

Radiation Safety Manual

	Policy Name	External Personnel Monitoring
	Policy Number	VII.1.
	Date this Version Effective	July 2016
	Responsible for Content	Radiation Safety Subcommittee

I. Description

To describe the requirements for monitoring worker doses from external sources of radiation at UNC Health Care.

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II. Rationale

Personnel monitoring for radiation dose is an important element of any radiation safety program. UNC Health Care is committed to maintaining an external monitoring program which provides appropriate dosimetry and effective program oversight in accordance with NC Regulations for the Protection Against Radiation and other applicable documents.

III. Policy

A. General Information

1. Personnel monitoring for external radiation exposure (optically stimulated luminescence (OSL) technology, thermoluminescent (TLD) dosimeters, pocket dosimeters, etc.) and by bioassay methods (urinalysis, body counting, etc.) for internal dose are provided by the UNC-CH Department of Environment, Health and Safety (EHS) through the Radiation Safety Officer (RSO).
2. The standard external monitoring device is issued as a clip-on dosimeter bearing the individual assignee's name, the date of the monitoring period and a unique identification number.
3. Dosimeters are provided, processed and reported through a commercial service company that meets current National Institute of Standards and Technology National Voluntary

Laboratory Accreditation Program (NVLAP) guidelines.

B. Regulatory Requirement

Radiation protection regulations and UNC Health Care policy require that appropriate personnel monitoring be provided to individuals who:

1. Are likely to receive a radiation dose in one year in excess of 10 percent of;
 - a. 5 rem, total effective dose equivalent, to the whole body;
 - b. 15 rem, eye dose equivalent, to the lens of the eyes;
 - c. 50 rem, shallow dose equivalent, to the skin or to each of the extremities.
2. Are under 18 years of age and are likely to receive a radiation dose in one year in excess of 10 percent of;
 - a. 0.5 rem to the whole body;
 - b. 1.5 rem to the lens of the eyes;
 - c. 5 rem to the skin or to each of the extremities.
3. Have declared a pregnancy or planned pregnancy.
4. Enter a High or Very High Radiation Area (exposure to greater than 100 millirem in any one hour).
5. Meet the External Issuance Criteria as assessed by the RSO.

C. External Issuance Criteria

1. Authorized users must submit to EHS a Lab/Radiation Worker Registration Form (access form at: <http://ehs.unc.edu/manuals/RadiationManual/appendb.doc>) for each individual who may work with radiation sources. This form provides the basic information regarding training, experience and personnel monitoring needs.
2. The Lab/Radiation Worker Registration Form shall be completed prior to first entry into a radiation restricted area under such conditions that an occupational radiation dose in excess of 10 percent of the specified dose limits may occur.
3. Initial personnel monitoring decisions will be based on information obtained by this form. Further evaluations, and re-evaluations, will be made through radiation employee registration updates, application reviews, personnel monitoring reports, high dose investigations, surveys and individual interviews by EHS.
4. EHS will request any prior radiation dose histories from past employers.
5. EHS periodically requests concurrent employment information from radiation workers and tracks cumulative radiation doses for all radiation workers receiving doses.
 - a. The METER (Multiple Employer Total Exposure Report) service provided by Landauer is utilized for tracking cumulative exposure received from multiple facilities/employers.
 - b. Any concurrently employed worker not included in METER tracking who meets the regulatory requirement for personnel monitoring described above will have doses requested from the outside monitoring facility.
6. Dosimeters are issued for occupational and/or educational radiation dose monitoring only.
7. Dosimeters will be exchanged on a monthly or quarterly basis depending on the anticipated exposure level as evaluated by EHS.

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- a. In general, dosimeters will be exchanged monthly for individuals needing personnel monitoring as specified in the REQUIREMENT section, above.
 - b. Devices may be exchanged quarterly when less frequent and/or smaller exposures are anticipated, or during trial periods. Experience has shown, for example, that quarterly exchanges are appropriate for operators of dental x-ray machines, many sealed sources and other machine radiation sources.
8. Dosimeters will not normally be issued to individuals who work solely with low energy beta emitters such as H-3, C-14 and S-35 or very small quantities of radioactive material such as I-125 in-vitro kits.
 9. The RSO may require the use of pocket dosimeters, ring dosimeters, or other monitoring devices when particular procedures are in operation.
 10. Dosimeters, including controls, should be stored in a low-radiation area when not in use.
 11. It is the responsibility of each individual dosimeter recipient to wear and use the dosimeter properly.
 12. Authorized Users are responsible for assuring that their radiation workers are using dosimeters appropriately and that they are returned on time for processing.

Note: A charge may be made to the individual or their department for lost or unreturned dosimeters.

D. Use of Personnel Monitoring Devices

1. The whole body dosimeter (or other device) is to be worn on the body where it will most uniformly measure radiation exposure to the head and torso of the wearer.
2. Generally, whole body dosimeters may be worn at the waist, breast pocket or collar. When a protective apron is worn, the dosimeter is to be worn at the collar, outside the apron. In some circumstances, where exposure of the neck and lenses of the eyes is negligible, the dosimeter may appropriately be worn under the apron. The Radiation Safety Office should be consulted for advice in these circumstances.
3. Dosimeters assigned for whole-body monitoring are not to be used to monitor the extremities (hands, forearms, feet, ankles). Separate devices must be assigned for extremity monitoring.
4. Extremity monitoring dosimeters (rings) are available in various sizes and for the right or left hand. Generally, ring dosimeters should be worn whenever handling radiation sources. When using radioactive materials, the ring-monitoring element (label area) should be turned toward the palm. Gloves should be worn over the ring badge when contamination is possible.
5. The exposure of a dosimeter to deceptively indicate a dose delivered to an individual is prohibited by North Carolina regulations.

