

**IDAHO STATE UNIVERSITY
RADIATION SAFETY POLICY MANUAL**

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THE RADIATION SAFETY COMMITTEE

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§1 PURPOSE

(1) This manual conveys the official policies of Idaho State University (ISU) for the control of all sources of, and exposures to, ionizing radiation that are within the jurisdiction of the University. The manual defines responsibilities of individuals and organizations for radiation control and it specifies the policies that guide specific decisions on radiation control matters. Requirements and procedures are developed, promulgated and enforced as necessary to implement the overall philosophy and policies for radiation protection.

(2) Rules and procedures promulgated for use within ISU shall comply with the regulations and requirements of the Federal and State agencies that license and regulate radiation sources and uses. Technical assessments, evaluations and interpretations shall also be consistent with the guidance and recommendations of authoritative advisory bodies, such as the International Commission on Radiological Protection (ICRP), the National Council on Radiation Protection and Measurements (NCRP), the Committee on the Biological Effects of Ionizing Radiation of the National Academy of Sciences (BEIR) and the American National Standards Institute (ANSI).

(3) Federal and State regulations require a written radiation protection program, which includes provisions for keeping doses As Low As Reasonably Achievable (10 CFR 20.1101). All radiation users must be included in the program and must be informed of the program and of their individual responsibilities. This manual is intended to satisfy these regulatory requirements.

§2.0 REGULATORY EXPOSURE LIMITS

§2.1 Introduction

The use of radioactive materials at Idaho State University is regulated by the United States Nuclear Regulatory Commission. Radiation Exposure Limits are specified within Title 10 of the Code of Federal Regulations in Part 20. The use of radiation producing machines at Idaho State University is regulated by the State of Idaho's Department of Health and Welfare. Radiation Exposure Limits established by the State of Idaho may be found in IDAPA 16, Title 02 Chapter 27 as the Idaho Radiation Control Rules.

§2.2 United States Nuclear Regulatory Commission

The United States Nuclear Regulatory Commission regarding exposure limits as specified in 10CFR20.1201 through 20.1208 are provided verbatim in this section. These rules may be reviewed in entirety at <http://www.nrc.gov/reading-rm/doc-collections/cfr/>

Subpart C--Occupational Dose Limits

Source: 56 FR 23396, May 21, 1991, unless otherwise noted.

§ 20.1201 Occupational dose limits for adults.

(a) *The licensee shall control the occupational dose to individual adults, except for planned special exposures under § 20.1206, to the following dose limits.*

(1) *An annual limit, which is the more limiting of--*

(i) *The total effective dose equivalent being equal to 5 rems (0.05 Sv); or*

(ii) *The sum of the deep-dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye being equal to 50 rems (0.5 Sv).*

(2) *The annual limits to the lens of the eye, to the skin of the whole body, and to the skin of the extremities, which are:*

(i) *A lens dose equivalent of 15 rems (0.15 Sv), and*

(ii) *A shallow-dose equivalent of 50 rem (0.5 Sv) to the skin of the whole body or to the skin of any extremity.*

(b) *Doses received in excess of the annual limits, including doses received during accidents, emergencies, and planned special exposures, must be subtracted from the limits for planned special exposures that the individual may receive during the current year (see § 20.1206(e)(1)) and during the individual's lifetime (see § 20.1206(e)(2)).*

(c) *When the external exposure is determined by measurement with an external personal monitoring device, the deep-dose equivalent must be used in place of the effective dose equivalent, unless the effective dose equivalent is determined by a dosimetry method approved by the NRC. The assigned deep-dose equivalent must be for the part of the body receiving the highest exposure. The assigned shallow-dose equivalent must be the dose averaged over the contiguous 10 square centimeters of skin receiving the highest exposure. The deep-dose equivalent, lens-dose equivalent, and shallow-dose equivalent may be assessed from surveys or other radiation measurements for the purpose of demonstrating compliance with the occupational dose limits, if the individual monitoring device was not in the region of highest potential exposure, or the results of individual monitoring are unavailable.*

(d) *Derived air concentration (DAC) and annual limit on intake (ALI) values are presented in table 1 of appendix B to part 20 and may be used to determine the individual's dose (see § 20.2106) and to demonstrate compliance with the occupational dose limits.*

(e) *In addition to the annual dose limits, the licensee shall limit the soluble uranium intake by an individual to 10 milligrams in a week in consideration of chemical toxicity (see footnote 3 of appendix B to part 20).*

(f) *The licensee shall reduce the dose that an individual may be allowed to receive in the current year by the amount of occupational dose received while employed by any other person (see § 20.2104(e)).*

[56 FR 23396, May 21, 1991, as amended at 60 FR 20185, Apr. 25, 1995; 63 FR 39482, July 23, 1998; 67 FR 16304, Apr. 5, 2002; 72 FR 68059, Dec. 4, 2007]

§ 20.1203 Determination of external dose from airborne radioactive material.

