



Standard Practice
RSP 2

Radiation Monitoring Requirements and Dose Limits

Effective Date May 18, 2000

I. PURPOSE

To establish minimum radiation monitoring requirements for individuals working with sources of radiation. Monitoring will be in compliance with the requirements in the North Dakota Radiological Health Rules, based on the established dose limits for radiation workers.

II. POLICY

This standard sets the minimum basis for determining what if any radiation monitoring an individual requires. The Radiation Safety Officer will review all radiation exposure reports and may require additional monitoring based on past performance or other factors affecting an individual's exposure. Personnel monitoring is for "occupational" exposure, or dose that an individual receives while using sources of radiation at the University of North Dakota. Badges must be worn whenever an individual is likely to be exposed to radiation while engaged in his or her assigned duties. Badges must be worn on that part of the body expected to receive the highest dose. The badges are not to be exposed to any radiation outside of the wearer's assigned duties such as medical x-rays, nuclear medicine procedures, or airport security systems. The goal is to maintain all doses below 10% of the regulatory limits.

III. SCOPE

This policy applies to employees of UND, outside contractors, students, fellows, volunteers, and visiting scholars that may be exposed to radiation from radioactive materials or from radiation producing machines.

IV. REFERENCES

1. US Nuclear Regulatory Commission's Regulatory Guides:
 - a. 8.20, "Applications for Bioassay for I-125 and I-131."
 - b. 8.32, "Criteria for Establishing a Tritium Bioassay Program "
2. North Dakota Radiological Health Rules:
 - a. subsection 2 of section 33-10-14.1-09, "Conditions requiring individual monitoring of external and internal occupational dose."
 - b. subdivision a of subsection 1 of section 33-10-04.1-06, "Occupational dose limits for adults."
 - c. subsection 8 of section 33-10-04.1-06, "Dose to an embryo or fetus."

- d. subsection 4 of section 33-10-04.1-06, "Determination of internal exposure." and table I, columns 1 and 2 of appendix B of Chapter 33-10-04.1, "Annual Limit on Intakes."

V. DEFINITIONS

- 1. Low to Moderate energy beta emitters: radioactive materials that emit beta particles having maximum energies less than 0.3 MeV
- 2. High energy beta emitters: radioactive materials that emit beta particles having maximum energies greater than 0.3 MeV

The most common isotopes used at UND are listed below. The first four isotopes are considered low to moderate energy beta emitters (<0.3 MeV) that do not pose a whole body exposure hazard. The last three isotopes are gamma or high energy beta emitters (>0.3 MeV) that can cause whole body exposure.

isotope	max. Beta energy	gammas dist. in air		dist. in tissue	
H-3	0.019 MeV	no gamma	2.5 inches	0.005 mm	
C-14	0.156 MeV	no gamma	11 inches	0.28 mm	
P-33	0.248 MeV	no gamma	15 inches	0.48 mm	
S-35	0.168 MeV	no gamma	11 inches	0.36 mm	
Cl-36	0.709 MeV	no gamma	70 inches	2.11 mm	
P-32	1.710 MeV	no gamma	260 inches	8.13 mm	
I-125	no beta	0.03549 MeV	----	----	

VI. RESPONSIBILITIES

A. Radiation Safety Officer (RSO) is responsible for:

- 1. Reviewing personnel monitoring reports and investigating any elevated readings. Investigation trigger levels are set at 75 millirem in one month for a whole body reading, and 200 millirem in one month for a ring badge reading.
- 2. Maintaining exposure records of all individuals monitored by the University and furnishing to each worker annually a written report of the worker's total radiation dose.
- 3. Ordering badges from the vendor and distributing them to the users

B. Authorized User/Radiation Producing Machine User is responsible for:

- 1. Ensuring that individuals that work with or in the vicinity of sources of radiation are properly monitored for radiation exposure according to this policy
- 2. Paying for radiation monitoring performed under their authorization.

C. Each affected employee/student is responsible for:

- 1. Wearing the monitoring devices properly, whenever they are exposed to radiation from material or machines licensed or registered by the University.
- 2. Keeping their radiation dose As Low As Reasonably Achievable (ALARA).

3. Keeping track of the monitoring devices and ensuring that the badges are available for exchange at the appropriate time.

VII. MONITORING REQUIREMENTS

The following table must be used to determine the minimum level of personnel monitoring required for a specific radioisotope or machine use. This policy does not prohibit personnel monitoring in excess of the required monitoring. For specific situations the Radiation Safety Officer may require monitoring in excess of the monitoring required by the following table. If the RSO requires enhanced monitoring, the RSO will send a written memo to the Authorized User detailing what monitoring is required and why it is required. The North Dakota Radiological Health Rules require monitoring of any individual likely to exceed 10% of any of the dose limits listed in the rules.

