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**RADIATION**

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**SAFETY**

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**MANUAL**

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University of Hawaii

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## TABLE OF CONTENTS

	Page Number
Emergency Telephone Numbers	0-1
Preface	0-2
Introduction	0-4
Part I: Possession and use of radioactive materials	
A. Authorization	
1. Application	1-1
2. Approval	1-2
3. Amendments	1-2
4. Renewal	1-2
5. Inactive Status	1-2
6. Termination	1-3
B. Procurement of Radioisotopes	
1. Purchases (Forms & Procedures)	1-3
2. Deliveries of radioisotopes	1-3
3. Transfers	1-3
4. Record Keeping	1-4
C. Training	
1. Radiation Safety Office	1-4
2. Principal Investigator	1-5
II. Part II: Safe Handling & Use	
A. Laboratory Facilities	2-1

B. Laboratory Equipment	2-1
C. Fume Exhaust Hoods	2-1
D. Protective Clothing	2-1
E. Hygiene	2-1
1. Personnel	2-1
2. Pipetting	2-2
3. Lab surveys	2-2
4. Contaminated Area (defined)	2-2
5. Contamination Criteria	2-2
6. Decontamination (general procedures)	2-2
F. Security of Radioactive Materials	2-3
G. Storage & Use of Radioactive Materials	2-3
H. Safe Opening of Packages	2-3
Part III: Emergency Procedures	
A. Minor Spills	3-1
B. Major Spills	3-1
C. Injuries to Personnel	3-2
D. Fires Involving Radioactive Materials	3-2
Part IV: Waste Storage & Disposal	
A. Waste Storage	4-1
B. Waste Disposal	4-1
1. General	4-1
2. Disposal by Release into Sanitary Sewer Systems	4-1

3. Liquid Wastes	4-2
4. Solid Wastes	4-2
5. Biological Wastes	4-2
6. Mixed Waste	4-2
7. Records	4-2
Part V: Permissible Doses, Exposure Levels & Concentrations	
A. Ionizing Radiation	5-1
1. Exposure Limits in Restricted Areas	5-1
2. Whole Body Dose (Limits)	5-2
3. Personnel Under Age 18	5-2
4. Exposure to Airborne Radioactive Materials	5-2
5. Permissible Levels of Radiation to Unrestricted Areas	5-2
6. Dose to Pregnant Women/Embryo/Fetus	5-2
B. Bioassay Requirements	5-3
C. Personnel Dosimetry	5-3
Part VI: Signs & Labels	
A. Radiation Warning Signs, Labels, & Controls	6-1
1. Caution - Radioactive Materials	6-1
2. Caution - Radiation Area	6-1
3. Caution – High Radiation Area	6-1
4. Labeling of Containers	6-2
5. Sealed Source Warning Label	6-2
B. Radiation Warning Sign Exceptions	6-2

## Appendix A: Sample Forms

RSP-1 – Application for Authorization for Radioisotope Use	App. A-1
RSP-2 - Statement of Training and Experience	App. A-5
RSP-3a – Application for Amendment of Authorization	App. A-6
RSP-4 – Procurement Authorization for Radioactive Materials	App. A-7
RSP-7 – Request for Personnel Dosimeters	App. A-8
Procedures for Isotope Shipments and Waste Disposal	App. A-10
Flow Chart for Isotope Shipments	App. A-11
Radioactive Waste Pickup Form Instructions	App. A-12
Radioactive Waste Pickup Request Form	App. A-13
Mixed Waste PickUp Form Instructions	App. A-14
Mixed Waste Pickup Request Form	App. A-15
Instructions for Cruise Radioactive Waste	App. A-16
Radioactive Waste Pick-Up Request form for R/V cruises	App. A-17
Mixed Waste Pick-Up Request form for R/V cruises	App. A-18
Waste Container Labels for Rad Waste containers for cruises	App. A-19
Swipe Test Diagram	App. A-20
Appendix B: Air and Water Release Limits	App. B-1
Appendix C: Exempt Quantities	App. C-1
Appendix D: Administration	App. D-1
Appendix E: Definitions	App. E-1
Appendix F: Isotope Fact Sheets	App. F-1
Appendix G: Laboratory Survey Procedures	App. G-1

Appendix H: Radiation Safety Disaster Plan	App. H-1
Appendix J: Enforcement Policy on Distribution & Lost Dosimetry	App. J-1
Appendix K: Policy for Use of Radioactive Materials at Sea Under the Jurisdiction of the University of Hawaii	App. K-1
Appendix L: Policy for Extended Vacation/Sabbatical Leave	App. L-1
Appendix M: Close out and Decommissioning Procedure	App. M-1

# RADIATION SAFETY MANUAL

## UNIVERSITY OF HAWAII

### PREFACE

Major advances in science have been and will continue to be accomplished through the use of radioactive materials. Since questions concerning the effects of low-level radiation exposure are still being debated, the basic principles of radiation protection and control must be continually practiced. Indeed, we all have an obligation to keep radiation exposure to radiation workers and to the general public As Low As Reasonably Achievable (ALARA). In accordance with this commitment, we have an administrative organization for radiation safety and will develop the necessary written policy, procedures, and instructions to foster the ALARA concept within our institution.

As a condition of applicable State requirements and the University's NRC license to possess and use radioactive materials, every radioisotope user must be familiar with the contents of this manual and follow established safe practices in the use and handling of radioisotopes and ionizing radiation producing sources.

Modifications to operating and maintenance procedures and to equipment and facilities will be made if they will reduce exposures unless the cost, in our judgment, is considered to be unjustified. We will be able to demonstrate, if necessary, improvements that have been sought, that modifications have been considered, and that they have been implemented when reasonable. If modifications have been recommended but not implemented, we will be prepared to describe the reasons for not implementing them.

In addition to maintaining doses to individuals as far below the limits as is reasonably achievable, the sum of the doses received by all exposed individuals will also be maintained at the lowest practical level.

This manual is for your individual reference while working with radioactive materials and potentially hazardous ionizing radiation at the University of Hawaii. It may be updated as required with replacement pages to modify procedures and forms. Should you discontinue work with applicable materials or devices under the Radiation Safety Program, please return this manual to the Radiation Safety Office.

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M.R.C. Greenwood  
President  
University of Hawaii  
October 6, 2011

**Radiation Safety Program  
Emergency Telephone Numbers**  
(Call in this order until one person is notified)

**Days (8:00 a.m. to 4:30 p.m.)**

Ms. Irene K. Sakimoto	956-6475
Ms. Nancy Miyake	956-8591
Mr. Roy Y. Takekawa	956-8660
Security (Manoa Campus)	956-6911

**Nights/Weekends/Holidays**

Security	956-6911
Ms. Irene K. Sakimoto	734-5909
Ms. Nancy Miyake	595-3451
Mr. Roy Y. Takekawa	261-2370



MANUAL NUMBER \_\_\_\_\_

ISSUED TO \_\_\_\_\_

Revised October 6, 2011

INTRODUCTION  
RADIATION SAFETY PROGRAM  
UNIVERSITY OF HAWAII

The University of Hawaii has a moral and legal obligation to establish work practices which will provide a safe and healthful environment for students, employees, and the general public who participate in official campus activities.

Because of potential hazards involved in the use of radioactive materials and ionizing radiation emitting devices, the University has established a Radiation Safety Program (Program). The Program is intended to protect personnel from unnecessary ionizing radiation exposure, to prevent contamination of our environment, and to meet the State and Federal regulations governing the possession and use of radioisotopes and radiation producing sources. To that end, this Radiation Safety Manual has been prepared by the Radiation Safety Committee (Committee) and approved by the President of the University.

This manual establishes procedures governing the safe use of sources of radiation in the University of Hawaii which conform to the regulations set forth by the U. S. Nuclear Regulatory Commission (NRC) and the Hawaii Occupational Safety and Health Law (HOSHL). This manual has been incorporated into the NRC license first issued to the University of Hawaii, August 10, 1971. Adherence to these procedures and regulations by authorized users of ionizing radiation sources is mandatory.

The use of radioisotopes within the University of Hawaii system is regulated by the Committee. The Program is responsible for the administration of Committee policy. The Committee reports directly to the President of the University of Hawaii.

Copies of all NRC regulations, NRC licenses and supporting documents, and notices of violations are available from the Program.

The Committee retains the right to amend this manual at any time as needed.

## **PART I: POSSESSION AND USE OF RADIOACTIVE MATERIALS**

### **A. AUTHORIZATION**

Any faculty member or researcher may apply for authorization to use radioisotopes as a Principal Investigator at the University of Hawaii. There are two types of authorizations:

- 1) Regular Authorizations – two years
- 2) Temporary Authorizations – 6 months or less

#### 1. Application

An applicant must submit to the Committee:

- a. A completed program description as required on Form RSP-1, Application for Use of Radioactive Materials and,
- b. Form RSP-2, Statement of Training and Experience, for the applicant and radiation workers working under the supervision of the Principal Investigator of this application. Approved personnel are designated as authorized users by the Committee.

See Appendix A for samples of all RSP forms. All applicants and amendments for use and possession of radioactive materials must be evaluated and approved by the Committee. Plan to apply for radioisotope use well in advance for your projected experiments. The Committee meets quarterly to review applications.

Authorizations may be tentatively approved between meetings by the Committee under unusual circumstances.

Authorizations may also be approved between meetings by the Chairperson in consultation with the Radiation Safety Officer (RSO) for authorizations of ten times the exempt quantity or less (see Appendix C). These approvals will be reviewed at the next scheduled Committee meeting.

Factors considered by the Committee in the evaluation of a proposed project include:

- 1) Mandatory attendance of all new personnel to the University of Hawaii radiation safety class.
- 2) Experience and ability of the applicant and users to cope with the hazards involved in the particular application.
- 3) Adequacy of the facilities and equipment for proposed usage and,

- 4) Thoroughness and attention given to safety precautions in the proposed experimental procedures and waste disposal methods.

The Committee may specify further conditions to be observed for certain types of operations and termination procedures for closing out his or her authorization.

**2. Approval for Use and Possession**

When the application is approved, the Committee will issue the Principal Investigator a Radioactive Materials Authorization.

The authorization issued by the Committee is valid for a maximum of two years for a regular authorization and up to six months for a temporary authorization.

**3. Laboratory Classification Scheme**

To assure the safe handling of radionuclides in our research laboratories, the quantity and toxicity of radioactive materials approved for use in each laboratory will determine the minimum facility and equipment requirements, the frequency and extent of surveillance, and the level of user training and monitoring.

**Radionuclide Toxicity Classifications**

Group 1: Very high Toxicity  
<sup>210</sup>Pb, <sup>210</sup>Po, <sup>226</sup>Ra, <sup>227</sup>Th, <sup>228</sup>Ra, <sup>231</sup>Pa, <sup>233</sup>U, <sup>238</sup>Pu, <sup>243</sup>Am, <sup>244</sup>Cm, <sup>249</sup>Cf

Group 2: High Toxicity  
<sup>22</sup>Na, <sup>36</sup>Cl, <sup>60</sup>Co, <sup>95</sup>Zr, <sup>125</sup>I, <sup>144</sup>Ce, <sup>181</sup>Hf, <sup>192</sup>Ir, <sup>207</sup>Bi, <sup>228</sup>Ac

Group 3: Moderate Toxicity  
<sup>7</sup>Be, <sup>14</sup>C, <sup>24</sup>Na, <sup>32</sup>P, <sup>35</sup>S, <sup>48</sup>Sc, <sup>48</sup>V, <sup>51</sup>Cr, <sup>65</sup>Zn, <sup>65</sup>Zn, <sup>90</sup>Y, <sup>91</sup>Sr, <sup>103</sup>Ru, <sup>126m</sup>Te, <sup>140</sup>La, <sup>153</sup>Gd, <sup>187</sup>W, <sup>198</sup>Au

Group 4: Low Toxicity  
<sup>3</sup>H, <sup>15</sup>O, <sup>58</sup>Co, <sup>71</sup>Fe, <sup>85</sup>Kr, <sup>87</sup>Rb, <sup>97</sup>Nb, <sup>99m</sup>Tc, <sup>103m</sup>Rh, <sup>125</sup>Cs, <sup>131m</sup>Xe, <sup>191</sup>Os, <sup>232</sup>Th

Radiotoxicity	Laboratory Classification		
	Type A	Type B	Type C
Very High (Group 1)	10 mCi or more	10 uCi to 10 mCi	<10 uCi
High (Group 2)	100 mCi or more	100 uCi to 100 mCi	<100 uCi
Moderate (Group 3)	1 Ci or more	1 mCi to 1 Ci	<1 mCi
Low (Group 4)	10 Ci or more	10 mCi to 1 Ci	<10 mCi

These classifications are based upon the total Maximum Possession Limit for all radionuclides for each Principal Investigator. If you use radioisotopes not listed here, please get a ruling from the Radiation Safety Committee.

There is no possession limit below which a user is excluded from compliance with the regulations governing the safe handling of radionuclides.

### Requirements of Specific Laboratory Types

#### Type A Laboratory

1. The restricted area shall be a separate room limited to the use of radioactive materials.
2. The restricted area shall be locked at all time; access to the restricted area shall be limited to approved users only.
3. The restricted area shall contain appropriate storage and waste containment equipment consistent with the type(s) of radionuclide(s) in use.
4. Surveys of restricted area, by methods appropriate for the type(s) of radionuclide(s) used, shall be performed after each use to determine the extent of radionuclide contamination within the restricted area.
5. Surveys, by methods appropriate for the type(s) of radionuclide(s) used, shall be performed at least weekly to determine the extent of radionuclide contamination beyond the restricted area and shall include work and office areas frequented by the radionuclide user(s). Survey records must be kept for at least three years.

#### Type B Laboratory

1. The restricted area(s) a) shall be clearly defined and marked by approved means if contained within all or part of a room, b) shall not function as a thoroughfare between non-restricted areas, and c) shall not include office areas or desks requiring access by non-users.
2. Rooms containing one or more restricted areas shall be locked in the absence of an authorized user.
3. Restricted area(s) shall contain appropriate storage and lockable waste containment equipment appropriate for the type(s) of radionuclide(s) in use.
4. Surveys of the restricted area, by methods appropriate for the radionuclide(s) in use, shall be performed after each use to determine the extent of radionuclide contamination within a restricted area.
5. Surveys, by methods appropriate for the type of radionuclide(s) in use, shall be performed at least semi-monthly to determine the extent of radionuclide contamination beyond the restricted area and shall include other work and office areas frequented by the radionuclide user(s). Survey records must be kept for at least three years.