E. Multiple Badge Use Criteria

1. Radiation fields may vary spatially as a result of job-or-location-specific conditions. Conditions which may contribute to this variability include x-ray fields, collimated radiation beams, source-to-worker distance and general orientation of the worker with respect to the source. The use of protective lead garments also cause non-uniform exposures between protected and unprotected parts of the body.

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2. "Multiple dosimetry" is the practice of placing more than one dosimeter on an individual's body to determine the doses at various regions of the torso, head, arms, and legs. This practice may be implemented for a number of reasons, including demonstration of compliance with federal and state regulations or administrative requirements, identification of the location of highest exposure, or to estimate the effective dose equivalent.

F. Effective Dose Equivalent Determination

1. Effective dose equivalent (EDE) may be estimated for those individuals working with medical fluoroscopic equipment when wearing multiple dosimeters as just described or when only one dosimeter is worn.
2. Effective dose equivalent (H_E) is defined as the sum of the product of the dose equivalent to the organ or tissue (H_T) and the weighting factor (w_T) applicable to each of the body organs or tissues that are irradiated. Or: $H_E = \sum w_T H_T$
3. EDE for exposure to external radiation shall be determined as follows [NCRP 1995]:
 - a. When only one individual monitoring device is used and it is located at the neck (collar) outside the protective apron, the reported deep dose equivalent value multiplied by 0.3 shall be the effective dose equivalent for external radiation; or
 - b. When individual monitoring devices are worn, both under the protective apron at the waist and outside the protective apron at the neck, the effective dose equivalent for external radiation shall be assigned the value of the sum of the deep dose equivalent reported for the individual monitoring device located under the waist under the protective apron multiplied by 1.5 and the deep dose equivalent reported for the individual monitoring device located at the neck outside the protective apron multiplied by 0.04.
4. When estimated, the EDE is used as the guide for notification of any dose in excess of Investigation Level I or II.

G. Pregnant Employee – Conceptus Dose Policy

1. The Conceptus Dose Policy incorporates the latest safety information and radiation dose guidelines for ensuring safe radiation limits for the conceptus of occupationally exposed employees.
2. A copy of the complete policy, consultation form and information booklet is available through EHS. Any person is welcome to discuss the policy or obtain a copy by contacting Environment, Health and Safety, Radiation Safety Section, 1120 Estes Drive Extension, CB# 1650, 962-5507.
3. Additional information about working around sources of radiation during pregnancy is available in Policy VII.3. – Pregnant Employee – Conceptus Dose.

H. **Investigational Levels, Action Procedures, and Records**

1. **Specific procedures for responding to any occupational radiation dose that exceeds Level I or Level II in the following table have been established.**

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Part of Body	Investigation Levels (millirem per monitoring period)	
	Level I	Level II
Whole body: head, trunk or gonads	100	400
Extremities: elbow, arm below the elbow, foot, knee, leg below the knee, or skin	1,000	3,000
Conceptus of declared pregnant worker	30	40

2. When a **Level I** dose is exceeded, the RSO will send a written description of the dose report, including the occupational dose history for the previous two monitoring periods, to the person involved with a copy to the Authorized User. The individual will be requested to review his or her radiation safety procedures and work habits in an effort to maintain all doses as low as reasonably achievable. Radiation Safety reviews and consultations will be offered.
3. When a **Level II** dose is exceeded, the RSO will conduct a direct investigation of the situation, including an interview with the person involved. A written investigation report shall be made, including dose trends over the past one year (as available) for that person. The person involved will be provided with a copy of the report for review and signature. Conclusions drawn from the investigation will provide a basis for confirming or modifying the dose and for establishing any corrective actions to be taken.
4. Dose information will be made available to monitored individuals. The RSO facilitates the delivery of dose reports to all departments participating in the personnel monitoring program.
5. Individual departments should maintain dosimetry records for at least one year.
6. In accordance with 10A NCAC 15.1004(b)(1), "Notification and Reports to Individuals", individuals will be provided personal notification of annual occupational dose in excess of 100 mrem (1 mSv) TEDE or 100 mrem (1 mSv) to any individual organ or tissue.
7. The RSO is responsible for maintaining personnel monitoring records indefinitely.
8. If a regulatory overexposure occurs, the required reports will be prepared in accordance with 10A NCAC 15.1647 – "Reports of Radiation Exceeding the Limits". The report will include: the name of the occupationally overexposed individual, last 4 digits of SSN and/or identifier, date of birth, estimated dose, levels of radiation and concentrations of radioactive material involved, cause of elevated exposure/dose rates/concentrations, and corrective action. Reports will be sent to the NC Radiation Protection Section and the exposed individual.

I. Disciplinary Procedures

1. Disciplinary procedures specified in the UNC Health Care personnel manual may be instituted when:

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- a. Employees do not wear radiation monitoring devices as instructed, lose monitoring devices, or fail to return monitoring devices.
- b. Employees intentionally expose monitoring devices.

IV. References

NCRP Report 122, Use of Personal Monitors to Estimate Effective Dose Equivalent and Effective Dose to Workers for External Exposure to Low-LET Radiation, 1995.

V. Original Policy Date and Revisions

November 2010, October 2011, October 2013, May 2016, July 2016.

VI. Comments

For comments or questions about the contents of this policy, contact the Radiation Safety Officer at 919-962-5507.