Licensees shall, when determining the dose from airborne radioactive material, include the contribution to the deep-dose equivalent, lens dose equivalent, and shallow-dose equivalent from external exposure to the radioactive cloud (see appendix B to part 20, footnotes 1 and 2).

Note: Airborne radioactivity measurements and DAC values should not be used as the primary means to assess the deep-dose equivalent when the airborne radioactive material includes radionuclides other than noble gases or if the cloud of airborne radioactive material is not relatively uniform. The determination of the deep-dose equivalent to an individual should be based upon measurements using instruments or individual monitoring devices. [56 FR 23396, May 21, 1991, as amended at 60 FR 20185, Apr. 25, 1995; 63 FR 39482, July 23, 1998]

§ 20.1204 Determination of internal exposure.

(a) For purposes of assessing dose used to determine compliance with occupational dose equivalent limits, the licensee shall, when required under § 20.1502, take suitable and timely measurements of—

- (1) Concentrations of radioactive materials in air in work areas; or*
- (2) Quantities of radionuclides in the body; or*
- (3) Quantities of radionuclides excreted from the body; or*
- (4) Combinations of these measurements.*

(b) Unless respiratory protective equipment is used, as provided in § 20.1703, or the assessment of intake is based on bioassays, the licensee shall assume that an individual inhales radioactive material at the airborne concentration in which the individual is present.

(c) When specific information on the physical and biochemical properties of the radionuclides taken into the body or the behavior or the material in an individual is known, the licensee may—

(1) Use that information to calculate the committed effective dose equivalent, and, if used, the licensee shall document that information in the individual's record; and

(2) Upon prior approval of the Commission, adjust the DAC or ALI values to reflect the actual physical and chemical characteristics of airborne radioactive material (e.g., aerosol size distribution or density); and

(3) Separately assess the contribution of fractional intakes of Class D, W, or Y compounds of a given radionuclide (see appendix B to part 20) to the committed effective dose equivalent.

(d) If the licensee chooses to assess intakes of Class Y material using the measurements given in § 20.1204(a)(2) or (3), the licensee may delay the recording and reporting of the assessments for periods up to 7 months, unless otherwise required by §§ 20.2202 or 20.2203, in order to permit the licensee to make additional measurements basic to the assessments.

(d) If the identity and concentration of each radionuclide in a mixture are known, the fraction of the DAC applicable to the mixture for use in calculating DAC-hours must be either—

(1) The sum of the ratios of the concentration to the appropriate DAC value (e.g., D, W, Y) from appendix B to part 20 for each radionuclide in the mixture; or

(2) The ratio of the total concentration for all radionuclides in the mixture to the most restrictive DAC value for any radionuclide in the mixture.

(e) If the identity of each radionuclide in a mixture is known, but the concentration of one or more of the radionuclides in the mixture is not known, the DAC for the mixture must be the most restrictive DAC of any radionuclide in the mixture.

(f) When a mixture of radionuclides in air exists, licensees may disregard certain radionuclides in the mixture if—

- (1) The licensee uses the total activity of the mixture in demonstrating compliance with the dose limits in § 20.1201 and in complying with the monitoring requirements in § 20.1502(b), and
- (2) The concentration of any radionuclide disregarded is less than 10 percent of its DAC, and
- (3) The sum of these percentages for all of the radionuclides disregarded in the mixture does not exceed 30 percent.

(h)(1) In order to calculate the committed effective dose equivalent, the licensee may assume that the inhalation of one ALI, or an exposure of 2,000 DAC-hours, results in a committed effective dose equivalent of 5 rems (0.05 Sv) for radionuclides that have their ALIs or DACs based on the committed effective dose equivalent.