## Type C Laboratory

1. The restricted area 1) shall be clearly defined and marked if contained within all or part of a room, 2) shall not function as a thoroughfare between non-restricted areas, and 3) shall not contain office areas or desks requiring access by non-users.
2. Rooms containing one or more restricted areas shall be locked in the absence of an authorized user.
3. The restricted area shall contain appropriate lockable storage and lockable waste containment equipment consistent with the type(s) of radionuclide(s) in use.
4. Surveys, by methods appropriate for the type of radionuclide(s) in use, shall be performed after each use to determine the extent of radionuclide contamination within the restricted area.
5. Surveys, by methods appropriate for the type of radionuclide(s) in use, shall be performed at least monthly to determine the extent of radionuclide contamination beyond the restricted area and shall include the work and office areas frequented by the radionuclide user(s). Survey records must be kept for at least three years.

### **4. Amendments**

Amendments to an authorization may be filed at any time by submitting Form RSP-3a, Application for Amendment of Authorization.

Amendments may include:

- a. Changes in materials possession limits
- b. New projects or revisions of current projects
- c. Changes in personnel using radioisotopes
- d. Adding a new radioisotope to an authorization

### **5. Renewal**

The Committee renews Principal Investigator's (PI) authorizations biennially (not to exceed 730 days). Renewal forms are sent out to PIs about a month prior to the expiration date.

### **6. Inactive Status**

If a Principal Investigator desires to stop using radioisotopes, but still wants to keep his/her authorization, the PI may ask for inactive status, good until the next biennial renewal. All radioactive materials must be surrendered to the RSP or transferred to an active PI. The restricted areas of the laboratory must be surveyed for closeout and decontaminated for unrestricted use. There are benefits in being inactive, e.g., no monthly surveys are required and no semi-annual inventories have to be submitted.

Inactivation/reactivation of the authorization requires a form RSP-3a, Application for Amendment of Authorization.

## **7. Termination**

Authorizations are terminated when a PI no longer wishes to use radioisotopes. The PI shall surrender all radioactive materials including waste. The PI shall notify the RSO of his/her plans at least one month prior to termination. A closeout or decommissioning survey must be performed by the Program. Any contamination found must be decontaminated to acceptable levels before the area can be released for unrestricted use.

## **B. PROCUREMENT**

All purchases and transfers of radioactive materials must be pre-approved by the Committee. The RSO is delegated the authority to approve requests for purchases and transfers of radioactive materials within the authorized limits allowed for each PI.

### **1. Purchases**

- a. Submit a completed Form RSP-4, Procurement Authorization for Radioactive Materials, to the Program for the RSO signature.
- b. Attach the signed yellow copy to your purchasing document. The Procurement & Property Management Office will not process your purchase orders without the form.

### **2. Deliveries of Radioisotopes**

Shipments of radioisotopes must be delivered to the RSP for inventory and monitoring. The RSP will assign a shipping code number for each shipment of isotope and include a waste disposal inventory form generated by the inventory database. (See Shipping Code Flow Chart in Appendix A). The shipping code number will be written on the RSP-4 form, the box of isotope and 3-4 stickers with the number will be attached to the computer generated waste inventory form. One sticker shall be placed on the "pig" containing the isotope and the rest used for tracking waste.

### **3. Transfers**

Form RSP-4 is used to transfer radioactive material between PIs with the transferor as the vendor. These forms must be submitted to the Program for approval.

### **4. Record keeping**

Each PI shall be responsible for maintaining an inventory of radioactive materials in their possession. This shall include:

- a. Copies of procurement authorization forms (pink);
- b. Records indicating type, quantity, and date of receipt of nuclides;
- c. Disposal of waste including method, type and quantity of materials, and date of disposal or transfer;
- d. And transfers to authorized receivers.

Any record keeping format providing accurate information of the above will be accepted. This information shall be provided to the Committee upon request.

Use the shipping code numbers generated by the database program, Health Physics Assistant, to track your shipments from receipt, use and disposal. A flow chart, instructions on using the shipping code numbers, the new waste tracking form and the new waste pickup request forms can be found in Appendix A.

## **C. TRAINING**

### **1. By the Radiation Safety Program**

#### a. Authorized Users

- 1) All new applicants wishing to use radioactive materials (PI, students and staff) must attend the UH Radiation Safety Initial Training class. The RSO is responsible for an ongoing training program for the safe handling and use of radioisotopes. Training sessions are given at periodic intervals and upon request.
- 2) Users will be instructed in the health protection problems associated with exposures to radiation or radioactive materials, including biological risks to embryos or fetuses; in precautions or procedure to minimize exposures; and in the purposes and function of protective devices. This is in keeping with our ALARA program.

#### b. Ancillary Personnel (Housekeeping or Security)

All ancillary personnel will be instructed to:

- 1) Recognize a radiation materials sign on doors, fume hoods, and floor markings and
- 2) Observe all radioactive materials signs, restricted area signs and avoid entering restricted areas.



c. Annual Refresher Training

**All authorized users must attend annual refresher training.** A yearly schedule of classes is posted on our website. Refresher training is posted on the EHSO website and class materials and testing will be done on Laulima.

2. **By the Principal Investigator**

It is the responsibility of the Principal Investigator to ensure that all individuals working in or frequenting any portion of a restricted area are properly trained. All radiation workers in a restricted laboratory are to be:

- a. Kept informed on the storage, transfer or use of radioactive materials or radiation level in any portion of a restricted area.
- b. Instructed to observe the applicable provisions of this manual for the protection of personnel from exposure to radiation or
- c. Enrolled to attend the UH radiation safety class.
- d. Instructed in lab techniques and the proper use and handling of radioisotopes.
- e. Instructed in proper record keeping for inventories, waste disposal and purchasing.

It is also the responsibility of Principal Investigators to properly train visitors entering a restricted area as to radiation hazards in the lab and that they should avoid restricted areas and not handling equipment labeled with radioactive stickers.

## **PART II: SAFE HANDLING AND USE**

### **A. LABORATORY FACILITIES**

Except for approval “field operations,” laboratories will be equipped with non-absorbent or disposable working surfaces, non-absorbent floor covering, and non-absorbent wall surfaces that are easy to decontaminate.

### **B. LABORATORY EQUIPMENT**

Standard laboratory equipment necessary for radioisotope operations, such as manual or automatic pipetting systems, protective gloves, appropriate trays, and approved monitoring equipment must be used.

### **C. FUME EXHAUST HOODS**

Radioisotope use which results in the volatilization or dispersal of nuclides that could exceed the Maximum Permissible Concentration in Air must be conducted within a properly functioning hood certified by the Environmental Health and Safety Office. The hood surfaces shall be easily decontaminated and the hood exhaust so arranged as to meet applicable regulations.

### **D. PROTECTIVE CLOTHING**

Appropriate rubber or plastic gloves, lab coats and covered shoes shall be worn when handling open containers of radioisotopes and during manipulations where the probability of radioactive contamination is high. Containers of radioactive materials shall be sealed and secured when not in use.

### **E. HYGIENE**

#### **1. Personnel**

All persons working with radioactive materials shall wash their hands thoroughly before leaving the laboratory. When applicable, they shall utilize the available monitoring equipment to assure that their skin is free of contamination.

**Eating or drinking of any foods or beverages and smoking are not allowed in any area where radioisotopes are used. There should also be no storage of food or beverages in these areas.**

#### **2. Pipetting of radioactive solutions by mouth is not permitted.**

### **3. Laboratory Surveys**

Survey shall mean an evaluation of the radiological hazard related to the use, release, disposal, or presence of radioactive materials. Such evaluation includes a physical survey of the locations of materials and equipment, and a measurement of the levels of radiation and/or contamination for the radioactive material present.

### **4. Contaminated Area**

A contaminated area is defined as an area where radioactive materials have been released into the environment (spill) such that a hazard exists to personnel through ingestion, absorption, inhalation or external exposure.

### **5. Contamination Criteria**

For beta-gamma emitting contamination, dose rates should not exceed an average of 0.2 mR/hr, nor exceed 0.5 mR/hr maximum, at 1 centimeter from the surface for any area of not more than 100 cm<sup>2</sup>. Removable contamination from any work surface should not exceed 500 dpm per 100 cm<sup>2</sup>. All fixed contamination (i.e., contamination which is not removable) above the contamination criteria must be labeled with proper warning signs stating the emitter and radiation level present.

### **6. Decontamination**

Contaminated areas are to be immediately decontaminated to acceptable levels.

The responsibility for decontamination is borne by the Principal Investigator. A survey shall be made and documented after cleaning to verify that the area is no longer contaminated.

All decontaminated procedures must follow NRC guidelines dated July 1982 (see Appendix G).

## **F. SECURITY OF RADIOACTIVE MATERIALS**

Radioactive materials can only be used and stored in authorized areas. Radioactive materials must be secured from unauthorized removal, e.g., locked refrigerators or storage cabinets. Radioactive waste is considered to be licensed material and must be secured from unauthorized removal.

The area must be properly posted with radioactive materials signs.

Radioactive materials not in storage must be tended under the immediate control of the radiation workers.

## **G. LOST, STOLEN, OR VANDALIZED RADIOACTIVE MATERIALS**

If any radioactive material that is lost, stolen or vandalized, the RSO shall be notified immediately. Lost radioactive material is a violation reportable to the NRC. Attempts must be made to retrieve or find the lost or stolen materials.

## **H. STORAGE AND USE OF RADIOACTIVE MATERIALS**

All areas where radioactive materials are stored in quantities greater than 10 times exempt quantities (see Appendix C) shall be clearly marked with the radiation symbol (see Part VI for proper warning signs).

All transfers of radioactive materials between hoods and storage devices must be conducted in a safe manner to avoid the possibility of spillage or breakage. Double containment is recommended as a safe transport practice. Use shielding if necessary while moving materials.

## **I. SAFE OPENING OF PACKAGES**

Principal Investigators receiving unopened packages of radioisotopes must use the following established procedures.

1. Note radiation units stated on the package; verify and record in receipt log.
2. If you receive a shipment of radioactive material directly, you must perform a wipe test *within 3 hours upon receipt*. If you receive the shipment at the end of the day, you must perform the wipe test first thing next morning. You must also perform a radiation survey i.e., mR/hr, if there is a diamond shaped Dept. of Transportation sticker, e.g., White I or Yellow II or III), within the same 3 hour time frame. If the RSP delivers the shipment, the wipe test and radiation surveys will have already been performed.
3. Place package in a properly functioning certified hood if the material is volatile.
4. Open outer package and remove packing slip. Open inner package and verify that the contents agree in name and quantity with the packing slip.
5. Measure radiation field of unshielded container. If necessary, place container behind shielding to reduce field to allowable limits and proceed with remote handling devices (hard beta and gamma only, e.g., P-32 Cr-51, I-125).
6. Check for possible breakage of seals or containers, loss of liquid or change in color of absorbing materials.

7. Survey the packing container with a survey meter appropriate for the isotope received. Note: the liner, shield, and isotope container may have surface contamination; if contaminated, discard as radioactive waste and if not contaminated, deface radioactive signs and discard as regular trash.
8. If contamination exists on a container, handle with protective gloves. If the contamination is severe, i.e., thousands of dpm, handle with tools and rubber gloves. PVC gloves have proven not to provide adequate protection for gross contamination.
9. Empty boxes that are free of contamination must have all radioactive labels removed or obliterated before disposal in ordinary trash or turned in for recycling.

### **PART III: EMERGENCY PROCEDURES**

In the event of a radioactive accident incident, the RSO shall be contacted as soon as possible for assistance. Refer to the emergency telephone number list on page 0 – 1.

**A. Minor Spills:** The following actions should be taken in the event of a small spill:

1. Warn others in the work area of the spill
2. Isolate the spill area – corridor the area from all pedestrian traffic
3. Minimize exposure to yourself and others by confining the material
  - a. Absorb liquid with a dry absorbent material and treat as solid radioactive waste.
  - b. If powder, dampen the area first to prevent spread of airborne activity.
  - c. Decontaminate to acceptable levels.

#### **B. Major Spills**

A major release of radioactive materials would be potentially hazardous to personnel who might inhale or ingest the loose material or receive direct external radiation. A major spill shall be controlled using the SWIM procedure:

- S Stop the spill or leak
- W Warn others in the work area
- I Isolate the spill area (see above)
- M Minimize exposure

Call the RSO for assistance. Turn off air handling systems, e.g. fans, air conditioners. Minimizing exposure means using appropriate time, distance, shielding techniques for strong gamma and/or beta emitter. It also means to avoid breathing vapors from evaporating liquids and dust powders as well as keeping materials from contaminating the skin and clothes.

#### **C. Injuries to Personnel Using Radioactive Materials**

1. Ensure that all minor wounds are washed under running water immediately.
2. Ensure that proper first aid is rendered immediately in case of a serious accident.
3. Call a physician immediately.
4. Report all accidents or injuries to the RSP (ph. 956-8591) as soon as possible.

**D. Fires Involving Radioactive Materials**

1. Pull the building alarm and evacuate the building without delay.
2. Call Campus Security at 956-6911, and the Fire Department at 911. Indicate that radioactive materials may be involved in the fire.
3. Where possible, close all doors and windows, do not under any circumstances silence the building fire alarm. Do not return to the building for any reason until instructed to do so by a competent authority.
4. Move away from the building entrance and fire department access. Do not obstruct fire hydrants.

## **PART IV: WASTE STORAGE AND DISPOSAL**

The University has established a central area for waste storage; however, it is the responsibility of all individuals producing radioactive wastes to be aware of disposal limits and to conform to all requirements for safe disposal. Efforts should be made to minimize the volume of waste generated and to furnish the RSP with the information concerning the nature of wastes being collected for storage and disposal. At this writing, most of our waste is sent to the mainland for disposal that is becoming more expensive each year.

Mixed waste (regulated hazardous chemical waste with regulated radioactivity in it) must be kept to a minimum. There are few or no waste sites in the U.S. that accept mixed waste at this time. If another material can be substituted which is more easily disposed, please do so.

A computer generated Waste Disposal Report Form is included with each shipment sent to the RSP for your inventory and waste tracking purposes. You can either use this form or use your own method of tracking materials and waste.

