

# Chapter V: Occupational Exposure Monitoring

## Policy

It is the policy of the University of Chicago to monitor personnel working with or around radiation emitting sources or devices and who are likely to receive 10% of the annual radiation dose limits identified in the Illinois Emergency Management Agency (IEMA), Division of Nuclear Safety regulations.

## Purpose

The purpose of this policy is to establish guidelines to ensure personnel exposures to radiation are maintained as low as reasonably achievable (ALARA) and meet the University of Chicago ALARA goals.

## Authority and Responsibility

*Office of Radiation Safety* is responsible for:

- 1 Providing radiation monitoring devices as requested by personnel.
- 2 Ensure appropriate personal monitoring equipment is provided for the type or radiation to be monitored.
- 3 Providing instructions to personnel on how to wear personal monitoring equipment.
- 4 Reviewing personnel monitoring reports.
- 5 Investigating causes for employee exposures which exceed the ALARA investigational limits or have abnormally high exposure readings.

*Principal Investigator* is responsible for:

- 1 Requesting personal monitoring equipment (e.g. whole body, extremity, collar) for their laboratory staff as required by this policy.
- 2 Ensure sufficient shielding is available for all personnel working with radiation emitting sources or devices to limit radiation exposure.
- 3 All personnel are knowledgeable in the requirements of this policy.

*Employees* are responsible for:

- 1 Wearing the personal monitoring equipment (dosimeter) assigned while working in areas where radiation emitting sources or devices are used and/or stored.
- 2 Making sure that the dosimeter does not leave the University property at any time except when being sent out for development and reading.
- 3 Making sure that the dosimeter for a particular wear period is exchanged for a dosimeter for the new wear period by the return due date.
- 4 Informing the Radiation Safety Officer, in writing, if they want to declare their pregnancy.
- 5 Using appropriate ALARA principles (time, distance and shielding) when required or applicable to maintain individual exposure to within ALARA levels.

## Monitoring Requirements

- All persons whose work is associated with radiation that could result in exposure above 10% of the above limits must wear radiation monitoring badges (5% for

- persons under 18 years of age). \* Whole body badges and extremity badges are issued for a two-month wear cycle and are used to monitor exposure from high-energy beta, gamma-ray, and neutron sources.
- Whole body badges and ring badges do not respond to the weak beta radiation from H-3, C-14, or S-35. Workers who use H-3 and C-14, and less than 1 mCi a month of S-35 or P-32, are not required to wear a radiation badge, but may request one. Workers using 1 mCi a month or more of P-32 or other high energy beta emitter must wear a whole body badge.
  - Workers that use 10 mCi or more of P-32 or other high-energy beta emitters at a time or use more than 1 mCi of a gamma-ray source are required to wear a whole-body dosimeter and ring badge.
  - Employees whose work is associated with radiation from X-ray producing equipment and are likely to receive exposure in excess of 10% of the annual dose limits must wear radiation monitoring badges (dosimeters).
  - A declared pregnant women must be monitored if she is likely to receive during the entire pregnancy, from radiation sources external to the body, a deep dose equivalent in excess of 1 mSv (0.1 rem) or is likely to receive a committed effective dose equivalent in excess of 0.5 mSv (0.05 rem). Pregnant employees have the option to voluntarily declare their pregnancy, in writing, to the Radiation Safety Officer. Declaration of the pregnancy allows the radiation exposure to the fetus to be closely monitored and allow for additional precautions, if needed. If you should have any questions, please contact the Office of Radiation Safety.
  - Exposure Limits
    - 1 Total Effective Dose Equivalent (TEDE) [Exposure to the Whole Body]: 5000 mRem
    - 2 Eye Dose Equivalent (LDE) [Exposure to the Lens of the Eye]: 15,000 mRem
    - 3 Shallow Dose Equivalent (SDE) [Exposure to the Skin or any Extremity]: 50,000 mRem
    - 4 Minor Dose Limits [Less than 18 years old]: 10% of Adult Doses listed in Items 1 – 3 above
    - 5 Declared Pregnant Worker [Dose Equivalent to an Embryo/Fetus]: 500 mRem during the gestation period

### **Requesting or Canceling Radiation Monitoring Badges**

- 1 To initiate monitoring service for exposure to radiation an individual must complete all information on both sides of the radiation monitoring request card. (Cards are available in the Office of Radiation Safety or at the badge drop off location.) This will ensure the proper monitoring device(s) is issued to the individual and will assist in determining if the individual has any previous exposure history. The individual shall submit the card to their Principal Investigator or supervisor for signature. The completed request card shall be submitted to the Office of Radiation Safety Office in AMB M-031A.
- 2 The Office of Radiation Safety will issue the monitoring device(s) to the individual as noted on the request card.
- 3 Radiation monitoring badges must be ordered and discontinued by the Office of Radiation Safety several weeks in advance. Request cards must be received in our

main office (AMB M-031A) by the 15th of the month to ensure that a permanent badge is started or canceled effective the first of the following month. If the deadline for starting a permanent badge for the next month has been missed, Radiation Safety can assign a temporary film badge. Indicate on the request card that a temporary film badge is needed until the permanent badge starts. The temporary film badge will be available for pick-up in room M-031A.