(2) When the ALI (and the associated DAC) is determined by the nonstochastic organ dose limit of 50 rems (0.5 Sv), the intake of radionuclides that would result in a committed effective dose equivalent of 5 rems (0.05 Sv) (the stochastic ALI) is listed in parentheses in table 1 of appendix B to part 20. In this case, the licensee may, as a simplifying assumption, use the stochastic ALIs to determine committed effective dose equivalent. However, if the licensee uses the stochastic ALIs, the licensee must also demonstrate that the limit in § 20.1201(a)(1)(ii) is met.

§ 20.1205 [Reserved]

§ 20.1206 Planned special exposures.

A licensee may authorize an adult worker to receive doses in addition to and accounted for separately from the doses received under the limits specified in § 20.1201 provided that each of the following conditions is satisfied—

(a) The licensee authorizes a planned special exposure only in an exceptional situation when alternatives that might avoid the dose estimated to result from the planned special exposure are unavailable or impractical.

(b) The licensee (and employer if the employer is not the licensee) specifically authorizes the planned special exposure, in writing, before the exposure occurs.

(c) Before a planned special exposure, the licensee ensures that the individuals involved are—

- (1) Informed of the purpose of the planned operation;
- (2) Informed of the estimated doses and associated potential risks and specific radiation levels or other conditions that might be involved in performing the task; and
- (3) Instructed in the measures to be taken to keep the dose ALARA considering other risks that may be present.

(d) Prior to permitting an individual to participate in a planned special exposure, the licensee ascertains prior doses as required by § 20.2104(b) during the lifetime of the individual for each individual involved.

(e) Subject to § 20.1201(b), the licensee does not authorize a planned special exposure that would cause an individual to receive a dose from all planned special exposures and all doses in excess of the limits to exceed—

- (1) The numerical values of any of the dose limits in § 20.1201(a) in any year; and
- (2) Five times the annual dose limits in § 20.1201(a) during the individual's lifetime.

(f) The licensee maintains records of the conduct of a planned special exposure in accordance with § 20.2105 and submits a written report in accordance with § 20.2204.

(g) The licensee records the best estimate of the dose resulting from the planned special exposure in the individual's record and informs the individual, in writing, of the dose within 30 days from the date of the planned special exposure. The dose from planned special exposures is not to be considered in controlling future occupational dose of the individual under § 20.1201(a) but is to be included in evaluations required by § 20.1206 (d) and (e). [56 FR 23396, May 21, 1991, as amended at 63 FR 39482, July 23, 1998]

§ 20.1207 Occupational dose limits for minors.

The annual occupational dose limits for minors are 10 percent of the annual dose limits specified for adult workers in § 20.1201.

§ 20.1208 Dose equivalent to an embryo/fetus.

(a) The licensee shall ensure that the dose equivalent to the embryo/fetus during the entire pregnancy, due to the occupational exposure of a declared pregnant woman, does not exceed 0.5 rem (5 mSv). (For recordkeeping requirements, see § 20.2106.)

(b) The licensee shall make efforts to avoid substantial variation above a uniform monthly exposure rate to a declared pregnant woman so as to satisfy the limit in paragraph (a) of this section.

(c) The dose equivalent to the embryo/fetus is the sum of—

(1) The deep-dose equivalent to the declared pregnant woman; and

(2) The dose equivalent to the embryo/fetus resulting from radionuclides in the embryo/fetus and radionuclides in the declared pregnant woman.

(d) If the dose equivalent to the embryo/fetus is found to have exceeded 0.5 rem (5 mSv), or is within 0.05 rem (0.5 mSv) of this dose, by the time the woman declares the pregnancy to the licensee, the licensee shall be deemed to be in compliance with paragraph (a) of this section if the additional dose equivalent to the embryo/fetus does not exceed 0.05 rem (0.5 mSv) during the remainder of the pregnancy.