### **A. WASTE STORAGE**

1. Liquid wastes must be stored in suitable safe containers and be properly labeled including the PI's name, isotope, amount, and date sealed. Safety coated plastic bottles are recommended. Place all liquid containers in a secondary container to prevent spillage onto floor surfaces.
2. Provisions must be made for the storage of volatile wastes in an Environmental Health and Safety Office (EHSO) certified chemical fume hood.
3. The amount of radioactive waste should be kept to a minimum. When temporary storage is necessary, the waste container shall be of an approved type. The program is responsible for the removal of wastes to a central storage facility.
4. All waste must be secured from unauthorized removal or access.

### **B. WASTE DISPOSAL**

#### **1. General**

Radioactive waste shall be accumulated, packaged, and transferred to the Office. No disposal of radioactive waste by incineration is permitted except by, or under the supervision of the RSP. Waste should be segregated and labeled according to type (short half-life, long half-life, liquid or solid, etc.). Use the appropriate waste pickup request form for each type of waste (i.e., radwaste, scintillation and mixed waste).



## 2. Solid Waste Segregation

- a. Ensure that **no** chemically hazardous material, e.g., lead, is placed inside the solid radwaste containers. Lead must be disposed appropriately as a chemical waste unless it is contaminated which then becomes a mixed waste.
- b. Special containers for radioactive solid waste are available from the Office. These containers must be clearly designated as radioactive waste receptacles and must not be used as general trash. Disposable plastic bag liners for these containers, provided by the PI, must be used and sealed before sealing the box. No freestanding liquids or chemical wastes are allowed in solid waste containers. Ensure that waste of each radioisotope is kept in a separate waste box. Double radiolabeled wastes must be specifically marked on the box. Photocopy and fill out the waste pick up forms in Appendix A.
- c. Properly seal and then label each radioactive waste container with the radioisotope, activity, date the box was sealed, PI name and the shipping code number(s) for waste inside the box.

## 3. Liquid Waste Disposal

- a. Disposal by Release into Sanitary Sewer Systems

The University of Hawaii adheres to the limits established in 10 CFR Part 20.2003 Disposal By Release Into Sanitary Sewer Systems. As a general rule, Principal Investigators may discharge radioactive material into sanitary sewer system if:

1. **It is readily soluble or is readily dispersible biological material in water (e.g., aqueous solutions, neutralized acid and bases, buffers with pH 6-8, etc.).**
2. The quantity of licensed or other radioactive material that is released into the sewer is less than the amounts listed in Appendix B of this manual. Please follow the recommended amounts allowable for sewer release in Appendix F of this manual.

- b. Liquid Wastes

Liquid wastes containing radioactivity not disposable into the sanitary sewer system shall be collected in sealed containers to permit transport by the Program without leakage.

#### **4. Biological Wastes**

Animal and biological waste materials must be placed in a sealed plastic bag and clearly labeled with the date, radioisotopes used, and radioactivity in microcuries and the type of animal material. All such wastes shall be stored in a secured freezer prior to calling for a waste pickup by the Program.

#### **5. Mixed Waste**

Mixed waste is radioactive waste that is combined with a listed regulated hazardous waste. This may include liquid as well as solid wastes. Please keep the volume of these wastes as small as possible. See Appendix A for the Mixed Waste Pick-Up Form.

Biohazardous radioactive waste (radioactive waste that contains a biohazardous agent) should be deactivated by autoclaving or any approved deactivating means as stated in the Biosafety Manual. Deface any biohazardous signs after deactivation and prior to radwaste disposal.

#### **6. Records**

An inventory must be maintained by the Principal Investigator of all waste disposals regardless of nature. Copies must be available to the Committee upon request. The computer generated Waste Inventory Form with the shipping code information is useful to track your waste streams and is provided for your convenience.

**PART V: PERMISSIBLE DOSES, EXPOSURE LEVELS AND CONCENTRATIONS**

The Committee has established an ALARA (As Low As Reasonably Achievable) program for monitoring areas involved in the use and disposal of radioactive materials as published in Appendix G to Regulatory Guide 10.8, Revision 2. The RSO shall notify the Committee of any exposure greater than the allowable levels as specified in the ALARA program. The Committee will conduct an investigation of such an exposure.

Limitations to radiation exposure, permissible dose rates and concentrations, and personnel monitoring requirement as set by the NRC are found in the below Table 1. Radiation exposure reports will be provided to all workers assigned TLD monitors.

**A. IONIZING RADIATION**

**1. Exposure of Individuals to Radiation in Restricted Areas**

Principal Investigators must not possess, use, or transfer sources of ionizing radiation in such a manner as to cause any individual to receive, in any period of one calendar year, a dose in excess of the limits established in Table 1.

As part of the ALARA program, our investigational levels are set at 10% of the allowable quarterly limits of Table 1. Calculated dose rates from typically used isotopes can be found in Appendix F.

---

TABLE 1

	REMs/yr	Sv/yr
Whole body: head and trunk; active blood forming organs; gonads	5	0.05
Hands and forearms; feet and ankle; skin	50	0.5
Lens of the eye	15	0.15
Whole body during entire gestation period for the declared pregnant worker, embryo/fetus	0.5	0.005

---

**3. Whole Body Dose**

Principal Investigators must not allow any individual to receive a dose to the whole body in excess of 100 millirems (1 mSv) per week. All over-exposures must be reported to the Program immediately.

**4. Personnel Under Age 18**

Principal Investigators must not permit any person who is under 18 years of age to receive in any period of one year a dose in excess of ten percent of the limits listed in Table 1. The Committee does not allow anyone under the age of 18 to handle any radioactive materials.

**5. Permissible Levels of Radiation in an Unrestricted Area**

Principal Investigators must not possess, use or transfer radioactive materials or other sources of ionizing radiation in such a manner as to create in any unrestricted area:

- a. Radiation levels which, if any individual were continuously present in the area, could result in his receiving a dose in excess of 2.0 millirems (20 mSv) in any seven consecutive days.
- b. Radiation levels which, if any individual were continuously present in the area, could result in his receiving a dose in excess of 100 millirems (1mSv) in any seven consecutive days.
- c. No member of the general public may receive a dose to the whole body in excess of 100 millirem (1 mSv) in any one calendar year.

**6. Dose to a Pregnant female radiation worker and embryo/fetus**

The dose to an embryo-fetus during the entire pregnancy, due to occupational exposure of a declared pregnant woman is limited to 0.5 REM (5 mSv) during the gestation period. Declaration of pregnancy is voluntary and should be declared to the worker's employer and the RSO in writing. Also, a letter to undeclare the worker's pregnancy must be submitted once the pregnancy is ended. See form letters for declarations in Appendix A.

The dose to an embryo/fetus shall be taken as the sum of:

- a. The deep dose equivalent to the declared pregnant woman, and
- b. The dose to the embryo/fetus from radionuclides in the declared pregnant woman.

## **B. BIOASSAY REQUIREMENTS**

The Committee will be responsible for the establishment of bioassay and medical monitoring procedures. The Committee will judge the necessity of such procedures based on the review of each program and on the prior and continuing investigation and surveillance by the RSO. All Committee requirements will follow NRC bioassay guides.

**Individuals involved in operations that utilize, at any one time, more than 100 millicuries of Hydrogen-3 in a non-contained form, other than metallic foil, shall have bioassays performed within one week following a single operation and at weekly intervals for continuing operations.**

## **C. PERSONNEL DOSIMETRY**

1. Principal Investigators must request and require the use of appropriate personnel dosimeters for:
  - a. Each individual who enters a restricted area where they will receive or is likely to receive a dose in excess of 10 percent of the applicable value specified in Part V, Table 1.
  - b. Each individual under 18 years of age who enters a restricted area where he will receive >5% of the allowable limit.
  - c. Each individual who enters a radiation area (5 mrem/hr to 100 mrem/hr) or a high radiation area (>100 mrem/hr) must wear a dosimeter.
  - d. Everyone entering a radiation area where a daily whole body exposure in excess of 10 millirems (100 uSv) is possible, must wear a dosimeter.

Note: Authorized workers who use soft beta radioisotopes (e.g. H-3, C-14, S-35) will not be issued dosimeters.

2. If none of the above situations are applicable, the PI may still request badges and rings. The PI must pay for these badges and rings. The RSP will continue to handle all contracts, distribution and pickups of all badges and rings used.
3. **Dosimeters shall be obtained from the Radiation Safety Program (see Dosimeter Request Form, RSP-7, Appendix A).**
4. Dosimeters will be delivered to the Principal Investigator by the first of the month and will be collected on the 4<sup>th</sup> of the following month or the next working day thereafter. See Appendix J for the enforcement policy on late and lost dosimeters.

5. If dosimeter (badge or ring) becomes contaminated, notify the RSP immediately.
6. Notify RSP immediately if you lose a badge or ring so we can order a replacement. You will be given a form to fill out to help us estimate your exposure. Exposure readings and calculated exposures become a permanent record of your occupational radiation exposure at this institution.
7. Declared pregnant workers should declare their pregnancy in writing and apply for dosimeters for both she and the fetus. Call the RSP for more information.

## PART VI: SIGNS AND LABELS

### A. RADIATION WARNING SIGNS, LABELS, AND CONTROLS

A radiation caution symbol with written warning is required for the following areas where radioactive materials or radiation levels exist. They may be either a magenta colored bladed symbol with yellow background or black colored bladed symbol on yellow background. The following five signs are to be used.

#### 1. Caution-Radioactive Material

Each area or room in which radioactive materials exist in an amount exceeding 10 times (100 times for natural uranium and thorium) the quantity of such material specified in Appendix B of this Manual shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words "CAUTION-RADIOACTIVE MATERIAL."

#### 2. Caution-Radiation Area

This sign is specifically designated for and shall be posted in areas where large external radiation fields exist and where an individual could receive over a major portion of his/her body a dose of 5 millirems [50uSv] in an hour, or if he/she were continuously present for five consecutive working days, a dose not in excess of 100 millirems [1 mSv].

#### 3. Caution-High Radiation Area

This sign shall be posted in areas where an individual might receive more than 100 millirems [1 mSv] in an hour. Each entrance or access point to a high radiation area shall be:

- a. Equipped with a control device which would reduce the radiation level so that an individual would receive a dose below 100 millirems [1 mSv] in an hour upon entry into the area; or
- b. Equipped with a control device which would energize a visible and/or audible alarm signal in such a manner that the individual entering the high radiation area and the Principal Investigator or a supervisor of the activity are made aware of the entry; or
- c. Locked except during periods when access to the area is required with positive control over each individual entry.
- d. The controls required under 3. above shall be established in such a way that no individual will be prevented from leaving a high radiation area.

#### 4. Labeling of containers

- a. Smaller signs of the stick-on type, tags or radiation tape shall be used only for containers of radioisotopes. They must not be used in place of the above mentioned signs. All containers of radioactive materials should be labeled with:
  - 1) Isotope
  - 2) Activity
  - 3) Date when the box was closed
  - 4) Name of PI
- b. Containers being used in the laboratory with less than one microcurie and with the user constantly present need not be labeled.

#### 5. Sealed sources warning label

Any sealed source which is not fastened to or contained in a radiographic exposure device shall have permanently attached to it a durable tag at least one inch square bearing the radiation caution symbol and the following instructions: "Danger-Radioactive Material-Do Not Handle-Notify Civil Authorities If Found."

### **B. RADIATION WARNING SIGN EXCEPTIONS**

1. A room or area storing a sealed source is not required to be posted with a radiation warning sign if the radiation level twelve (12) inches from the surface of the source container or housing does not exceed five millirems [50 mSv] per hour.
2. Radiation warning signs are not required to be posted at areas or rooms storing radioactive materials for a period of less than eight hours if the materials are constantly guarded during such periods by an individual who shall take the precautions necessary to prevent the exposure of others to radiation or radioactive materials in excess of the limits established in this part, and such an area or room is under the Principal Investigator's control.
3. A room or area which is a high radiation area solely because of the presence of radioactive materials already prepared for transport and packaged and labeled in accordance with the Department of Transportation regulations is not required to be posted with a high radiation warning sign, and control is not required for each entrance.



**APPENDIX A**  
**SAMPLE FORMS**

## APPLICATION FOR USE OF RADIOACTIVE MATERIALS

**Please refer to the UH Radiation Safety Manual for detailed application instructions. Submit application to: Radiation Safety Office, 2040 East-West Road, Honolulu, Hawaii 96822**

1. Name and Title: \_\_\_\_\_ Date: \_\_\_\_\_  
(Principal Investigator)

2. Building and room number: \_\_\_\_\_

Department: \_\_\_\_\_ Phone ext. \_\_\_\_\_

3. Authorization: \_\_\_\_\_ Regular (2 years)  
\_\_\_\_\_ Temporary (6 months or less)

4. Nature of Program: \_\_\_\_\_ Research \_\_\_\_\_ Instruction

5. List the names of all persons using radioactive materials under supervision of the applicant. Submit a Form RSP-2, Training and Experience, for each person.

\_\_\_\_\_  
\_\_\_\_\_

6. List all open sources of radioactive material needed:

<b>RADIOISOTOPE(S)</b>	<b>MATERIAL FORM</b> organic, inorganic	<b>ACTIVITY</b> per procedure, uCi, mCi	<b>POSSESSION LIMIT</b> Max. no. mCi of each that you will possess at any time

7. List sealed radioactive sources needed:

<b>RADIOISOTOPE</b>	<b>MANUFACTURER AND MODEL NUMBER</b>	<b>SERIAL NO. (if known)</b>	<b>ACTIVITY in mCi</b>

8. RADIATION DETECTION EQUIPMENT:

- a) List the type of portable survey meter you now have or will buy. Call the Radiation Safety Office if you need information in purchasing a portable survey meter. Make certain that your equipment is able to detect the energy and type of radioisotopes being used.

<b>Type of Instrument (Make and Model No.)</b>	<b>Sensitivity Range (mR/hr or cpm)</b>	<b>Type of use (Radiation or Contamination Monitoring)</b>

- b) Personnel dosimetry needed (see Radiation Safety Manual for dosimetry policy). Complete and submit an RSP-7 form for each person needing dosimetry.

9. PROPOSED USE: Give sufficient detail of your proposed use and radiological controls (i.e., security of isotopes and waste, restricted and unrestricted areas, etc.) in your laboratory setup which will be used to keep personnel exposures As Low As Reasonably Achievable (ALARA). (Use a separate sheet if necessary).

10. Describe your laboratory. Attach a diagram of the lab and include: type of floor, bench top material, type of hood, hood velocity, date of last certification, show location of equipment coming into contact with radioactive materials and distinguish restricted areas from unrestricted areas if the entire lab is not restricted.
  
