RPR 46
PERSONAL EXPOSURE INVESTIGATIONS AND REPORTING

PURPOSE

This document identifies the criteria used to determine when an investigation of a radiation exposure to an individual, based on exceeding internal and/or external radiation dose investigation levels, is required. The responsibility and methods of investigating, documenting and reporting these events is outlined, including the timely reporting of radiation doses that exceed regulatory limits.

POLICY

As mandated by regulation (Utah Administrative Code R313-15-101[2]), the University of Utah is committed to use sound radiation protection principles to achieve occupational doses that are as low as reasonably achievable (ALARA). One method to ensure radiation doses are ALARA, is to investigate circumstances and incidents that lead to unusual or unexpected radiation exposures, even if the regulatory limit is not exceeded. To achieve this end, investigation levels are established below regulatory required dose limits.

The University of Utah Radiation Safety Policy Manual (6/96) states:

> *"The RSO Shall establish investigation levels, i.e. levels of radiation dose received during a monitoring period, for each category of "normally exposed" radiation users. Whenever the dose … exceeds the investigation level, the RSO shall cause an investigation to be made to determine the cause of the dose and steps that might be taken to prevent recurrence. (Page 11)*
>
> *"For external exposures, the investigation level is based on the expected exposure for a category or specific group of radiation users … For internal exposures, the investigation level is 0.05 ALI per single intake or per calendar quarter." (Page 13)*

Values of the Investigation Level (IL) for internal exposures or for external doses to the body, lens of the eye, or extremities, for various individuals, are listed in Table 1.

Note that, per R313-15-202[3], for purposes of determining compliance with annual dose limits and reporting requirements, an internal exposure shall be included in the calculation of total effective dose equivalent, only if an individual receives an intake of radionuclides greater than ten percent of the applicable oral Annual Limit of Intake (ALI) for all radionuclides combined.

Every potential internal exposure due to personal contamination or an injury involving radioactive materials, shall be investigated regardless of the actual, or suspected, radiation dose.

A radiation dose to an individual that exceeds the annual dose limit shall be investigated and must be reported to the regulatory agency. Notification time requirements are listed in Table 2 and are dependent on the nature of the dose and the dose magnitude. The Radiation Safety Officer (RSO) will direct the investigation, evaluate the results, and submit the required report to the regulatory agency. The exposed individual is obligated to provide correct information regarding the circumstances of the exposure. The Responsible User shall be informed of the exposure and of any subsequent restrictions that may need to be imposed on the individual's use of radioactive material.

DEFINITIONS

"Annual Limit of Intake (ALI)" means the activity of a single radionuclide (expressed in millicuries [mCi]) which, if ingested or inhaled by a single individual, would result in an effective dose equivalent equal to that individual of a whole body dose of 5 rem or individual organ dose of 50 rem. The ALI is dependent on the route of intake. For most laboratory purposes, involving contamination control and bioassay procedures, the ALI for ingestion is used. Ingestion is the most common route of accidental intake of radionuclides. For gases, the inhalation ALI is used. Values of the ALI for most radionuclides is found in RPR 10.

"External Exposure" means exposure to all or a part of the human body from an external penetrating radiation field.

"Internal Exposure" means exposure to all or a part of the human body from internally deposited radioactive material.

"Investigation Level (IL)" means a dose from either external or internal exposure to an individual which exceeds a certain limit. Limits are described in Table 1.

PROCEDURES

The RSO shall ensure that dosimetry reports are reviewed, to determine whether any reported doses exceed the IL. Those which exceed the investigation level shall be promptly investigated, and reported as necessary. Investigations of external exposures shall be completed and documented, using the "External Exposure (ALARA) Investigation Report" (RPR 46A), or electronic database equivalent. Investigations of internal exposures shall be completed and documented, using the "Internal Exposure (ALARA) Investigation Report" (RPR 46B).

For an overexposure requiring a report to a regulatory agency (see Table 2), a signed, written statement shall be submitted by the exposed individual describing the circumstances that led to the overexposure, and the measures that will be taken to prevent recurrence. It is important for an honest, accurate, and complete accounting from all individuals involved. Individuals

should be informed that all or part of these statements may be sent to the regulatory agency. Information to be shared with regulatory agencies is outlined in R313-15-1203(2).