[56 FR 23396, May 21, 1991, as amended at 63 FR 39482, July 23, 1998]

§2.3 Idaho Radiation Control Rules

The Idaho Radiation Control Rules 16.02.27.100 are provided verbatim in this section. These rules may be reviewed in entirety at <http://adm.idaho.gov/adminrules/rules/idapa16/0227.pdf>

100. STANDARDS FOR PROTECTION AGAINST RADIATION.
101. -- 109. (RESERVED).

110. OCCUPATIONAL EXPOSURES. Section 100 establishes standards for protection against radiation hazards. Except as otherwise specifically provided, Section 100 applies to all registrants. Nothing in Section 100 can be interpreted as limiting the intentional exposure of patients to radiation for the purpose of medical diagnosis or therapy. In addition to complying with these requirements, every reasonable effort must be made to maintain radiation exposures, to unrestricted areas, as far below the limits specified in Section 100 as practicable. The phrase "as far below the limits specified in Section 100 as practicable" means as low as is practicably achievable taking into account the state of technology, and the economics of improvements in relation to benefits to the public health and safety and other socioeconomic considerations in relation to the utilization of ionizing radiation in the public interest.

(7-1-98)

01. Exposure of Individuals to Radiation in Restricted Areas. Except as provided in Subsection 110.01.b., no registrant may possess, use, receive, or transfer radiation machines in such a manner as to cause any individual in a restricted area to receive in any period of one (1) calendar quarter from all radiation machines in the registrant's possession a dose in excess of the limits specified in Subsection 110.01.a.:

(7-1-98)

a. Occupational Exposure Limits. (7-1-98)

OCCUPATIONAL EXPOSURE LIMITS	
Rem Per Calendar Quarter	
Whole Body, head and trunk, active	
blood-forming organs, lens of the eye, or gonads	1 1/4
Hands and Forearms, feet and ankles	18
3/4	
Skin of whole body	7 1/2

b. A registrant may permit an individual in a restricted area to receive a dose to the whole body greater than that permitted in the table in Subsection 110.01.a., provided:

(7-1-98)

- i. During any calendar quarter the dose to the whole body from radiation machines in the registrant's possession does not exceed three (3) rem; and
(7-1-98)
- ii. The dose to the whole body, when added to the accumulated occupational dose to the whole body, does not exceed five (5) (N-18) rem where "N" equals the individual's age in years at his last birthday; and
(7-1-98)
- iii. The registrant has determined the individual's accumulated occupational dose to the whole body on a clear and legible record containing all the information required pursuant to Subsection 140.01.a. and has otherwise complied with the requirements of Subsection 110.02 as used in Subsection 110.01.b. "Dose to the whole body" includes any dose to the whole body, gonads, active blood-forming organs, head and trunk, or lens of the eye.
(7-1-98)

c. For determining the doses specified in Section 110 a dose from x-rays or gamma rays up to ten (10) MeV can be assumed to be equivalent to the exposure measured by a properly calibrated appropriate instrument in air at or near the body surface in the region of the highest dose rate. (7-1-98)

d. No registrant can change the method observed by him of determining calendar quarter for purposes of these rules except at the beginning of a calendar year from Subsection 010.13. (4-2-08)

02. Determination of Accumulated Dose. (7-1-98)

a. Each registrant shall require any individual, prior to first entry of the individual into the registrant's restricted area during each employment or work assignment under such circumstances that the individual will receive or is likely to receive in any period of one (1) calendar quarter an occupational dose in excess of twenty-five percent (25%) of the applicable standards specified in Subsections 110.01 and 110.04.a., to disclose in a written, signed statement: (7-1-98)

i. That the individual had no prior occupational dose during the current calendar quarter; or (7-1-98)

ii. The nature and amount of any occupational dose which the individual may have received during the specifically identified current calendar quarter, from radiation machines possessed or controlled by the other persons, and each registrant shall maintain records of such statements until the Agency authorizes disposition. (7-1-98)

b. Before permitting any individual in a restricted area to receive exposure to radiation in excess of the limits specified in Subsection 110.01, each registrant must: (7-1-98)

i. Obtain a signed certificate on a clear and legible record containing all the information required, showing each period of time after the individual attained the age of eighteen (18) in which the individual received an occupational dose of radiation (copies of certificates can be obtained from the Radiation Control Agency); and (7-1-98)

ii. Calculate, on a clear and legible record containing all the information required pursuant to Subsection 140.01.a., the previously accumulated occupational dose received by the individual and the additional dose allowed for that individual under Subsection 110.01.b. (7-1-98)

iii. In the preparation of a clear and visible record containing all the information required, make a reasonable effort to obtain reports of the individual's previously accumulated occupational dose. For each period for which the registrant obtains such report, he must use the dose shown in the report. In any case where a registrant is unable to obtain reports of the individual's occupational dose for a previous complete calendar quarter, it must be assumed that the individual has received the occupational dose specified in the following applicable columns: (7-1-98)