11. The University of Hawaii has an ALARA program which requires keeping personnel exposures As Low As Reasonably Achievable. Please describe shielding, remote handling equipment and personnel monitoring procedures if gamma, high energy beta emitters or neutron emitters are to be used.
  
12. Describe your proposed procedures for disposal of solid radioactive waste. Ensure the physical separation of long- and short-lived radwaste containers. Refer to the Radiation Safety Manual for waste forms and instructions.
  
13. If disposing down sanitary sewer systems, describe how you will ensure no hazardous chemicals pH <6 or > 8 and *biological* material will be disposed. Liquids must be miscible with water.
  
14. Occupancy area - list personnel in the area who are not radiation workers and will occupy the lab. Notify Radiation Safety Program of any change in occupancy.

NAME	UNDERGRADUATE	GRADUATE	FACULTY/STAFF

## APPLICATION AGREEMENT

I have read and I will abide by the University regulations as set forth in the Radiation Safety Manual. I agree to notify the Radiation Safety Program at least one month before I close down my laboratory to transfer and/or dispose of all my radioactive material and waste and clean any contamination to background levels.

The Radiation Safety Program (RSP) is required to perform a close out survey to ensure that no contamination exists prior to releasing the laboratory for occupation by other department personnel. If it is necessary for RSP to conduct further decontamination, we understand it will be the department's responsibility to cover any costs incurred.

---

Signature of Principal Investigator

Date

---

Signature of Department Chairperson

Date

### STATEMENT OF TRAINING AND EXPERIENCE

Instructions: This form is to be completed by all personnel working with radioactive materials.

**NAME:** \_\_\_\_\_ **DEPT.:** \_\_\_\_\_ **P.I.:** \_\_\_\_\_

Position Description (Circle One): Faculty, Staff, Grad. Student, Post Doc., Visiting Prof., Undergrad.

TYPE OF TRAINING	WHERE TRAINED/ WHERE COURSE TAKEN	DATES AND DURATION OF TRAINING	ON THE JOB	FORMAL COURSE
Principles and practices of radiation protection			Yes   No	Yes   No
Radioactivity measurement			Yes   No	Yes   No
Mathematics and calculations basic to use and measurement of radioactivity			Yes   No	Yes   No
Biological effects of radiation			Yes   No	Yes   No

#### RADIOISOTOPE HANDLING EXPERIENCE

ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED	DATES AND DURATION OF EXPERIENCE	TYPE OF USE

Have radiation exposure records been maintained for you at another institution? Yes \_\_\_ No \_\_\_. If "Yes", indicate the address where these records may be obtained and the dates these records cover.

\_\_\_\_\_

\_\_\_\_\_

**Social Security Number:** \_\_\_\_\_ **Date of Birth:** \_\_\_\_\_

I have read and will abide by the University regulations as set forth in the University of Hawaii Radiation Safety Manual.

**Signature** \_\_\_\_\_ **Date** \_\_\_\_\_

If additional space is needed, use the back of this sheet. Return original to the Radiation Safety Office, 2040 East-West Road.

**APPLICATION FOR AMENDMENT OF AUTHORIZATION**  
University of Hawaii

- 1. Principal Investigator Name: \_\_\_\_\_ 2. Date: \_\_\_\_\_
- 3. Department: \_\_\_\_\_ 4. Auth. No.: \_\_\_\_\_
- 5. Building & Room No.: \_\_\_\_\_ 6. Phone No.: \_\_\_\_\_

7. Proposed Amendment(s): Check what type of amendment and circle add or remove.

- Add / Remove Authorized user(s): \_\_\_\_\_
- Add/ Remove Isotope(s): \_\_\_\_\_
- Add / Remove Laboratory: \_\_\_\_\_
- Close out request – Bldg. & room number: \_\_\_\_\_
- Other: \_\_\_\_\_

**NOTE:**

If you are adding new authorized users, please submit a Statement of Training, Form RSP-2, for each new worker. Please ensure that these new workers have attended the UH Radiation Safety Initial Training Class. If they need dosimeters, please submit an RSP-7, Request for Personnel Dosimetry.

If you are adding a new lab to your authorization, please submit a floor plan and mark restricted and unrestricted areas, show location of equipment, fume hoods (indicate date of last EHSO certification, radioactive material and waste storage areas, sinks, and describe security measures to be taken.

If you are deleting a laboratory from your list of authorized locations, please call RSP to perform a closeout survey of that lab in addition to submitting this form.

**Signature of Principal Investigator:** \_\_\_\_\_

\*\*\*\*\*

Committee Action Taken: \_\_\_\_\_  
\_\_\_\_\_

Remarks: \_\_\_\_\_  
\_\_\_\_\_

Recommended for Approval: \_\_\_\_\_  
Radiation Safety Officer Date

Amendment Approved: \_\_\_\_\_  
Chair, Radiation Safety Committee Date

## PROCUREMENT AUTHORIZATION FOR RADIOACTIVE MATERIALS

*All purchase orders or requisitions for the procurement, or transfer of radioactive materials must be directed to and approved by the Radiation Safety Program. All deliveries must be directed to: University of Hawaii Radiation Safety Program, Attn.: (Authorization No.), 2040 East-West Road, Honolulu, HI 96822. Submit the white and yellow copies of this form to the Radiation Safety Program. If approved, the yellow copy will be returned to you and must be attached to the purchase order or requisition. Keep the pink copy for your files.*

NAME: \_\_\_\_\_ AUTHORIZATION NO.: \_\_\_\_\_  
(Principal Investigator)

DEPARTMENT: \_\_\_\_\_ PHONE NO., EXT.: \_\_\_\_\_  
PURCHASE ORDER NO.: \_\_\_\_\_

### RADIOACTIVE MATERIALS TO BE ORDERED

Nuclide	Solid or liquid	Chemical Name	Activity per shipment (in mCi/Bq)	Number of shipments	Total Activity (in mCi/Bq)	Catalog Number

VENDOR: \_\_\_\_\_

DELIVERY DATE(S): \_\_\_\_\_

SPECIAL INSTRUCTIONS TO RSP (refrigerate, freeze, etc.): \_\_\_\_\_

SIGNATURE OF P.I.: \_\_\_\_\_ DATE: \_\_\_\_\_

### RSP USE ONLY

RSO APPROVAL: \_\_\_\_\_ DATE: \_\_\_\_\_

- (CHECK ONE):  UN 2910, Radioactive Material, Limited Quantity, Emergency Response Guide No. 161  
 UN 2915, Radioactive Material, n.o.s., White I, Emergency Response Guide No. 162  
 UN 2915, Radioactive Material, n.o.s., Yellow II, Emergency Response Guide No. 163

**DOT HAZARD CLASS 7.** *The 24-hour emergency phone number is: (808) 956-8591 or (808) 956-6911 (campus security). USNRC license number: 53-00017-23.*

DOT labeled box:  White I,  Yellow II (check one). Radiation reading on contact: \_\_\_\_\_ mR/hr T.I.: \_\_\_\_\_

Instrument used: \_\_\_\_\_ Serial number: \_\_\_\_\_

Wipe test results: \_\_\_\_\_ dpm/cm<sup>2</sup>. Detector used: Packard 2900TR LSC, Ser. No.: DG04072518

Time received at RSP: \_\_\_\_\_ a.m./p.m. Signature of surveyor: \_\_\_\_\_

Ship Code: S/C \_\_\_\_\_ HPAssistant :  Log Book :

SIGNATURE OF RECEIVER: \_\_\_\_\_ DATE: \_\_\_\_\_



**REQUEST FOR PERSONNEL DOSIMETERS**

**Instructions:** Each applicant must complete this form and submit it to the Radiation Safety Office, 2040 East West Road. If you are a new authorized user, submit a Statement of Training form, RSP-2, and an Amendment to Authorization form, RSP-3a, completed by the Principal Investigator, with this form.

1. NAME: \_\_\_\_\_ SEX: \_\_\_\_\_  
(First) (MI) (Last) M/F

2. Mailing Address: \_\_\_\_\_  
(City, State) (Zip)

3. Date of Birth: \_\_\_\_\_

4. Principal Investigator: \_\_\_\_\_ Authorization No.: \_\_\_\_\_

5. Will you work with radiation sources longer than 6 months? \_\_\_\_\_

6. Date badge service first needed: \_\_\_\_\_

7. Type of radiation to which applicant may be exposed (X-ray, beta, gamma, neutron).  
List isotopes, x-ray equipment, etc.: \_\_\_\_\_

8. Building and room number where badge will be located: \_\_\_\_\_

9. Have you been monitored for occupational exposure to radiation this year prior to coming to the University of Hawaii? \_\_\_\_\_

If yes, please fill out the attached sheet. Photocopy additional sheets as necessary for each institution at which radiation exposure was monitored.

**NOTE: See policy on lost dosimeters in the Radiation Safety Manual!**

\*\*\*\*\*

**For Radiation Safety Program Use Only**

Account No.: \_\_\_\_\_ Frequency: \_\_\_\_\_

WH: \_\_\_\_\_ RI: \_\_\_\_\_ Visitor badge date: \_\_\_\_\_

Date service started: \_\_\_\_\_ Date service ended: \_\_\_\_\_

REQUEST FOR RADIATION EXPOSURE HISTORY

Date: \_\_\_\_\_  
Institution: \_\_\_\_\_  
Address: \_\_\_\_\_  
\_\_\_\_\_  
Department: \_\_\_\_\_  
Dates Employed: From: \_\_\_\_\_ To: \_\_\_\_\_

**Attention RSO:**

Please furnish the occupational exposure history of the individual named below, who may have received radiation exposure at your institution, so that we may complete our records to be in compliance with the U. S. Nuclear Regulatory Commission regulations.

Name of Employee: \_\_\_\_\_  
SSN#: \_\_\_\_\_

I hereby authorize the University of Hawaii to secure my past exposure history.

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Thank you for your prompt attention to this matter. Please send the information requested to:

University of Hawaii  
Environmental Health and Safety Office  
Attn: Irene Sakimoto  
2040 East-West Road  
Honolulu, HI 96822

Sincerely,

Irene K. Sakimoto  
Radiation Safety Officer

## **NEW PROCEDURES FOR ISOTOPE SHIPMENTS AND WASTE DISPOSAL**

This new procedure is to help facilitate inventory control over radioisotope shipments and their disposal.

A unique 7-digit ship code number (S/C) will be assigned to each shipment. This unique number will be generated by the HP Assistant software program, which is the Radiation Safety Program's database program to track the University's inventory of radioactive material. Upon receiving a shipment of radioactive material, it will be matched for the correct RSP-4 Form (Procurement Authorization for Radioactive Material form), then the box and the form will be annotated by a sticker with this assigned number.

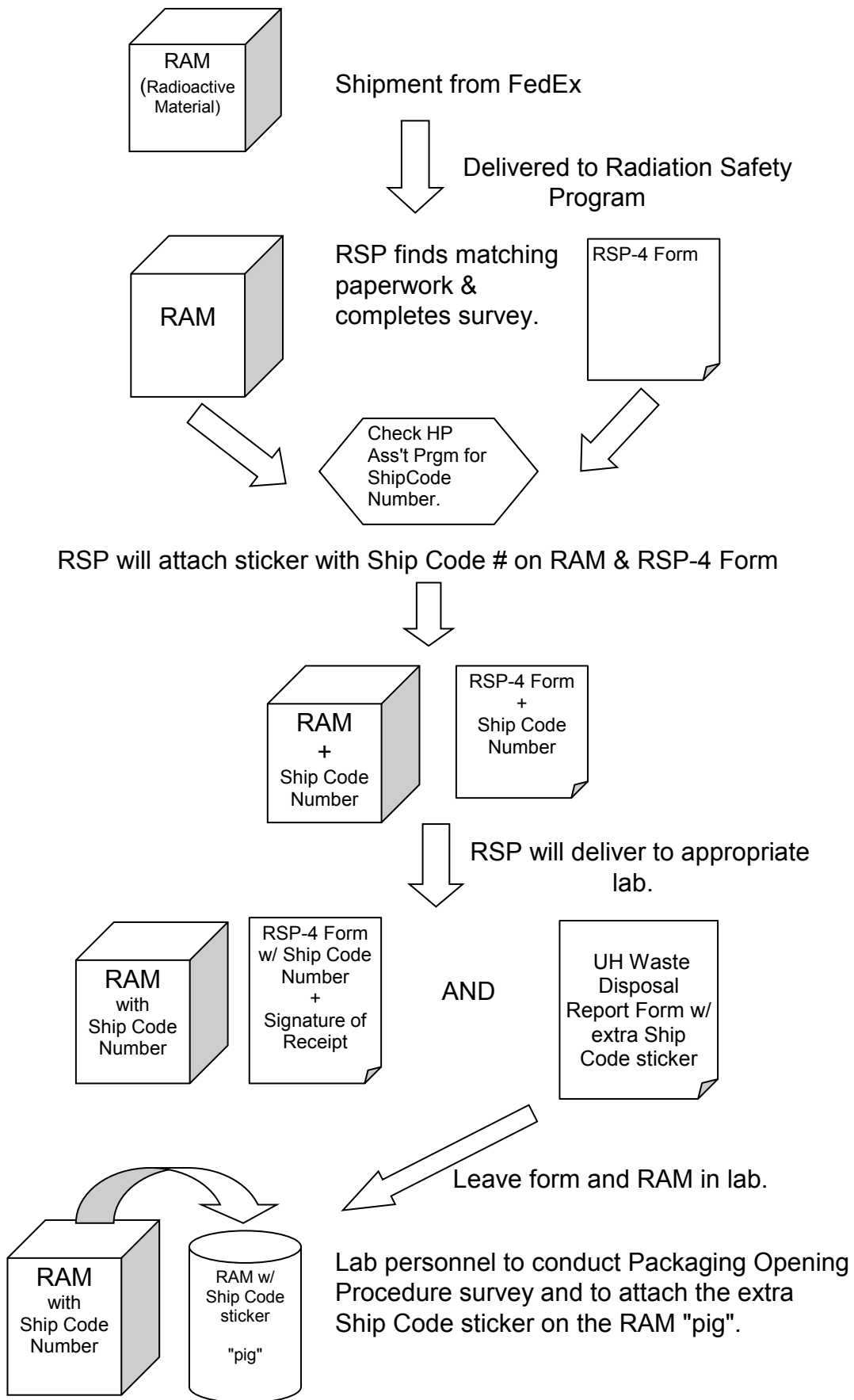
With the delivery of the shipment to your lab, you will be given a new form and have the option to use it or not. If you already have an existing procedure to track your radioactive material, you do not have to use this new form. The new form generated by the database is called the "University of Hawaii Waste Disposal Report Form" and is specific to the shipment delivered. This form has the S/C number, isotope information, licensee's name and authorization number and entry lines designating how the isotope was used and the remaining amount of radioisotope. Attached to this form will be extra ship code stickers. One sticker must be attached to the "pig" by the person who conducts the required "Package Opening Procedures" surveys. The remaining stickers can be used for waste boxes or wherever you need them.