### **Location of Individual Monitoring Device**

The radiation monitoring device shall be worn in the appropriate location on the whole body or extremity as follows:

- The whole body monitoring device shall be worn at the unshielded location of the whole body likely to receive the highest exposure. Note: When a protective apron is worn, the location of the monitoring device is typically at the neck (collar). The whole body means, for purposes of external exposure, head, trunk (including male gonads), arms above the elbow and legs above the knee.
- The extremity monitoring device shall be worn on the extremity likely to receive the highest exposure and shall be oriented on the appropriate finger (label inward toward palm) to measure the highest dose to the extremity being monitored. The extremity badge must be protected from contamination; therefore, it must be worn under gloves when you are working with unsealed radioactive material.
- The monitoring device to monitor eye dose equivalent shall be located at the neck (collar), outside any protective apron being worn by the monitored individual, or at an unshielded location closer to the eye.
- The monitoring device to monitor the dose to an embryo/fetus of a declared pregnant woman shall be located at the waist under any protective apron being worn by the woman.

**Please Note:** Radiation monitoring badges are to be worn only by the individual to whom they are assigned to.

### **Exchange and Processing of Monitoring Device**

- Each monitored individual shall exchange their radiation monitoring device monthly for the new wear period monitor by the 10th day of the month of the current (new) badge wear period.
- The (Badge Distribution Location) document indicates the pickup and drop-off location for your laboratory/department radiation monitoring badges.
- The Office of Radiation Safety will assign a temporary badge to you if you lost your dosimeter (radiation badge). Contact the Office of Radiation Safety as soon as you know the dosimeter is lost.
- The Office of Radiation Safety will collect and ship the monitors to the outside vendor for processing.
- The vendor provides exposure reports to the Office of Radiation Safety and a copy is provided to the Principal Investigator or Department.
- The exposure reports are reviewed by the Radiation Safety Officer (RSO) or designee.

## Review and Investigation of Exposures

The RSO will review the exposure reports and evaluate individual exposures exceeding the following ALARA investigational limits:

- **Quarterly Investigational Limits for Monthly Wear Dates**
  - **Total Effective Dose Equivalent (TEDE)** [Exposure to the Whole Body]: Level I Investigational Limit:  $\geq 125$  mRem and Level II Investigational Limit:  $\geq 312$  mRem
  - **Eye Dose Equivalent (LDE)** [Exposure to the Lens of the Eye]: Level I Investigational Limit:  $\geq 375$  mRem and Level II Investigational Limit:  $\geq 938$  mRem
  - **Shallow Dose Equivalent (SDE)** [Exposure to the Skin or any Extremity]: Level I Investigational Limit:  $\geq 1250$  mRem and Level II Investigational Limit  $\geq 3125$  mRem
- **Bimonthly Investigational Limit for Bimonthly Wear Dates**
  - **Total Effective Dose Equivalent (TEDE)** [Exposure to the Whole Body]: Level I Investigational Limit:  $\geq 83$  mRem and Level II Investigational Limit:  $\geq 208$  mRem
  - **Eye Dose Equivalent (LDE)** [Exposure to the Lens of the Eye]: Level I Investigational Limit:  $\geq 250$  mRem and Level II Investigational Limit:  $\geq 625$  mRem
  - **Shallow Dose Equivalent (SDE)** [Exposure to the Skin or any Extremity]: Level I Investigational Limit:  $\geq 833$  mRem and Level II Investigational Limit  $\geq 2080$  mRem

The RSO or RSO designee will conduct his/her investigation as follows:

- 1 If a personnel dose is less than Investigational Level I no further action will be taken unless deemed appropriate.
- 2 If a personnel dose is equal to or greater than Investigational Level I but less than Investigational Level II the RSO or RSO designee will submit a notice to the individual who received the exposure informing them of the exposure and to remind them of ALARA principles to be used. No further action will be taken unless deemed appropriate by the RSO or RSO designee.
- 3 If a personnel dose is equal to or greater than Investigational Level II the RSO or RSO designee will submit a notice to the individual who received the exposure informing them of the exposure and to remind them of ALARA principles to be used. In addition, the notice will require the individual to complete a questionnaire to evaluate any factors affecting the exposure and return the questionnaire to the appropriate Safety Office.
- 4 If the RSO or RSO designee determine further investigation is warranted due to an abnormally high exposure reading(s) the following may be conducted:
  - Request the vendor to reprocess the radiation monitor device(s) involved to verify the reading.
  - Evaluate the equipment involved, if necessary.
  - Perform any necessary radiation surveys to assist in determining the cause.
- 5 A summary of personnel exposures exceeding Investigational Levels I and II will be presented to the University Radiation Safety Committee.

- 6 In the event a worker's or a group of workers' doses need to exceed an investigational level, a new, higher investigational level may be established for that individual or group on the basis that it is consistent with good ALARA practices. Justification for new investigational levels will be documented and must be approved by the University Radiation Safety Committee.
- 7 The employee(s) who receive a notice of exceeding a investigational level must complete the following:
  - If receiving a notice for a dose equal to or greater than Investigational Level I but less than Investigational Level II, the employee shall review their procedural technique for possible reduction of exposure and apply the basic rules of time, distance and shielding to keep their exposure ALARA.
  - If receiving a notice for a dose greater than Investigational Level II, the employee shall complete the questionnaire after consultation with their supervisor and the RSO or MP, if needed. The questionnaire shall be returned to the appropriate Safety Office within 10 working days. In addition, the employee shall review their procedural technique for possible reduction of exposure and apply the basic rules of time, distance and shielding to keep their exposure ALARA.
- 8 The RSO or RSO designee will determine if any other actions should be implemented to assure adequate protection in the future.