

## Limits of Exposure to Ionizing Radiation

### All Employees

No user shall be permitted to receive radiation doses in any one year in excess of the limits specified below:

Body Part	Rems Per Year
Whole Body	5
Lens of the Eye	15
Hands and Feet	50
Skin of the Whole Body	50

### ALARA

The general goal is to limit radiation exposure so that individuals receive annual doses well below these basic limits. This maintenance of radiation exposure well below the established limit is called the "ALARA" - As Low As Reasonably Achievable - philosophy.

The ALARA philosophy involves the reduction in radiation exposure while taking into account the state of technology and the economics in relation to the benefits to public health and safety. That is, there should be an appropriate balance between resources committed to reduction of dose and the real benefit derived in the subsequent reduction of health effects.

The maintenance of radiation exposure at the University ALARA level requires a commitment by everyone: Administration, Radiation Protection, Authorized Users and lab workers. The ALARA goal is achievable, because radioactive material and radiation use while widespread, generally involves relatively small quantities of material and low radiation dose rates.

# Personnel Dosimetry and Bioassays

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Work can be maintained ALARA through minimizing radiation dose rates, airborne radioactivity concentrations and radioactive material contamination of work surfaces.

## Minors

No individual under the age of 18 years shall be permitted to receive a radiation dose in excess of 10 percent of the limits described above.

## Pregnant Workers

The Radiation Safety Committee recommends that pregnant workers declare their pregnancy to the Radiation Safety Officer. Radiation exposure to the embryo/fetus of a declared pregnant worker is limited to 0.5 rem during the entire pregnancy.

# Personnel Monitoring and Dosimetry

## Criteria for Monitoring

Personnel likely to receive a dose in excess of approximately 10 percent of the annual limit for occupational workers must wear a personnel monitoring device. The RSC has determined that personnel monitoring devices shall be worn at USC by anyone in the following categories:

- ❖ Personnel who work in the vicinity of radioactive material or radiation-producing machines in the Department of Radiation Oncology
- ❖ Personnel working with x-ray producing devices with the exception of electron microscopes and cabinet x-ray units
- ❖ Personnel who work in the vicinity of radioactive material in the Departments of Nuclear Medicine and PET
- ❖ Personnel specifically working with radionuclides that emit beta particles with energies greater than 1 MeV when these radionuclides are used in quantities exceeding 5 mCi of activity
- ❖ Personnel specifically working with radionuclides that emit gamma rays when these radionuclides are used in quantities exceeding 1 mCi of activity
- ❖ Any persons required to enter a posted high radiation area

# Personnel Dosimetry and Bioassays

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- ❖ Nursing staff caring for radiation therapy patients or working in the vicinity of radiation producing machines

## Note

The Radiation Safety Officer will make the final determination as to whether or not personnel monitoring is required.

## Exceptions

The Radiation Safety Officer may remove the requirement to wear personnel dosimetry if dosimetry records over a period of at least one year indicate only minimal exposure.

## Request Form

A *Personal Dosimetry Add/Delete Form* must be completed and signed by the individual requesting dosimetry.

Requests for personnel monitoring devices for special uses will be evaluated on an individual basis and the approval of Radiation Protection will be required.

## Dosimetry Monitoring Devices

Two types of personnel dosimeters are routinely used at USC, whole body dosimeters and extremity dosimeters. These dosimeters are outlined in the following table.

Dosimetry Device	Exchange Schedule
Whole Body Dosimeter	Dosimeters are generally exchanged every other month
Extremity Dosimeter (finger ring)	Dosimeters are generally exchanged every other month

# Personnel Dosimetry and Bioassays

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## Monitoring

All dosimeters are processed commercially. The exposure reports are sent to Radiation Protection and reviewed by the staff. Any exposures that exceed the maximum permissible limits or are much higher than average are discussed with the individual and the individual's supervisor and appropriate steps are taken to prevent reoccurrence. Any individual may receive a copy of his exposure history by requesting it in writing from Radiation Protection.

## Purpose

The sole purpose of the personnel dosimeters is to record a radiation exposure. IT DOES NOT PROTECT AGAINST RADIATION!

## Proper Use and Care of Dosimeters

Dosimeters must be properly used and cared for in order to give an accurate reading. The following guidelines provide proper care instructions.

- ❖ Dosimeters are worn between the waist and the collar with the name showing. Dosimeters must be worn at all times while on duty. If you are wearing a lead apron, the badge should be worn at the collar outside the apron.