Please see the attached flow chart diagram of this new procedure.

## **USE OF STICKERS FOR WASTE DISPOSAL**

The use of the 7-digit S/C number will also change the waste pick up procedure. The old "Radioactive Waste Request Form" has been amended to accommodate this new procedure change (see new "Waste Pickup Request Form"). Fill out the form as usual except you need to include a ship code (S/C) number in the designated column. A box of waste may contain more than one S/C number, but only one box of waste for each request form (i.e., do not put more than one box of waste on a form).

# Radiation Safety's SHIPMENT PROCEDURES FLOW CHART



## **RADIOACTIVE WASTE PICKUP REQUEST FORM INSTRUCTIONS**

This form is to be filled out for liquid or solid waste that contains radioisotopes but no hazardous chemicals. The form must include all information requested. Use one form per box or bottle of waste. Use additional sheets as necessary. Send the completed form to the Radiation Safety Program and a pickup for your waste will be scheduled.

**LIQUID RADIOACTIVE WASTE** – for pickup of liquid waste that has been contaminated with radioisotopes (the pH must be between 6 and 8). Liquid wastes should be collected in containers that are no larger than one gallon which seal tightly. The bottles should be properly labeled with the isotope, activity and a radioactive material warning label. Old bottle labels shall be obliterated. At least two (2) inches of free air space should be left at the top of the bottle. Place bottles in a box with padding between bottles to prevent breakage. The shipping code number should be placed on the bottles as well as on the pickup form.

**SOLID RADIOACTIVE WASTE** – for pickup of dry waste boxes with no free-standing liquids. Dry waste must be placed in a sealed plastic bag inside the cardboard waste boxes that are provided by the RSP. Do not use red autoclave bags as the liner bag. Autoclaved bags must be defaced or show that they have been autoclaved prior to putting them into the box. Indicate on the waste box and on the form the following information.

<b>ISOTOPE(S)</b>	Indicate what isotope(s) is in each box or bottle. Include the ship code numbers contained in the box or bottle.
<b>ACTIVITY</b>	Indicated how many millicuries and bequerels are in each container.
<b>DATE BOX SEALED</b>	Indicate the date that the box was sealed.
<b>COMPOSITION OF</b>	Indicate what type of waste is in the container, (e.g., gloves, paper, metals, buffer solution name, etc.).
<b>SHIPPING CODE</b>	Use shipping code number on the vial or “pig”.

**LIQUID SCINTILLATION VIALS** – Scintillation vials are considered “mixed waste” and should not be included on the radioactive waste pickup form. The Mixed Waste Pickup Request Form should be filled out and sent to the Office for pickup.



## MIXED WASTE PICKUP REQUEST FORM INSTRUCTIONS

This form is to be used for “mixed wastes,” which are liquid or solid wastes which contain radioisotopes and hazardous chemicals. One form should be filled out for each container. Include all information requested.

**LIQUID MIXED WASTE** -- Liquid waste should be collected in containers that are not larger than one gallon and which seal tightly. At least two inches of free air space should be left at the top of the bottle. The form should be filled out as indicated below.

AMOUNT	Indicate the quantity of waste, i.e., one gallon, one liter, etc.
RADIOISOTOPE	Identify the radioisotope. Do not mix different isotopes together unless it cannot be avoided. If isotopes are mixed together, list all isotopes in the bottle.
ACTIVITY	Record the activity in millicuries and bequerel for each isotope listed.
pH	Before sealing the waste container, check and record the pH.
CHEMICAL NAMES	Identify all chemicals in each container.
% BY VOLUME	Indicate the percentage of each chemical in the container.
SHIPCODE NUMBER	Indicate the ship code numbers in each container.

**SOLID MIXED WASTE**- Solid waste should be double bagged. All headings on the form should be filled out as indicated below.

AMOUNT	Indicate the quantity of waste, i.e. ten pounds, two ounces, etc.
RADIOISOTOPE	Identify the radioisotope. Do not mix different isotopes together unless it cannot be avoided. If isotopes are mixed together, list all isotopes separately.
ACTIVITY	Record the activity in millicuries and becquerels for each isotope listed.
CHEMICAL NAMES	Identify all chemical substances that are in the bag of waste.
SHIPCODE NUMBER	List the ship code numbers contained inside the waste.

**UNIVERSITY OF HAWAII RADIOACTIVE MIXED WASTE PICKUP REQUEST FORM**  
(WASTE CONTAINING BOTH RADIOISOTOPES AND HAZARDOUS CHEMICALS)

**INSTRUCTIONS:**

1. Use and place one form for EACH container/bottle.
2. Enter total volume amount. DO NOT fill container/bottle to the top!
3. List isotope(s) and their activity(s).
4. Enter pH value. (We need this value for disposal purposes)
5. Enter chemical name(s) and the percent% each chemical is present in the total volume.  
(example: total volume is 1 gallon, chemical is toluene, 25% (1 quart of 1 gallon is toluene))
6. Permanently LABEL container/bottle with the following: P.I.'s name, Isotope(s) and their activity(s), Date container/bottle was sealed.

P.I.:	Lab/Location:	Phone:
-------	---------------	--------

**LIQUIDS** pH value: \_\_\_\_\_ Total VOLUME: \_\_\_\_\_

Date	Isotope(s)	Activity(s)	Ship Code(s)	Chemical Name(s)	Percent%

**SOLIDS** pH value: \_\_\_\_\_ Total WEIGHT: \_\_\_\_\_

Date	Isotope(s)	Activity(s)	Ship Code	Chemical Name(s)	Percent%

Date Container/Bottle Closed: \_\_\_\_\_. I HAVE READ AND UNDERSTAND ALL CONDITIONS ON THIS FORM.

GENERATOR CERTIFICATION: I certify the above waste contains NO UNTREATED biohazardous materials.

PRINCIPLE INVESTIGATOR SIGNATURE: \_\_\_\_\_ Date: \_\_\_\_\_

Radiation Safety Program Use Only

Container/Bottle #: \_\_\_\_\_

RSO Signature: \_\_\_\_\_ Date: \_\_\_\_\_

**24-HR EMERGENCY PHONE NUMBER: (808)956-6911. CONTACT: RADIATION SAFETY PROGRAM, 956-8591.**



## Procedures for packing and submitting radioactive cruise waste to UH's Radiation Safety Program<sup>10/2011</sup>

1. Use a strong and sturdy box for dry waste, and carboy or similar for liquid waste.
2. Boxes need to be marked as a "Radioactive Material Container" and must have the universal radiation symbol on it.
3. When a box is used, tape the flaps shut with strong packing tape. (DO NOT CRISS-CROSS THE FLAPS). Boxes taped with lab tape, duct tape, masking tape or any other type of inadequate tape will not be accepted.
4. Boxes need to have a plastic bag liner e.g., a garbage bag. NO LIQUIDS are allowed in these boxes. Boxes with signs of leakage will not be picked up unless packaged in plastic bags.
5. If you are submitting liquids in a carboy jug or something similar, make sure the container is closed tightly. Complete the "**Waste Pick-Up Form for Cruises**" and "**Waste Label**" and attach.
6. The isotope to be disposed in a box should be visibly written on the front of the box for all to see. This is to keep long and short lived isotopes in separate boxes and/or people from tossing in the different isotope(s) in the wrong box.
7. When the box is full, the bag is to be taped shut with clear or packing tape. Lab tape, duct tape or masking tape is not acceptable. Close box (DO NOT CRISS-CROSS THE FLAPS) and seal with the same strong tape used for the bottom.
8. After the box is sealed, it needs to be clearly marked with the "**Waste Pick-Up Form for Cruises**" and a "**Waste Label**". This needs to be done before sending in the waste request form(s) and before the arrival of Radiation Safety staff.
9. Dispose scintillation vials by keeping vials in the cardboard flats and putting flats inside a waste box. If no flats are available, place vials into a plastic bag lined box and seal when full as stated above. Use the "**Waste Label**" and the "**Mixed Waste Pick Up Form for Cruises**".
10. To submit a waste pick up request form(s), download the current form from our website, <http://www.hawaii.edu/ehso/radiation/reference.htm>.
11. There is only one form per box, forms should indicate which box it is, e.g. Box 1 of 5, and the boxes/bottles of waste should match the forms. All information must be complete and clearly filled out.
12. Ship Codes **must** be filled in. This is to track radioactive material and to properly remove it from the PI's license inventory into the waste stream.
13. Forms must be signed by the Chief Scientist.
14. Forms can be submitted to our office via email ([isakimot@hawaii.edu](mailto:isakimot@hawaii.edu), [ntg@hawaii.edu](mailto:ntg@hawaii.edu)) or by fax at 808-956-3205.
15. If you are submitting the waste request form(s) for pick up at an off campus facility, like Snug Harbor, the waste containers need to be swiped (see "swipe" document and the results of those swipes are to be submitted with the request pick up form.
16. If there are any questions in packaging and submitting radioactive waste please call our office at 956-8591.
17. All instructions are to be followed or we will not pick up your waste.

Thank you for your patience and cooperation. These measures are to help keep everyone and our campus safe.



**UNIVERSITY OF HAWAII RADIOACTIVE MIXED WASTE PICKUP REQUEST FORM**  
(WASTE CONTAINING BOTH RADIOISOTOPES AND HAZARDOUS CHEMICALS)  
**(DO NOT MIX RADIOACTIVE LIQUIDS WITH RADIOACTIVE SOLIDS)**

**INSTRUCTIONS:**

1. Use and place one form for EACH container/bottle.
2. List isotope(s) and their activity(s).
3. **A \$70 fee will be charged for unknown chemical analysis.**
4. LABEL container/bottle with the following: P.I.'s name, Isotope(s) and their activity(s), Date container/bottle was sealed and identifying container/bottle number.
5. For **liquids**, a) DO NOT fill container/bottle to the top! Enter total volume amount.  
b) Enter pH value (we need this for disposal purposes) and volume.  
c) Enter chemical name(s) and the percent (%) each chemical is present in the total volume.  
(example: total volume is 1 gallon, chemical is toluene:25%, water 75% (1 quart of 1 gallon is toluene))

P.I.:	Res. Vessel:	Cruise No.:
Tech Name:	Tech Info (cell/email/fax):	
Chief Scientist:	Chief Info (cell/email/fax):	
Waste Location (I.E. under bench, in hood, etc.)		

**LIQUIDS** pH value: \_\_\_\_\_ Total VOLUME: \_\_\_\_\_

Date	Isotope(s)	Activity(s)	Ship Code(s)	Chemical Name(s)-Be Specific!	Percent%

**OR                                      OR                                      OR                                      OR                                      OR**

**SOLIDS**

Date	Isotope(s)	Activity(s)	Ship Code(s)	Content(s)

Date Container/Bottle Closed: \_\_\_\_\_. I HAVE READ AND UNDERSTAND ALL CONDITIONS ON THIS FORM.

GENERATOR CERTIFICATION: I certify the above waste contains NO UNTREATED biohazardous materials.

CHIEF SCIENTIST SIGNATURE: \_\_\_\_\_ Date: \_\_\_\_\_

<i>Radiation Safety Program Use Only</i>	
Container/Bottle #: _____	W #: _____
RSO Signature: _____	Date: _____

**24-HR EMERGENCY PHONE NUMBER: (808)956-6911. CONTACT: RADIATION SAFETY PROGRAM, 956-8591.**

!!!! ONE FORM PER BOX OR BOTTLE !!!!

**\*WASTE INFORMATION FORM\*** DATE SEALED WASTE : \_\_\_\_\_

ISOTOPE: \_\_\_\_\_ ACTIVITY: \_\_\_\_\_ ; ISOTOPE: \_\_\_\_\_ ACTIVITY: \_\_\_\_\_

ISOTOPE: \_\_\_\_\_ ACTIVITY: \_\_\_\_\_ ; ISOTOPE: \_\_\_\_\_ ACTIVITY: \_\_\_\_\_

**DETAILED** WASTE ITEMS: \_\_\_\_\_

(i.e. 1qt. of C-14 in 10% benzene, 90% seawater)

YOUR NAME, EMAIL, PHONE: \_\_\_\_\_  
(PRINT CLEARLY)

CHIEF SCIENTIST NAME, EMAIL, PHONE: \_\_\_\_\_  
(PRINT CLEARLY)

BOAT: **K.M./K.O.K.** CRUISE DATE & NAME: \_\_\_\_\_

WASTE LOCATION: \_\_\_\_\_ WASTE NUMBER: \_\_\_\_\_  
(BE SPECIFIC, i.e. under bench, in hood, etc.) (i.e. #2 of 5, box A)

K.M./K.O.K. STAFF SIGNATURE: \_\_\_\_\_ DATE: \_\_\_\_\_

----- cut ----- cut ----- cut ----- cut ----- cut -----

!!!! ONE FORM PER BOX OR BOTTLE !!!!