ASSUMED OCCUPATIONAL DOSES		
Part of Body	Column 1	Column 2
	Assumed Dose in Rem for Calendar Quarters Prior to January 1, 1961	Assumed Dose in Rem for Calendar Quarters on or After January 1, 1961
Whole Body, gonads, active blood-forming organs, head and trunk, lens of eye	3 3/4	1 1/4

- iv. *The registrant shall retain and preserve all records used until the agency authorizes their disposition. If calculation of the individual's accumulated occupational dose for all periods prior to January 1, 1961, yields a result higher than the applicable accumulated dose value for the individual as of that date, as specified in Subsection 110.01.b., the excess can be disregarded.* (7-1-98)

03. Exposure of Minors. Registrants must not possess, use or transfer radiation machines in such a manner as to cause any individual within a restricted area, who is under eighteen (18) years of age, to receive in any period of one (1) calendar quarter from all sources of radiation in such licensee's or registrant's possession a dose in excess of ten percent (10%) of the limits specified in the table in Subsection 110.01.a. For determining the doses specified in Subsection 110.04.a., a dose from x-rays or gamma rays up to ten (10) MeV can be assumed to be equivalent to the exposure measured by a properly calibrated appropriate instrument in air at or near the body surface in the region of the highest dose rate. (7-1-98)

04. Permissible Levels of Radiation from External Sources in Unrestricted Areas. (7-1-98)

a. Except as authorized by the Radiation Control Agency pursuant to Subsection 110.04.c., licensees or registrants must not possess, use, or transfer radiation machines in such a manner as to create in any unrestricted area from such sources of radiation in his possession: (7-1-98)

- i. Radiation levels which, if an individual were continuously present in the area, could result in his receiving a dose in excess of two (2) millirem in any one (1) hour; or (7-1-98)
- ii. Radiation levels which, if an individual were continuously present in the area, could result in his receiving a dose in excess of one hundred (100) millirem in any seven (7) consecutive days. (7-1-98)

b. It is the intent of Subsection 110.04 to limit radiation levels so that it is unlikely that individuals in unrestricted areas would receive a dose to the whole body in excess of five-tenths (0.5) rem in any one (1) year. If in specific instances, it is determined by the Radiation Control Agency that this intent is not being met, the Radiation Control Agency can, under Section 019 of these rules impose such additional requirements on the licensee or registrant as necessary. (4-2-08)

c. Any person can apply to the Radiation Control Agency for proposed limits upon levels of radiation in unrestricted areas in excess of those specified in Subsection 110.04.a. resulting from the applicant's possession or use of radiation machines. Such applications must include information as to anticipated average radiation levels and anticipated occupancy times for each unrestricted area involved. The Radiation Control Agency will approve the proposed limits if the applicant demonstrates to the satisfaction of the Radiation Control Agency that the proposed limits are not likely to cause any individual to receive a dose to the whole body in any period of one (1) calendar year in excess of five-tenths (0.5) rem.

§3.0 ALARA

§3.1 ALARA POLICY

(1) Two basic principles apply to every individual that may be exposed to radiation:

(a) All radiation doses are to be kept As Low As Reasonably Achievable (ALARA).

(b) No dose to an individual shall exceed the appropriate individual dose limit.

(2) The University is committed to an effective radiation protection program to eliminate unnecessary exposures to radiation and to reduce all exposures to levels that are As Low As Reasonably Achievable (ALARA), taking into account all social and economic situations. The ALARA principle is a formal requirement of the U.S. Nuclear Regulatory Commission (NRC) and the Idaho Department of Health and Welfare.

(3) The ALARA principle is implemented by a comprehensive radiation protection program that includes specific requirements and procedures for:

(a)..... training of all radiation users

(b)..... safety evaluations of proposed facilities or projects utilizing radiation in any way

(c)..... regular surveys of work areas for contamination and exposure rates

(d)..... monitoring of radiation exposures to groups and individuals

(e)..... investigations of all exposures that exceed predetermined levels

(f)..... reviews of the program by the Radiation Safety Committee

(4) Each facility or program using radiation-producing machines or radioactive materials must be justified on its merits and must be specifically authorized by the Radiation Safety Committee (RSC). The review and evaluation by the RSC covers the

training and experience of individuals authorized to use radiation sources, the adequacy of facilities and equipment, and procedures for the safe use of radiation sources.

