	37	
Floor at work surface	252	
Pipettor	40	
Cehmmical fume hood	42	
Floor at fume hood	41	

Using the information above and the table provided on the following page, complete the table above by converting the sample data to the units of DPM/100cm2.

Counting efficiencies for various isotopes using Beckman™ LS 6500 Scintillation System

Isotope	Estimated Counting efficiency %
^{3}H	56*
^{14}C	95
^{32}P	98
^{35}S	95
^{109}Cd	50
^{125}I	77

*RS data using unquenched standard from Perkin Elmer.

- What will you do about the elevated result from the floor at the RAM work surface?

11. After your experiment, the dry solid waste is 80% full and you need a pickup. What do you need to do?

12. What would you write on an unlabeled bottle of hydrochloric acid (how would you label it)?