For doses below a reportable level, a Radiation Analyst or Health Physicist may obtain relevant information by communicating with individuals involved. The RPR 46A questionnaire serves as a guide to help ensure that all relevant information is obtained and documented.

A dosimeter reading shall be assumed valid, and shall not be changed on the permanent record, unless there is a complete, written description of the circumstances leading to an invalid exposure. A determination of the invalid exposure reading shall be reached by a Health Physicist after a discussion with the RSO and the individual badge wearer. A report, signed by the Health Physicist, is prepared and put in the personal dosimetry record for the individual and the correction is forwarded to the dosimetry vendor for record correction. A copy of the report is available to be provided to the exposed individual, upon request.

TABLE 1: ALARA INVESTIGATION LEVELS

(Dose measured in [mrem])

<table>
<tr><th>USE TYPE</th><th>Whole Body Dose (From Body Badge or Calculated from Collar & Waist Badge) [a]</th><th>Extremity Dose (From Ring Badge)</th><th>Lens Dose (Calculated from Collar Badge)[b]</th><th>Internal Dose by Any Route (From Bioassay)</th></tr>
<tr><td>Cardiac Catheterization or other Special Procedures</td><td>300 per month</td><td rowspan="3">500 per month</td><td rowspan="6">1,000 cumulative per year-to-date</td><td rowspan="6">0.05 ALI per event or per quarter</td></tr>
<tr><td>Diagnostic Radiology</td><td rowspan="4">100 per month</td></tr>
<tr><td>Nuclear Medicine</td></tr>
<tr><td>Cyclotron</td><td rowspan="2">2,500 per month</td></tr>
<tr><td>Radiopharmacy</td></tr>
<tr><td>All Others</td><td>50 per monitoring period</td><td>500 per monitoring period</td></tr>
</table>

[a] Two badges may be worn in tandem with a lead protective apron — one at the collar **outside** the apron and the other **under** the apron at the waist. The effective dose is then calculated per R313-15-201(3)(b)(ii) as the sum of 4% of the deep dose equivalent recorded by the collar badge plus 150% of the deep dose equivalent recorded by the body badge.

[b] In evaluating eye dose equivalent, per NUREG 1556, Vol. 9, it is acceptable to take credit for shielding provided by protective lenses worn by the individual.

TABLE 2: REPORTING LEVELS and NOTIFICATION REQUIREMENTS

(Dose Measured in [rem])

DOSE	Notification to Regulatory Agency is Required Within:		
	Immediate [a]	**24 Hours [b]**	**30 Days [c]**
Whole Body	25 per event	5 per event	5 per year
Eye	75 per event	15 per event	15 per year
Skin or Extremities	250 per event	50 per event	50 per year
Any Other Single Organ			

[a] *Utah Administrative Code R313-15-1202 (1)*
[b] *Utah Administrative Code R313-15-1202 (2)*
[c] *Utah Administrative Code R313-15-1203 (1)*

REFERENCES

Utah Division of Radiation Control, *Utah Radiation Control Rules, Standards for Protection Against Radiation*, R313-15

U.S. Nuclear Regulatory Commission, Regulatory Guide 8.10, *Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Reasonably Achievable*, Revision 1R, May 1997

U.S. Nuclear Regulatory Commission, Regulatory Guide 8.10, *Information Relevant to Ensuring that Occupational Radiation Exposures at Medical Institutions Will Be ALARA*, Revision 2, April 2011

U.S. Nuclear Regulatory Commission, Regulatory Guide 8.10, *Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Reasonably Achievable*, Revision 1R, May 1997, Washington DC

U.S. Nuclear Regulatory Commission, NUREG-1556, Volume 9, *Consolidated Guidance about Materials Licenses: Program-Specific Guidance about Medical Use Licenses*," Washington, DC

U.S. Nuclear Regulatory Commission, NUREG-1556, Volume 12, *Consolidated Guidance about Materials Licenses: Program-Specific Guidance About Possession Licenses for Manufacturing and Distribution*," Washington, DC

U.S. Nuclear Regulatory Commission, NUREG-1556, Volume 13, *Consolidated Guidance about Materials Licenses: Program-Specific Guidance About Commercial Radiopharmacy Licenses*," Washington, DC