**Note:** Individuals who wear an apron, thyroid shield, and eye shield of at least 0.25 mm lead equivalent (0.5 mm for individuals working around fluoroscopic machines lacking lead drapes) may request in writing a variance to be permitted to wear their badge under their apron.

- ❖ Leave the dosimeter in a safe place when you are not on duty. Make sure it is away from all sources of radiation. Personnel dosimeters should not be taken off campus.
- ❖ Never wear a dosimeter issued to another person or allow anyone else to wear yours.
- ❖ Take care not to send the dosimeter to the laundry.
- ❖ Make sure to return the dosimeter at the proper time to exchange for a new one. This is your responsibility.
- ❖ Do not tamper with the dosimeter.

# Personnel Dosimetry and Bioassays

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- ❖ If you lose or damage your dosimeter, a replacement must be obtained from Radiation Protection immediately. A "Radiation Exposure Investigation Form" must be obtained from Radiation Protection. Upon completion of this form, an exposure is assessed for the time period lost and added to your personal exposure history.
- ❖ Report any other incident relative to the wearing of the dosimeter (such as possible accidental exposure when the dosimeter is not worn) to Radiation Protection.
- ❖ Do not wear your dosimeter during any medical procedure that involves radiation or radioactive material in which you are the patient.

## Return of Dosimeters

Return your personnel dosimeters to Radiation Protection by the 5th working day of the new wear period. If you do not, you will receive a "Radiation Exposure Investigation Form" and be instructed to return either the completed form or the dosimeter by the 14th working day of the month/quarter.

## Consequences of Failure to Return Dosimeters

Action	Consequence
Individuals who work with radionuclides	If either the dosimeter or the form is not returned by the 14th working day, Radiation Protection will not approve purchases or receive radioactive materials for the Use Permit under which you work until the dosimeter or form is returned
Individuals who work with radiation producing machines	If either the dosimeter or the form is not returned by the 14th working day, Radiation Protection will notify your Department Chair that you are not permitted to operate radiation producing equipment until the dosimeter or form is returned

## Exemptions

Exemptions regarding the deadline for returning the dosimeter or form will be granted on an individual basis for individuals on vacation, sick leave, etc.

# Personnel Dosimetry and Bioassays

## Bioassay Guidelines for Individuals Working with $^{125}\text{I}$ and $^{131}\text{I}$

### Introduction

Radioiodinated solutions and compounds undergo decomposition that may result in the volatilization of radioiodine. If this occurs, individuals working with these materials have a potential for accidental uptake of radioactive iodine. Once inside the body, the iodine concentrates in the thyroid and irradiates that organ. This bioassay program will enable Radiation Protection to determine the radioiodine burden in an individual's thyroid and calculate the radiation dose to the thyroid. In addition, the program will monitor the effectiveness of radionuclide use procedures.

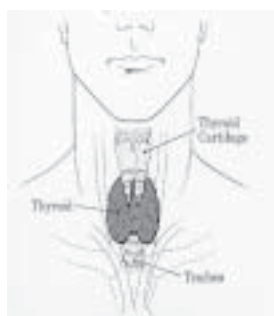
This program is designed to meet California Department of Health Services requirements for bioassay of  $^{125}\text{I}$  and  $^{131}\text{I}$ .

### Program Participation

All individuals who use unsealed radioiodine (such as  $^{125}\text{I}$  and  $^{131}\text{I}$ ) in quantities exceeding those listed in the following table shall participate in this bioassay program. The quantities in the table apply to that amount used in a single day.

Authorized Users are responsible for supplying Radiation Protection with the names of those individuals who meet the criteria for inclusion in the bioassay program. Authorized Users shall not permit anyone who meets any of the criteria to work with radioiodine until they have undergone a baseline bioassay.

### Levels Requiring Bioassay



Activity Levels Above Which Bioassay for $^{125}\text{I}$ and $^{131}\text{I}$ is Required		
Type of Operation	Activity Used in Unsealed Form	
	Volatile/Dispersible	Non-Volatile
Processes in open room or bench with possible escape of iodine from reaction vessel	0.1 mCi	1 mCi

# Personnel Dosimetry and Bioassays

Processes with possible escape of iodine, carried out within a fume hood of adequate design, face velocity and performance reliability	1 mCi	10 mCi
Processes carried out within glove boxes, ordinarily closed, but with possible release of iodine or with occasional exposure to contaminated box and/or box leakage	10 mCi	100 mCi

**NOTES:**

- 1) Individuals using 10 mCi or more of radioiodine per month will require a bioassay even if the quantities used at any one time are less than those described above.
- 2) Radiation Protection will determine bioassay requirements for unique procedures and equipment.
- 3) The term “use” means removal of the radioactive material from the primary container and introduction into research procedures or other chemical processes.