	Type of exposure	Required monitoring
1.	Working in laboratories that utilize only low to moderate energy beta emitters (less than 0.3 MeV)	No badges
2.	Working only with low to moderate energy beta emitters (less than 0.3 MeV) but in areas where gamma or high energy beta emitters are used	Whole Body Badge, exchanged at least quarterly
3.	Working with less than 2 mCi total per week <u>and</u> less than 1 mCi amounts per procedure of gamma or high energy beta emitters	Whole Body Badge, exchanged at least quarterly
4.	Working with greater than 2 mCi per week <u>or</u> greater than 1 mCi amounts per procedure of gamma or high energy beta emitters	Whole Body Badge and ring TLD, exchange rate will be determined by the RSO based on apparent risk and past history
5.	¹ Working with greater than 10 mCi per procedure or 30 mCi per week of unsealed radioiodine or tritium. (If not using a hood then the limit is 1 mCi per procedure or 3 mCi per week. US NRC Reg. Guides 8.20 and 8.32 will be followed.)	bioassay, (thyroid bioassay will be performed through Altru Hospital)
6.	Working with medical x-ray machines	Whole Body Badge, exchanged at least quarterly
7.	Working with electron microscopes	based on case by case evaluation of dose rate and past history
8.	Working with analytical XRF or XRD machines	based on case by case evaluation of dose rate and past history
9.	Am-241:Be Moisture content gauges (such as Moisture/density or Moisture/depth gauges)	Whole Body Badge with neutron detection capability, exchanged at least quarterly

¹Due to the small amount of material used and procedures to minimize a radioisotope intake, internal monitoring

(bioassay) is not routinely performed. Bioassay will be performed on individuals involved in an abnormal incident or in accordance with US NRC Reg Guides 8.20 for Iodine and 8.32 for tritium.

VIII. DOSE LIMITS

The consensus of opinion is that exposure to any amount of radiation could have a harmful effect. Radiation exposure must be kept As Low As Reasonably Achievable or ALARA. Experiments should be designed to prevent unnecessary exposure of personnel. The following dose limits are not to be construed as safe levels, rather as absolute upper bounds. The goal of the Radiation Safety Program is to keep all radiation workers' doses less than 10% of the stated limits.

- A. Dose limits for adult radiation workers: (Subdivision a of subsection 1 of section 33-10-04.1-06 of the North Dakota Radiological Health Rules.) No user will possess, use, or transfer materials or use machines in such a manner as to cause a radiation worker to receive an occupational dose in excess of the limits specified in the following table:

ANNUAL ADULT RADIATION DOSE LIMITS

Total Effective Dose Equivalent (Whole Body + Internal Dose)	5,000 mrem
Dose to any Organ or Tissue except the lens of the eye (Deep dose + internal organ dose)	50,000 mrem
Eye dose equivalent	15,000 mrem
Shallow dose equivalent to the skin or to any extremity (hands and arms below the elbows, feet and legs below the knees)	50,000 mrem

- B. Dose limits for an embryo or fetus: (Subsection 8 of section 33-10-04.1-06 of the North Dakota Radiological Health Rules.) A female radiation worker has the option of voluntarily informing the University, in writing, of a pregnancy along with the estimated date of conception. The RSO must ensure that declared pregnant females receive less than 500 mrem occupational dose over the course of the pregnancy with no more than 50 mrem received in any one month. Pregnant females who do not declare themselves pregnant will be treated as if they are not pregnant
- C. Dose limits for Minors: (Subsection 7 of section 33-10-04.1-06 of the North Dakota Radiological Health Rules.) No minor will receive a dose in excess of 10% of the limits for adult radiation workers. At the University of North Dakota individuals under 18 years of age cannot work with radiation sources without written permission from a parent or legal guardian and the RSO.
- D. Determination of dose due to internal exposure: (Subsection 4 of section 33-10-04.1-06 and table I, columns 1 and 2 of appendix B of Chapter 33-10-04.1 of the North Dakota Radiological Health Rules.) Internal dose limits are included in the above table, "Annual Adult Radiation Dose Limits". If routine bioassays are not required under the provisions of this standard, then internal dose will be considered to be insignificant. When bioassays are performed, the dose contribution will be determined by the Radiation Safety Officer in accordance with the North Dakota Radiological Health Rules.