ATTACHMENTS

RPR 46A External Exposure (ALARA) Investigation Report

RPR 46B Internal Exposure (ALARA) Investigation Report

RPR 46A. EXTERNAL EXPOSURE (ALARA) INVESTIGATION REPORT

UID: _____ **ALARA REVIEW #:** _____

LAST NAME: _____ **FIRST NAME:** _____

PI NAME: _____ **DEPARTMENT:** _____

PARTICIPANT ID: _____ **OFFICE PHONE:** _____

PERIOD BEGIN DATE: _____ **USE TYPE:** _____

SERIES	DDE (Whole Body)	LDE (Eye)	SDE (Extremity)	Dosimeter Type

EFFECTIVE DOSE (If Lead Shielded Apron Was Worn = 0.04 Collar Exposure + 1.5 Waist Exposure): _____

RECEIVED BY: _____ **RECEIVED DATE:** _____

Results of Investigation:

INTERVIEWED BY: _____ **INTERVIEWED DATE:** _____

Recommendations to Prevent Recurrence:

Regulatory Notification Requirements. (If "YES" is selected, notification is required.)			
DOSE	**NO**	**YES**	**NOTIFICATION**
IN ONE EVENT GREATER THAN 5 X ANNUAL LIMIT?	☐	☐	IMMEDIATE
IN ONE EVENT GREATER THAN ANNUAL LIMIT?	☐	☐	WITHIN 24 HOURS
CUMULATIVE IN EXCESS OF ANNUAL LIMIT?	☐	☐	WITHIN 30 DAYS

HP SIGNATURE: _____ **DATE:** _____

EXTERNAL EXPOSURE INVESTIGATION QUESTIONNAIRE

For all investigations of high dosimeter readings:

1. Where did you work during the exposure period? Hospital, clinic, building, room, hood/bench, etc., or any other information which would help to determine the source of exposure, and whether it is valid.

2. What type and number of procedures did you perform during the monitoring period? How much time was spent on these procedures? (The details of the procedures are not as important as a reliable estimate of your potential exposure.)

3. Where on your person is your badge worn, i.e. collar, apron, sleeve, right hand, left hand and which finger?

4. Where is your dosimeter kept when not being worn? Was it ever taken out of the lab area by you or anyone else? Could anyone else have used it or exposed it to a radiation source?

5. What type of personal protective apparel did you wear, i.e. lab coat, lead apron, thyroid collar, goggles, gloves?

For radioisotope users:

6. Did you use shielding? (When and where it was necessary.) Was it the proper type of shielding for the nuclide being used? Could the exposure have been caused by another individual, e.g. someone working near you, a sample placed near you or in a drawer?

For cardiologists:

7. Was the mobile ceiling shield used during all procedures? If not, how often and for how long did you need to bypass the mobile shield in order to perform a procedure?

8. Do you use the X-ray equipment in such a way that the angle of the primary beam is not perpendicular to the patient? If so, how do you ensure that your distance from the primary beam is maintained?

9. Is it possible that you could have leaned over the patient and exposed the badge to the primary beam? If so, how many times could this have happened? Estimate the amount of time the badge could have been exposed to the primary beam.

RPR 46B. INTERNAL EXPOSURE (ALARA) INVESTIGATION REPORT

UID: _____ **ALARA REVIEW #:** _____

LAST NAME: _____ **FIRST NAME:** _____

PI NAME: _____ **DEPARTMENT:** _____

PARTICIPANT ID: _____ **OFFICE PHONE:** _____

REASON FOR INVESTIGATION:

- ☐ **Personal Contamination or Injury** **Date:** _____
- ☐ **Abnormal Urinalysis Bioassay** **Date:** _____
- ☐ **Abnormal Thyroid Bioassay** **Date:** _____

INITIATED BY: _____ **Date:** _____

Results of Investigation: Include verified intake results expressed as a percent of ALI. Attach all necessary documentation including a detailed employee statement as warranted.

INTERVIEWED BY: _____ **INTERVIEWED DATE:** _____

Recommendations to Prevent Recurrence:

Regulatory Notification Requirements. (If "YES" is selected, notification is required.)

DOSE	NO	YES	NOTIFICATION
IN ONE EVENT GREATER THAN 5 X ANNUAL LIMIT?	☐	☐	IMMEDIATE
IN ONE EVENT GREATER THAN ANNUAL LIMIT?	☐	☐	WITHIN 24 HOURS
CUMULATIVE IN EXCESS OF ANNUAL LIMIT?	☐	☐	WITHIN 30 DAYS

HP SIGNATURE: _____ **DATE:** _____