**\*WASTE INFORMATION FORM\*** DATE SEALED WASTE: \_\_\_\_\_

ISOTOPE: \_\_\_\_\_ ACTIVITY: \_\_\_\_\_ ; ISOTOPE: \_\_\_\_\_ ACTIVITY: \_\_\_\_\_

ISOTOPE: \_\_\_\_\_ ACTIVITY: \_\_\_\_\_ ; ISOTOPE: \_\_\_\_\_ ACTIVITY: \_\_\_\_\_

**DETAILED** WASTE ITEMS: \_\_\_\_\_

(i.e.. 1qt. of C-14 in 10% benzene, 90% seawater)

YOUR NAME, EMAIL, PHONE: \_\_\_\_\_  
(PRINT CLEARLY)

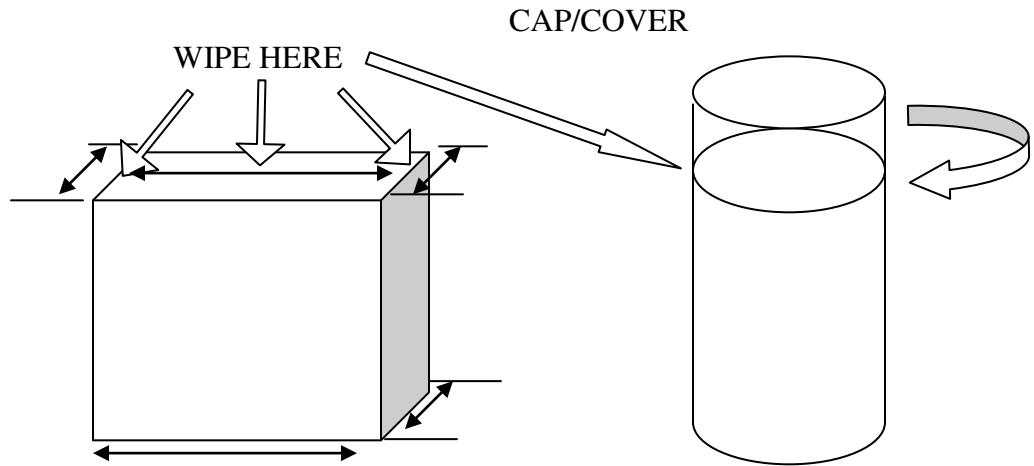
CHIEF SCIENTIST NAME, EMAIL, PHONE: \_\_\_\_\_  
(PRINT CLEARLY)

BOAT: **K.M./K.O.K.** CRUISE DATE & NAME: \_\_\_\_\_

WASTE LOCATION: \_\_\_\_\_ WASTE NUMBER: \_\_\_\_\_  
(BE SPECIFIC, i.e. under bench, in hood, etc.) (i.e. #2 of 5, box A)

K.M./K.O.K. STAFF SIGNATURE: \_\_\_\_\_ DATE: \_\_\_\_\_

## Contamination Swipe Locations for Waste Container Surveys



## **APPENDIX B**

### **AIR AND WATER RELEASE LIMITS**

Appendix B to 10 CFR Part 20—Annual Limits on Intake (ALIs) and Derived Air Concentrations (DACs) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sewerage

This document is available online at:

<http://www.nrc.gov/reading-rm/doc-collections/cfr/part020/part020-appb.html>

**APPENDIX C**  
**EXEMPT QUANTITIES**

Appendix C to 10 CFR Part 20—Quantities of Licensed Material Requiring Labeling

This document is available online at:

<http://www.nrc.gov/reading-rm/doc-collections/cfr/part020/part020-appc.html>

## **APPENDIX D**

### **ADMINISTRATION**

In conformance with applicable sections of the Nuclear Regulatory Commission (NRC) Rules and Regulations, the following administrative procedures have been established.

#### **A. University of Hawaii Administration**

The President of the University of Hawaii is responsible to the NRC for the utilization and maintenance of the by-product materials license. For administrative purposes, these responsibilities have been delegated to the Radiation Safety Committee of the University of Hawaii.

#### **B. Radiation Safety Committee**

Members of the Radiation Safety Committee (Committee) are appointed by the President for a term of three years. The Committee membership includes the Radiation Safety Officer; a representative for the University administration; and four or more members actively engaged in research involving sources of radiation. The President appoints the Committee Chairperson.

The Committee will meet as often as required to carry out its responsibilities but will meet no less than quarterly.

The Committee makes recommendations for the President's approval to establish policies and procedures for the control of acquisition, receipt, storage, use and disposal of sources of radiation.

The responsibilities of the Radiation Safety Committee include but are not restricted to those presented below. The Committee has full authority to discharge these responsibilities.

1. Review all applications, amendments, and renewals for use of radioisotopes or other sources of radiation at the University of Hawaii. Approval will be given only when the training and experience of the Principal Investigator and users are deemed adequate from the standpoint of personnel and public safety and take appropriate measures to maintain exposures ALARA.
2. The Committee will prescribe special conditions and procedures to ensure maintenance of sound practices of radiological health and ALARA. Such conditions may include, but are not restricted to, biomedical tests on users, requirements for additional training, limitations of areas of locale of use and specification of the type and frequency of personnel and area monitoring.



3. The Committee will serve as a source of information on radiological safety, will disseminate pertinent information to all users or to individuals and will provide guidance in the training of users with regard to source materials, courses, and other means of improving the level of expertise.
4. The Committee will establish and maintain an ALARA review plan. This will include a review of dosimetry, bioassay, and lab survey reports. Quarterly radiation safety reports will be presented to the Committee. Exposures which exceed investigational limits as described in Part V, Permissible Doses, will be investigated. This review is to assess trends in occupational exposure as an index of the ALARA program quality and to decide if action is warranted when investigational levels are exceeded.

**C. Radiation Safety Committee Chairperson Responsibilities**

The chairperson may act on behalf of the Committee in any safety related situation that requires immediate action.

**D. Principal Investigator Responsibilities**

The person in charge or responsible for a University project(s) involving radioactive materials is considered the Principal Investigator. He or she is responsible for maintaining a safe and healthful environment for those persons under his or her control by providing them with the protection from hazardous radiation. This manual requires that Principal Investigators comply with the standards and policies contained herein and to maintain all supervised individual's exposures ALARA.

**E. Radiation Safety Officer Responsibilities**

With delegated authority to act for the Committee, the Radiation Safety Officer (RSO) is responsible for the execution of the Radiation Safety Program. The primary responsibility of the RSO is to monitor the adherence to the regulations set forth in this manual.

The RSO is authorized to make inspections and surveys, to monitor all use of radiation sources, and to review any records required by this manual and applicable State and Federal regulations.

The RSO assists and advises users on matters of radiation health and safety in such a manner as to assure a minimum of delay and inconvenience to their research. The RSO assists the users in observing proper safety precautions and assures all concerned that adequate measure of safety are being practiced to keep exposures ALARA. In the event of any violation of these regulations or discovery of unsafe conditions, the RSO shall

bring this matter to the attention of the Principal Investigator. If no corrective action is taken, the RSO has the authority to impose cessation of the operation and/or to confiscate radioactive materials. The RSO shall promptly report all instances of non-compliance to the Chairperson of the Committee.

The RSO is responsible for the maintenance and control of all central record keeping requirements including the registration of sources of hazardous radiation, Principal Investigators under the program, inventory of radioactive materials, disposal of radioactive waste, inspection reports, monitoring records and other records required by the NRC, and other enforcing agencies.

The RSO is delegated the authority to approve requests for purchases of radioactive materials within the authorized limits allowed for each PI.

The RSO is delegated authority to approve amendments to existing authorizations which involve no increase in hazard, e.g., changes in personnel, use location, minor changes in isotope type, form or quantity.

The RSO will perform an annual review of the radiation safety program for adherence to ALARA concepts. Reviews of specific methods of use may be conducted on a more frequent basis.

The RSO will review at least quarterly the external radiation doses of authorized users and workers to determine that their doses are ALARA.

#### **F. Radiation Workers**

For the purposes of this manual, radiation workers are those employees and students working with radioactive materials under the supervision of a Principal Investigator. All radiation workers shall comply with the standards, rules, regulations in the manual which are applicable to their actions and conduct.

#### **G. Enforcement Policy**

The Committee will carry out the following enforcement policy if needed.

1. First violation: A written notification to the Principal Investigator (PI), from the Radiation Safety Program (RSP), of any significant violation of the NRC license condition.
2. Second or repeat violation: A written notification to the PI from the Committee of any serious or repeat violation. The PI may be put on probationary status\*.

3. Third or continuing violation: A written notification to the PI from the Committee putting the PI on probationary status.\* The Committee may revoke or suspend authorization and require the PI to appear before the Committee prior to reinstatement of authorization.

\* Probationary status: a period during which continuing violations of University requirements will result in suspension or revocation of a PI's authorization.

## APPENDIX E

### DEFINITIONS

Absorbed dose	The energy imparted by ionizing radiation per unit mass of irradiated material. The units of absorbed dose are the rad and the gray (Gy).
Activity	The rate of disintegration (transformation) or decay of radioactive material. The units of activity are the curie (Ci) and the Becquerel (Bq).
ALARA	(Acronym for “as low as reasonably achievable”) means making every effort to maintain exposures to radiation as far below the dose limits in 10 CFR 20 as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.
Annual limit on intake (ALI)	The derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by the reference man that would result in a committed dose equivalent of 50 rems to any individual organ or tissue. See Table 1, Columns 1 and 2 of Appendix B.
Background Radiation	Radiation arising from sources other than the one directly under consideration.
Becquerel (Bq)	Amount of radioactive material defined as the quantity of any radioactive material in which the number of disintegrations is one per second.
Bioassay	The determination of kinds, quantities or concentrations, and in some cases, the locations of radioactive material in the human body, whether by direct measurement (in vivo counting) or by analysis and evaluation of materials excreted or removed from the human body.

Byproduct Material	Any radioactive material (except special nuclear material) yielded in, or made radioactive by, exposure to the radiation incident to the process of producing or utilizing special nuclear material; and, the tailings or wastes produced by the extraction or concentration of uranium or thorium from ore processed primarily for its source material content, including discrete surface wastes resulting from uranium solution extraction processes. Underground ore bodies depleted by these solution extraction operations do not constitute “byproduct material” within this definition.
Committed dose equivalent	The dose equivalent to organs or tissues of reference (T) that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.
Committed Effective dose equivalent	The sum of products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to these organs or tissues.
Committee	means the Radiation Safety Committee of the University of Hawaii
Curie (Ci)	Amount of radioactive material defined as the quantity of any radioactive material in which the number of disintegrations per second is 37 billion ( $3.7 \times 10^{10}$ ).
Declared pregnant woman	A woman who voluntarily informs her employer, in writing, of her pregnancy and the estimated date of conception.
Derived Air Concentration (DAC)	The concentration of a given radionuclide in air which, if breathed by the reference man for a working year of 1,000 hours under conditions of light work (inhalation rate 1.2 cubic meters of air per hour), results in an intake of one ALI. DAC values are given in Table 1, Column 3, of Appendix B.
Dose or radiation dose	The quantity of radiation absorbed per unit of mass by the body or any portion of the body. It is a generic term that means absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, or total effective dose equivalent.

Effective dose equivalent	The sum of the products of the dose equivalent to the organ or tissue and the weighting factors applicable to each of the body organs or tissues that are irradiated.
Exposure	Being exposed to ionizing radiation or to radioactive material.
External dose	That portion of the dose equivalent received from radiation sources outside the body.
Extremity	Means the hand, elbow, arm below the elbow, foot, knee or leg below the knee.
Eye dose equivalent	Applies to the external exposure of the lens of the eye and is taken as the dose equivalent at a tissue depth of 0.3 centimeters (300 mg/cm <sup>2</sup> ).
Gray (Gy)	The SI unit for the rad. 1 gray = 100 rads
High Radiation Area	Any area accessible to personnel in which there exists radiation levels such that a major portion of the body could receive in any hour a dose in excess of one hundred millirems at 30 centimeters from the radiation source or from any surface that the radiation penetrates.
Individual monitoring devices	Devices designed to be worn by a single individual for the assessment of dose equivalent such as film badges, thermoluminescent dosimeters (TLDs), pocket ionization chambers, and person (lapel) air sampling devices.
Internal dose	That portion of the dose equivalent received from radioactive material taken into the body.
Ionizing radiation	Any electromagnetic or particulate radiation capable of producing ions, directly or indirectly, in its passage through matter. Includes gamma rays and x-rays; alpha and beta particles, electrons, neutrons, protons, and other nuclear particles; but not sound or radio waves, or visible, infrared or ultraviolet light.
Licensed Material	Means source material, special nuclear material, or byproduct material received, possessed, used, transferred or disposed of under a general or specific license issued by the Commission.

Licensee	The holder of a license
Lost or missing licensed material	Licensed material whose location is unknown. It includes material that has been shipped but has not reached its destination and whose location is not a member of the public during any period in which the individual receives an occupational dose.
Minor	An individual less than 18 years of age.
Microcurie (uCi)	One millionth of a curie, viz. 37 thousand disintegrations per second = 2.22 million disintegrations per minute ( $2.22 \times 10^6$ ).
Millicurie (mCi)	One thousandth of a curie, viz. 37 million disintegrations per second per second ( $3.7 \times 10^7$ )
Mixed Waste	Hazardous regulated waste that is contaminated with radioisotopes.
Nuclear Regulatory Commission	Means the United States Nuclear Regulatory Commission (NRC) or any successor thereto.
Occupational Dose	The dose received by an individual in a restricted area or in the course of employment in which the individual's assigned duties involves exposure to radiation and the radioactive material from licensed and unlicensed sources of radiation, whether in the possession of the licensee or other person. Occupational dose does not include dose received from background radiation, as a patient from medical practices, from voluntary participation in medical research programs, or as a member of the general public.
Personnel Monitoring	The measurement of radiation levels, concentrations, surface area concentration or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposures and doses.
Planned Special Exposure	An infrequent exposure to radiation, separate from and in addition to the annual dose limits.