**Frerquency of Bioassays**

Type of Bioassay	Necessary When?	How Often?
Baseline or Preoperational	Beginning work with <sup>125</sup> I or <sup>131</sup> I in quantities requiring participation in the bioassay program	Once, prior to beginning work with radioiodines
Routine	Working with quantities of radioiodine that require participation in the bioassay program	Within 7 days for <sup>125</sup> I or 3 days for <sup>131</sup> I after completion of the procedure, but no more than once every two weeks. (After three months of routine bioassays, the frequency may be reduced to quarterly upon the approval of the Radiation Safety Officer
Diagnostic	An individual has exceeded an action level	As determined by the Radiation Safety Officer

# Personnel Dosimetry and Bioassays

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Emergency	There is a possibility that an individual has received an uptake in excess of 0.5 uCi of <sup>125</sup> I or 0.14 uCi of <sup>131</sup> I	As soon as possible each time it is suspected that an individual has received an excessive uptake
Postoperational	Work with radionuclides is terminated, to be done within 3 days (but not less than 6 hours after discontinuing operations with radionuclides)	Once, before the individual leaves the University

## Action Levels

The thyroid burden at the time of measurement should not exceed:

- ❖ 0.12 uCi of I-125
- ❖ 0.04 uCi of I-131
- ❖ a corresponding appropriate amount of a mixture of these two isotopes

## Corresponding Action

Whenever the above Action Levels are exceeded, the following actions shall be taken:

- ❖ Radiation Protection shall conduct an investigation of radioiodine handling procedures. If it is determined that continuation of current operations would cause further uptake, use of radioiodine shall be discontinued until further corrective actions can be implemented.
- ❖ The affected individual will be restricted from further work with radioiodine until the thyroid burden is less than the Action Levels.
- ❖ Diagnostic bioassays will be performed on the affected individual at biweekly intervals until the thyroid burden is less than the Action Levels.
- ❖ Radiation Protection staff will calculate the committed thyroid dose, make exposure record entries and notify the California Department of Health Services as appropriate.
- ❖ If the affected individual or others working in the same areas are on a quarterly bioassay schedule at the time Action Levels are exceeded, reinstate the biweekly schedule until it can be demonstrated that further work with radioiodine will not cause the Action Levels to be exceeded.

# Personnel Dosimetry and Bioassays

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In addition to the above actions, whenever the thyroid burden exceeds 0.5 uCi  $^{125}\text{I}$ , 0.14 uCi  $^{131}\text{I}$ , or a corresponding appropriate amount of a mixture of these two isotopes:

- ❖ Refer the case to appropriate medical consultation, and
- ❖ Perform diagnostic bioassays at weekly intervals until the thyroid burden is less than the values stated above.

## Bioassay Testing Procedure

The procedure for bioassay testing is as follows:

- ❖ Based on information provided by the Authorized User, Radiation Protection shall contact those individuals involved and schedule a baseline bioassay.
- ❖ Individuals participating in the program shall notify Radiation Protection following their initial contact with radioiodine to schedule the first routine bioassay (to be performed within 3 days for  $^{131}\text{I}$  or 7 days for  $^{125}\text{I}$ .) Upon completion of this first bioassay, a schedule shall be established for further testing.
- ❖ Any individual who is participating in this program shall notify Radiation Protection prior to leaving this University.

## Guidelines for Individuals Working With Other Radioactive Material

### Introduction

The use of unsealed sources in Radioactive Materials Laboratories may result in an unplanned uptake of radioactive materials into the body and subsequent internal exposure. The purpose of the bioassay program is to monitor the uptake of radioactive materials by USC radiation workers to determine the internal dose resulting from any uptake, and to provide guidance in keeping internal doses as low as reasonably achievable (ALARA).

### Program Participation

Each individual who uses more than 100 mCi per month (30 days) of any radionuclide in an unsealed form, with the exception of Technetium-99m and

# **Personnel Dosimetry and Bioassays**

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other radionuclides with an effective half-life of less than eight (8) hours is required to participate in the bioassay program. The Radiation Safety Officer may also require a bioassay to be performed following any accident involving radioactive material where there is a possibility of significant contamination of personnel.

## **Bioassay Procedure**

Individuals who are required to participate in the bioassay program must submit a urine sample to Radiation Protection within one week of use, or as directed by the Radiation Safety Officer.