Principal Investigator	The person in charge or responsible for a radiological project who has been approved on an Application for Use of Radioactive Materials or Ionizing Radiation Devices
Public Dose	The dose received by a member of the public from exposure to radiation and to radioactive material released by a licensee, or to another source of radiation either within a licensee's controlled area or in unrestricted areas. It does not include occupational dose or doses received from background radiation, as a patient from medical practices, or from voluntary participation in medical research programs.
Quality Factor (Q)	The modifying factor that is used to derive dose equivalent from absorbed dose.
Rad	Means a measure of the dose of any ionizing radiation to body tissues in terms of energy absorbed per unit of mass of the tissue. One rad is the dose corresponding to the absorption of 100 ergs per gram of tissue (1 millirad = 0.001 rad).
Radiation	Ionizing radiation means alpha particles, beta particles, gamma rays, x-rays, neutrons, high-speed electrons, high-speed protons, and other particles capable of producing ions. Radiation, as used in this part, does not include non-ionizing radiation, such as radio or microwaves, or visible, infrared, or ultraviolet light.
Radiation Area	Any area accessible to personnel in which there exists radiation levels such that a major portion of the body could receive in any hour a dose in excess of five millirem at 30 centimeters from the radiation source or from any surface that the radiation penetrates.
Radiation Worker	Any person who works with radiation sources. The Principal Investigator and the Radiation Safety Officer will decide if an individual is a radiation worker.
Radioactive Material	Means any material which emits by spontaneous nuclear disintegration corpuscular or electromagnetic emanations.
Radioisotope laboratory	Is defined as any room (except those containing only sealed sources or used exclusively for storage) which contain radioactive materials in amounts in excess of 5 millicuries



	of natural uranium or thorium, or more than exempt quantities of any other radioactive material.
Radioisotopes	Unless otherwise specified by the Radiation Safety Committee, for purposes of this manual, the word “radioisotope” means any material, solid, liquid, or gas which emits radiation spontaneously.
REM	<p>“Rem” means a measure of the dose of any ionizing radiation to body tissue in terms of its estimated biological effect relative to a dose of one roentgen of x-rays (1 millirem (mrem) = 0.001 rem). The relation of the rem to other dose units depends upon the biological effect under consideration and upon the conditions for irradiation. Each of the following is considered to be equivalent to a dose of 1 rem:</p> <ol style="list-style-type: none"> <li>a. A dose of 1 rad due to x, gamma, or beta radiation;</li> <li>b. A dose of 0.1 rad due to neutrons or high energy protons;</li> <li>c. A dose of 0.05 rad due to particles heavier than protons and with sufficient energy to reach the lens of the eyes.</li> </ol>
Restricted Area	Any area access which is controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials. “Restricted area” shall not include any areas used as residential quarters, although a separate room or rooms in a residential building may be set apart as a restricted area.
Shall	Requirements that are to be applied in the interest of minimizing radiation exposure
Sievert (Sv)	The SI unit for the REM 1 Sievert = 100 REMS
State	Means the State of Hawaii and any of its agencies empowered to establish regulations regarding radiation and radioactive materials.
Survey	An evaluation of the radiological conditions and potential hazard incident to the production, use transfer, release, disposal, or presence of radioactive material or other sources of radiation. When appropriate, such an

evaluation includes a physical survey of the location of radioactive material and the measurements or calculations of levels of radiation, or concentrations or quantities of radioactive materials present.

TLD Dosimetry

A thermoluminescent dosimeter – a crystal having thermoluminescent properties used for personnel and environmental monitoring. Normally used by personnel for the detection of ionizing radiation exposure to the individual wearing a TLD badge.

Total Effective Dose Equivalent

(TEDE) means the sum of the deep-dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposure).

University

The term “University” means the University of Hawaii and applies to all locations which are owned or controlled by the Board of Regents and are under the administrative control of the President of the University or his duly appointed delegates.

Unrestricted Area

An area, access to which is not controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials, and any area used for residential quarters.

Whole Body

For external exposure includes the head, trunk (including male gonads), arm above the elbow, or legs above the knee.

## APPENDIX F

University of Hawaii  
Radiation Safety Office

02/99

### Nuclide Fact Sheet: **Hydrogen - 3 (H<sup>3</sup>) or Tritium**

1. Chemical Symbol: H Atomic Number: 1 Mass Number: 3

2. Half-Life and Decay Data: B-  
 ${}^3\text{H} \text{-----} > {}^3\text{He}$   
 12 years

3. Specific Activity: 9.78 x 10<sup>3</sup> Curies/gm

4. Significant Radiation (Energy in MeV)

<u>Radiation</u>	<u>Energy (MeV)</u>	<u>Fraction/dis</u>
B-	0.0181	1.0

5. Dose Rates per millicurie (assuming point source unshielded): Negligible

6. Range and Shielding Data:

The range of the 0.0181 MeV Beta is less than 0.1 mg/cm<sup>2</sup> of any material or of any material or 0.001 inches of Lucite.  
 The range in air is less than 6 inches.

7. Effective Biological Half-Life: 12 days

8. Occupational Values

<u>Oral Ingestion ALI (uCi)</u>	<u>Inhalation ALI(uCi)</u>	<u>DAC(uCi/ml)</u>
8 x 10+4	8 x 10+4	2 x 10-5

9. Legal Requirements

1. Caution Radioactive Material Sign.....10 mCi
2. Caution Radioactive Material Label.....1 mCi
3. Maximum amount in Sanitary Sewer in One Day (Soluble only).....200 uCi

Nuclide Fact Sheet: **Iodine-125**

1. Chemical Symbol: I Atomic Number: 53 Mass Number: 125

2. Half-Life and Decay Data: Electron Capture  
 $^{125}\text{I} \text{-----} > ^{125}\text{Te}$   
60 days

3. Specific Activity: 17.4 Curies per milligram

4. Significant Radiations

<u>Radiations</u>	<u>Energy MeV</u>	<u>Fraction/djs</u>
K a-1 x-ray	0.028	0.74
K a-2 x-ray	0.027	0.38
K B-1 x-ray	0.031	0.20
K B-2 x-ray	0.032	0.04
Y ray	0.035	0.07

Monoenergetic Electrons

<u>Energy MeV</u>		<u>#/100 Decays</u>
0.035	Conversion	8
0.031	Conversion	11
0.023	Auger	14
0.026	Auger	6
0.030	Auger	1
0.004	Conversion	75
0.003	Auger	149
0.0008	Auger	359

5. Dose Rates per millicurie (assuming point source unshielded):

<u>Beta (skin dose)</u>	<u>Gamma</u>	<u>Bremstrahlung</u>
<u>mrad/hr/mCi @ cm</u>	<u>mrad/hr/mCi @30cm</u>	<u>mrad/hr/mCi @30 cm</u>
Negligible*	1.63 mrad/hr/mCi	Negligible

\*Negligible from external point of view, not negligible for internal disposition.

6. Range and Shielding Data

Approximate Tenth Value Thickness in cm:

<u>Gamma Energy</u>	<u>Fe</u>	<u>Pb</u>	<u>Al</u>
0.035	0.06	0.02	1.2

The monoenergetic electrons can be stopped by 2 mg/cm<sup>2</sup> of any material; 0.001 cm of Lucite is sufficient.

7. Effective Biological Half-Life: 42 Days, depending on organ of reference.

8. Occupational Values

<u>Oral Ingestion ALI (uCi)</u>	<u>Inhalation ALI (uCi)</u>	<u>DAC(uCi/ml)</u>
4 x 10 <sup>+1</sup> (thyroid)	6 x 10 <sup>+1</sup> (thyroid)	3 x 10 <sup>-8</sup>

9. Legal Requirements:

1. Caution Radioactive Material Sign..... 10 uCi
2. Caution Radioactive Material Label..... 1 uCi
3. Maximum Amount in Sanitary sewer in One Day(soluble).... 10 uCi
4. Amount of Water to Insure Adequate Dilution of 10 uCi..250 liters

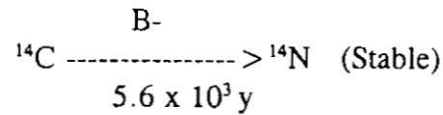
10. Comments:

High vapor hazard. Care must be taken to prevent free iodine release. Work in a hood and ventilated room.

Nuclide Fact Sheet: **Carbon-14**

1. Chemical Symbol: C Atomic Number: 6 Mass Number: 14

2. Half-Life and Decay Data:



3. Specific Activity: 4.61 Curies/gm

4. Significant Radiation (energy in MeV):

<u>Radiation</u>	<u>Energy (MeV)</u>	<u>Fraction/dis</u>
Beta	0.155	1.0

5. Dose Rates per millicurie (assuming point source unshielded):

Beta (Skin Dose)  
Rad/hr/mCi @ 10 cm  
0.6

6. Range and Shielding Data:

The 0.155 MeV beta can be stopped by approximately 29 mg/cm<sup>2</sup> of any material.  
0.009 inches of Lucite is sufficient.  
The range in air is 10 inches

7. Effective Biological Half-Life:

<u>Fat</u>	<u>Total Body</u>	<u>Bone</u>
12 days	10 days	40 days

8. Occupational Values

<u>Oral Ingestion ALI (uCi)</u>	<u>Inhalation ALI (uCi)</u>	<u>DAC(uCi/ml)</u>
$2 \times 10^{+3}$	$2 \times 10^{+3}$	$1 \times 10^{-6}$

9. Legal Requirements:

1. Caution Radioactive Material Sign.....1 mCi
2. Caution Radioactive Material Label.....100 uCi
3. Maximum amount in sanitary sewer in one day (soluble only)... 50 uCi
4. Amount of H<sub>2</sub>O needed to insure adequate dilution of 50 uCi...2.5 liters

Nuclide Fact Sheet: **Sulfur-35**

1. Chemical Symbol: S Atomic Number: 16 Mass Number: 35

2. Half-Life and Decay Data: Beta  
 $^{35}\text{S} \xrightarrow{87 \text{ days}} ^{35}\text{Cl} \text{ (stable)}$

3. Specific Activity: 43 Curies per milligram

4. Significant Radiations:

<u>Radiation</u>	<u>Energy MeV</u>	<u>Fraction/dis</u>
Beta	0.167	1.00

5. Dose Rates per millicurie (assuming point source unshielded):

<u>Beta (skin dose)</u> <u>mrad/hr/mCi @10cm</u>	<u>Gamma</u> <u>mrad/hr/mCi @30 cm</u>	<u>Bremmstrahlung</u> <u>mrad/hr/mCi @ 30 cm</u>
625	None	Negative

6. Range and Shielding Data:

The 0.167 MeV Beta can be stopped by 34 mg/cm<sup>2</sup> of any material.  
0.01 inches of Lucite is sufficient.  
The range in air is about 11 inches.

7. Effective Biological Half-Life: 44 to 82 days, depending on organ of reference.

8. Occupational Values

<u>Oral Ingestion ALI (uCi)</u>	<u>Inhalation</u> <u>ALI (uCi)</u>	<u>DAC(uCi/ml)</u>
1 x 10 <sup>+4</sup>	2 x 10 <sup>+4</sup>	7 x 10 <sup>-6</sup>

9. Legal Requirements

1. Caution Radioactive Material Sign..... 1 mCi
2. Caution Radioactive Material Label..... 100 uCi
3. Maximum amount in sanitary sewer in one day (soluble only).... 100 uCi
4. Amount of water to insure adequate dilution of 50 uCi..... 25 liters



Nuclide Fact Sheet: **Phosphorus-32**

1. Chemical Symbol: P Atomic Number: 15 Mass Number: 32

2. Half-Life and Decay Data: Beta-  
 $^{32}\text{P} \xrightarrow{14.22 \text{ days}} ^{32}\text{S} \text{ (stable)}$

3. Specific Activity: 2.86 x 10<sup>5</sup> Curies/gram

4. Significant Radiations (Energy in MeV):

<u>Radiation</u>	<u>Energy (MeV)</u>	<u>Fraction/dis</u>
beta	1.70	1.0

5. Dose Rates per millicurie (assuming point source unshielded):

<u>Beta (skin dose)</u> <u>Rad/hr/mCi @ 10cm</u>	<u>Bremmstrahlung</u> <u>mrad/hr/mCi @ 30 mCi</u>
3.7	0.17

6. Range and Shielding Data

The 1.7 MeV beta can be stopped by 800 mg/cm<sup>2</sup> of any material.  
0.3 inches of Lucite is sufficient.  
The range in air is 270 inches.

7. Effective Biological Half-Life: 13.5 to 14.1 days depending on organ of reference

8. Occupational Values

<u>Oral Ingestion ALI (uCi)</u>	<u>Inhalation</u> <u>ALI (uCi)</u>	<u>DAC (uCi/ml)</u>
6 x 10 <sup>+2</sup>	9 x 10 <sup>+2</sup>	4 x 10 <sup>-4</sup>

9. Legal Requirements:

1. Caution Radioactive Material Sign.....100 uCi
2. Caution Radioactive Material Label..... 10 uCi
3. Maximum amount in sanitary sewer in one day (soluble only)..... 10 uCi
4. Amount of water needed to insure adequate dilution of 10 uCi ..... 20 liters

10. Comments:

### DOSE RATES

It is not realized by many users that the skin doses from phosphorus-32 tend to be astronomical as displayed in the following table:

Dose rates from 1 mCi Phosphorus-32 over 1 cm<sup>2</sup> of skin are:

At surface of the skin (contact)	2000 rads/hr
At 1 cm	200 rads/hr
At 10 cm	22 rads/hr*

\*Differs from No. 5 above which theoretically considers a point source unshielded.

Dose rate for 1 mCi Phosphorus-32 in 1 ml of water:

At surface	780 rads/hr
------------	-------------

It is obvious that in any incident involving personnel contamination of the skin, immediate decontamination and medical attention is indicated. Beta contamination surveys should be a standard procedure following all phosphorus-32 experiments.

### BODY DOSE

The maximum permissible body burden of Phosphorus-32 is 30 uCi. However, the maximum permissible burden for the bone critical organ is 6 uCi. Although about 60% of Phosphorus-32 that is ingested is excreted within the first 24 hours, only about 1% per day is excreted after the second or third day following ingestion. Therefore, in the event of a suspected or confirmed ingestion, the Environmental Health and Safety Office should be notified immediately and urine samples should be submitted, followed by rapid analysis. Dose evaluations also require knowledge of the approximate date and time the isotope was handled.

### PRECAUTIONS

1. Employ both low and high density shielding. Avoid direct contact with skin. Use gloves. Protect eyes from chemical splash and unnecessary radiation. Use remote handling tools. Prevent ingestion. Isolate waste.
2. Film badges should be used by all personnel working with Phosphorus-32. If millicurie quantities are manipulated, wrist and finger badges should also be used.

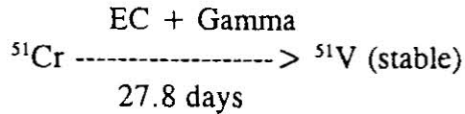
3. Wrist badge readings serve ONLY as an indicator of exposure problems in the laboratory. Relatively low wrist badge readings may fail to reveal high exposure to the fingers.
4. One of the greatest hazards associated with beta emitters of this energy exists in handling uncovered vessels containing the material. For example, the surface dose rate of 1 mCi of Phosphorus-32 in 1 ml of solution is approximately 13 rads/minute.

The dose rate will not be appreciably reduced by attenuation in a few centimeters of air, nor will there be much reduction by inverse square law from a source of this kind. It is obvious that a hand or face over such an open container may receive a considerable dose of radiation in a short period of time.

Nuclide Fact Sheet: **Chromium-51**

1. Chemical Symbol: Cr Atomic Number: 24 Mass Number: 51

2. Half-Life and Decay Data:



3. Specific Activity: 92.3 Curies per milligram

4. Significant Radiations

<u>Radiations</u>	<u>Energy MeV</u>	<u>Fraction/dis</u>
Gamma	0.320	0.09
Internal Bremsstrahlung	End point 0.75	1.00

5. Dose Rates per millicurie (assuming point-source unshielded):

<u>Beta (skin dose)</u>	<u>Gamma</u>	<u>Bremsstrahlung</u>
<u>mrad/hr/mCi@30 cm</u>	<u>mrad/hr/mCi@30cm</u>	<u>mrad/hr/mCi@30cm</u>
none	0.178	0.11

6. Range and Shielding Data

Tenth Value Thickness with buildup (in cm)

<u>Gamma Energy</u>	<u>Fe</u>	<u>Pb</u>
0.320	4.5	0.8

7. Occupational Values

<u>Oral Ingestion ALI (uCi)</u>	<u>Inhalation</u>	<u>DAC (uCi/ml)</u>
	<u>ALI (uCi)</u>	
4 x 10 <sup>+4</sup>	5 x 10 <sup>+4</sup>	2 x 10 <sup>-5</sup>

8. Effective Biological Half-life = 26.6 days

9. Legal Requirements

1. Caution Radioactive Material sign.....1 mCi
2. Caution Radioactive Material label..... 100 uCi
3. Maximum amount in sanitary sewer in one day (soluble) .... 50 uCi
4. Amount of water to insure adequate dilution of 50 uCi..... 10 liters

## APPENDIX G

### LABORATORY SURVEY PROCEDURES

#### A. Surveying for Contamination with a Portable Meter

1. Ensure the portable survey meter is the appropriate one for the isotope in question.
2. Ensure that the meter is in calibration and operationally check each meter prior to making a survey. The operational check is a test for battery condition and meter response.
3. Monitoring for removable contamination must be performed in the restricted areas after each use of radioisotopes. Frisk (scan with the Geiger counter) all surfaces that are likely to be contaminated in the restricted area. If contamination is found, extend the monitoring to include unrestricted areas. Check that all door knobs leading to and from the laboratory. Frisk drawer handles and dials and knobs on instruments. Contamination is commonly found on the handles and the shelves of refrigerators, counter tops and floors near work areas and sinks.
4. If gross contamination over a large area is found, remain calm and advise laboratory personnel to leave the contaminated area. Frisk all personnel before they leave the area to avoid tracking contamination to clean areas. Call the RSP then secure the area.
5. Record your findings on your survey floor plan and document your findings. Sign and date your survey sheet. Ensure all results are reported in **disintegrations per minute (dpm)**, not in counts per minute (cpm). You must have a final survey showing that the contaminated area was cleaned to background levels. If contamination cannot be removed, label the area as 'fixed' contamination and note that spot in your survey floor plan. Notify the RSP about the fixed contamination during close out surveys or decommissioning of your lab.

#### B. Surveying for Contamination using Wipes or Smears

1. Monitoring for removable contamination must be performed in the restricted area after each use of radioisotopes. If contamination is found, extend the monitoring to include unrestricted areas. See Section I, A, 3, for survey frequency based on laboratory classification scheme.
2. Tape wipes with an absorbent paper, usually a Whatman #1 filter paper. Using moderate pressure, wipe an area that is at least 100 cm<sup>2</sup>. In some cases it may be better to take a long letter "S" shaped wipe that is at least 16 inches long rather than a 10 x 10 cm square area. Store each marked wipe in an envelope marked for that laboratory or area and return to the counting room.

3. Wipes of sink drains and other small openings can be done with cotton swabs.
4. For quick check of an area found to have small amounts of removable contamination, use a paper towel and take a gross wipe. Hold it to the detector and see if any contamination was removed. If so, proceed to decontaminate the area. Document the results of your clean up to show that contamination levels were brought down to background levels.

### **C. Records**

1. After the samples have been analyzed and recorded in units of dpm/100 cm<sup>2</sup>, record any remarks and follow up information. You can use the laboratory survey sheet sample or use one of your own designs which include the same information.
2. The person performing the survey must sign and date the survey forms. Include the instrument used for detection (e.g., Packard liquid scintillation counter, Beckman gamma counter, Ludlum Geiger counter) and the serial number of the counter.
3. All survey records must be kept for at least three years. Spill and cleanup results must be kept until the University decommissions its radioactive material license.

## APPENDIX H

### University of Hawaii Radiation Safety Disaster Plan

#### INTRODUCTION

The purpose of this plan is to ensure the safety of personnel and the security of radioactive materials possessed by researchers under the USNRC license number 53-00017-23 and the State of Hawaii Department of Health licenses.

We cannot anticipate every disaster that the University will face, however, there are basic steps you can take to minimize the release of radioactive materials to unrestricted areas and avoid unauthorized removal of these sources.

#### 1. SECURITY OF RADIOACTIVE SOURCES

Radioactive sources may be sealed (e.g. encapsulated radioactive materials used in equipment or for calibration purposes), or open (liquid isotopes used in tracer studies or powders).

- Sources must be properly secured during an incident to prevent unauthorized removal.
  - All open source shall be closed, stored, and secured to prevent contamination from spreading. Freezers and refrigerators containing radioisotopes should be locked to prevent its contents from being ejected if the lab floods and the freezer/refrigerators start floating in water.
  - Sealed sources shall be secured so they cannot become dislodged from equipment and lost or stolen.
- Radioactive wastes are also considered to be licensed material which must also be secured from unauthorized removal. At the very least, the doors to rooms with radioactive waste should be locked. If time permits, secure the plastic bag liners inside the waste boxes so if waste boxes get wet, the contents remain dry. Label the plastic bags with a radioactive sticker with the PI's name, isotope, activity and date and type of waste.

#### 2. ELECTRICAL BACK UP FOR EQUIPMENT

Some buildings on campus have emergency back up power to keep equipment such as freezers and refrigerators and incubators from failing. If you are in a building without back up generators, you might consider purchasing a small generator for your own lab. Ensure that it is exhausted to the outside to prevent carbon monoxide poisoning.

### 3. BACK UP SENSITIVE DATA

Sensitive data on computers should be backed up in case your computers sustain any damage.

### 4. LOCATE NEAREST EMERGENCY SHELTERS

Locate the nearest shelter for you and your family. You may have to remain at the University which have several emergency shelters on campus and are designated as Civil Defense Shelters. Have a plan for your and your family as to where to go or meet in case of an emergency situation. Have a plan for your family pets, too.

### FLOODS

In addition to the above steps please do the following. If you are located in a flood inundation zone, such as the 1<sup>st</sup> and 2<sup>nd</sup> floors of the JABSOM buildings in Kakaako, Kewalo Marine Laboratories, HIMB, and Snug Harbor, secure your radioactive materials and go to an area on higher ground above the flood zones to wait out the danger.

### HURRICANES

In addition to the above please do the following. Secure all items that can be picked up and tossed in strong winds. Tape or cover windows to prevent broken glass from injuring personnel. Evacuate the building and seek an emergency shelter if told to do so.

### EARTHQUAKES

Since we do not know when an earthquake will occur, you should take precautions to secure heavy equipment located above the floor so they will not fall on someone. Ensure that your chemicals are placed on shelves that prevent the bottles from falling.



## **APPENDIX J**

### **ENFORCEMENT POLICY ON DISTRIBUTION AND LOST DOSIMETERS**

1. A fine will be assessed for all badges and rings not returned two days after the pickup date (i.e., late badges/rings now considered as lost) will be assessed to the Principal Investigator. The fine will be the price of the lost badge or ring.
2. Repetitive fines for lost badges will force our Program to take enforcement policy actions which have been adopted for more serious violations. In addition, the user who loses his or her badge repetitively may not be allowed to handle radioisotopes.
3. The ultimate enforcement policy action would be a temporary revocation of the Principal Investigator's authorization followed by a total revocation of the authorization if the problem persists.

## **APPENDIX K**

### **POLICY FOR USE OF RADIOACTIVE MATERIALS AT SEA UNDER THE JURISDICTION OF THE UNIVERSITY OF HAWAII**

#### **CRITERIA**

1. For University of Hawaii owned and operated vessels.

#### **WASTE DISPOSAL**

Under current conditions of the UH NRC license, no radioactive materials may be disposed of at sea. All material and waste must be brought back to port for proper disposal. Waste disposal forms specifically for cruises (RSP-CRZ-WASTE) in Appendix A shall be filled out for each box or container of waste generated and given to RSP upon arrival back to Hawaii.

#### **RECOMMENDATIONS**

The use of all radioisotopes on UH vessels is regulated by a strict set of guidelines specified in the Materials License granted to the University of Hawaii by the U. S. Nuclear Regulatory Commission. It is the legal responsibility of the Principal Investigators to ensure that all isotope use aboard UH research vessels is consistent with the regulations contained in the license. The Committee has confidence that UH Principal Investigators are capable of ensuring that isotope use aboard UH vessels is consistent with our materials license. The current regulations are quite rigorous adding further to the requirements would be counterproductive.

The Committee recognized that the use of radioisotopes is of great importance to many marine research efforts. Consequently, the University should continue its policy of permitting the use of radioisotopes by qualified personnel (i.e., licensed by the Radiation Safety Program) on all UH research vessels. Recognizing that contamination problems can result from the use of radioisotopes used at sea, the Committee does feel that the use of isotope vans should be encouraged whenever possible. However, the lack of an appropriate isotope van should not prevent the use of isotopes on UH vessels.

#### **REGULATIONS GOVERNING ISOTOPE USE ON UH RESEARCH VESSELS**

1. The University of Hawaii's current license permits the use of radioisotopes on research vessels. Principal Investigators wishing to use radioisotopes at sea for the first time should first contact the RSO to ensure that they are allowed to do so under their authorization. If they are first time users of a UH vessel for radioisotope use, their protocol should be forwarded to the Committee for approval.
2. Our license requires that all isotopes, including contaminated liquid and solid waste, be

returned to the University for disposal. When appropriate, special arrangements can be made for the disposal of radioactive waste at other licensed facilities in cooperation with the University RSP.

3. It is the PI's responsibility to ensure that all isotope work on board ship is carried out in a manner consistent with the regulations in our materials license (i.e., environmental contamination is avoided and no individual receives significant exposure to radiation). Researchers using Phosphorus-32, Fe-59 and other strong beta and gamma emitters shall ensure that radiation exposure are controlled with proper shielding and handling techniques. The use of a fume hood is recommended when off-gassing or using volatile isotopes.
4. Transportation is probably the most difficult problem faced by UH marine researchers. Strict regulations in transporting isotopes beyond the campus boundaries are monitored by the Department of Transportation (DOT) and USNRC. All radioactive materials being transported from campus to ships and back, must be done through the RSP. The RSP will fill out the proper shipping papers for you and transport them for you if you do not have the required DOT training. DOT training is available through our Office, if needed. Visiting researchers can have their samples shipped back to their respective campuses upon their return by the RSP.
5. Monthly or semi-monthly wipe testing of all University laboratories and research vessels are seagoing laboratories and so are also required to perform the wipe tests. Surveys must also be taken after any radioisotope use each day and at the end of the cruise. Records of surveys must be maintained and stored where they can be audited. Our Radiation Safety Program cannot always oversee this procedure, because the ships are frequently on extended cruises. In order to ensure that UH research vessels remain free of contamination, the Captain oversees the use of isotopes on board our vessels. The use of isotopes on any cruise must be coordinated with the Chief Scientist and the Captain.
6. The use of radioisotopes vans is recommended on UH research vessels. There are currently three vans owned and used by Dr. David Karl and another van owned by the Ocean Technology Group (OTG). The vans are self-contained laboratories. Each van is equipped with an air conditioner, electrical outlets, fume hood, storage cabinets, working bench space, and some have a liquid scintillation counter. Any Principal Investigator wishing to use the vans should contact Dr. Karl for his vans, and Daniel Fitzgerald at OTG.

## **APPENDIX L**

### **SABBATICAL/EXTENDED VACATION POLICY**

#### **Short-term leaves of absence (30 days or less)**

A contact person must be established as indicated on authorization renewal forms. This person must be available to confer with if an emergency arises, radioactive material needs to be delivered, or waste picked up. This person must be an authorized user (Post Doctoral Fellow, technician, or junior researcher). Graduate and undergraduate students are not acceptable.

The contact person has no authority to sign for radioactive material purchases.

#### **Long-term leaves of absence (more than 30 days)**

Only another Principal Investigator can be responsible for signing radioactive material purchases and any laboratory work.

If only undergraduates are working in the laboratory, no radioactive work may be performed.

The Principal Investigator leaving must notify the Radiation Safety Program in writing as to who will be the designated PI for his lab while he is away.

## APPENDIX M

### CLOSEOUT PROCEDURES FOR RADIOISOTOPE LABORATORIES

#### **A. Moving to Another Laboratory**

1. Submit an Amendment Application to Authorization Form, RSP-3a, to add new a laboratory location to your current authorization.
  - a. Include floor plan of new lab space with areas marked for restricted area. Indicate where radioisotopes and radioactive waste will be stored.
  - b. Indicate which sink will be the hot sink, if any.
2. Once new lab space is approved by the Radiation Safety Committee, do the following:
  - a. Dispose of any radioactive waste by calling RSP for a waste pickup.
  - b. If you need to move any radioisotopes to the new lab, call RSP to make arrangements to move your material.
  - c. Clear out all big equipment not being kept at old lab. Clear all lab benches of materials, supplies, chemicals, etc.
    - 1) Move refrigerators, freezers, LSCs, gamma counters, and glassware from lab benches.
    - 2) Do a wipe test survey to ensure no contamination is left. Mark any fixed contamination that is present.
3. Call RSP to perform a final close out survey. If any contamination is found, you will have to decontaminate it and have RSP resurvey the area.
4. If you fail to clean up contaminated areas found, RSP will charge your department for its time used in cleaning up the laboratory.

#### **B. Leaving the University or Stopping Radioisotope Use**

1. Submit a memorandum to the RSO stating that you will close out your authorization.
2. Arrange to have radioisotopes transferred to another PI or university, or dispose of your radioisotopes and arrange for a waste pick up. The RSP will assist you with the paperwork to transfer your radioisotopes to another university.

3. Clean your lab equipment of any contamination and transfer equipment to another PI or have them disposed. Notify RSP if giving fixed equipment to another PI.
4. Clear lab benches as much as possible of all lab supplies which were used with radioisotopes.
5. Call RSP for a close out survey or decommissioning survey. If any contamination is found, you must decontaminate the areas and have RSP resurvey your lab. If you do not decontaminate the area, RSP will charge your department for the time spent in the cleanup.