(5) Specific rules and procedures may be issued by the Radiation Safety Officer (RSO) in support of the ALARA principle as well as to assure compliance with all legal and regulatory requirements. The RSO and supporting staff provide training, consultation and other services to radiation users to assist them in controlling radiation sources and reducing exposures.

§3.2 IDAHO STATE UNIVERSITY'S ALARA GOALS

(1) The ALARA goals for Idaho State University are set by the Radiation Safety Committee. The RSC reviews the University's goal annually to verify all exposures at ISU are consistent with the ALARA policy of the NRC. The goals are based upon the legal limits set by the NRC, good radiation protection practices, and when available, historical dose information for each active radiation program. The following goals have been set by the Radiation Safety Committee:

3.2.1 Radiation Technology Program

(1) *The total effective dose equivalent (TEDE) being equal to 600 mrem/year (150 mrem/calendar quarter - notification level)*

3.2.2 Idaho Accelerator Center

(1) The total effective dose equivalent being equal to 200 mrem/year for radiation workers (100 mrem/calendar quarter – notification level)

3.2.3 All Other Radiation Safety Programs

(1) The total effective dose equivalent being equal to 100 mrem/year (25 mrem/quarter - notification level).

(2) The Technical Safety Office (TSO) reviews all exposure records to ensure that the ALARA goals are appropriate for the particular activity. If an ALARA goal is exceeded, the TSO will perform an investigation. The TSO's investigation is intended to determine if the personnel are following appropriate radiation protection practices and if the ALARA goals are appropriate for the particular activity. Appropriate action will be taken based upon the results of the TSO's investigation. In order to maintain control of the individual exposures during a calendar year, the RSO may employ quarterly notification levels (four times lower than the above annual ALARA goals).

§4.0 EXECUTIVE MANAGEMENT

§4.1 Vice-President of Research (VPR)

(1) The VPR is the Senior Management representative for radiation protection matters at ISU. The RSC and RSO report directly to the Vice President of Research for matters concerning the use of radiation sources at ISU.

(2) The VPR meets with the Radiation Safety Committee Chairperson and the Radiation Safety Officer at least once per year to discuss the University's radiation safety program. In addition to the annual meetings with the RSC Chairperson and the RSO, the VPR is a voting, ex-officio member of the RSC and must attend at least one meeting of the RSC per year. The VPR also participates in periodic audits and reviews of the radiation safety program through annual briefings with the chairman of the RSC and the RSO. An alternate, executive management representative may be sent to the remaining meetings not attended by the VPR.

§4.2 Radiation Safety Committee (RSC)

(1) The purpose of ISU's Radiation Safety Committee is to set policy and to promulgate rules and procedures to ensure the safe use of radioactive sources at the University. Members of the RSC are appointed from the major academic and research areas that use ionizing radiation at ISU. RSC members are appointed to the Committee by the VPR for indefinite terms. Changes to RSC membership are recommended by the respective departments to the VPR. Any change of the RSO or of the RSC Chairperson must be approved by the NRC. Other changes are at the discretion of the VPR.

(2) The RSC meets as often as is necessary to conduct business but not less than once per calendar quarter. Minutes are kept and maintained by the TSO or his designee for each RSC meeting. Approved minutes are held on file in the TSO.

(3) The RSC conducts audits of and discusses issues pertaining to the radiation safety program. Reviewing personnel dosimetry data, survey results, significant events, ALARA performance, responsible user compliance, etc. are activities performed and discussed by the RSC. The findings of audits and the associated audit responses conducted by the RSC are maintained on file in the TSO.

(4) A quorum of the RSC consists of at least one-half of the voting RSC membership, which must include the Committee Chairperson and the RSO. The current voting RSC membership in addition to the Vice-President for Research and the Radiation Safety

Officer is as follows:

<u>Unit</u>	<u>Maximum Number of Representatives¹</u>
Department of Biological Sciences	(2)
Department of Geosciences	(1)
Department of Physics	(2)
College of Pharmacy	(1)
College of Engineering	(1)
College of Technology	(1)
Department of Radiographic Sciences	(1)
School of Dental Hygiene	(1)
Idaho Accelerator Center	(2)
Center for Advanced Engineering Studies	(2)

¹Appointment of any RSC representatives is at the discretion of the Vice President for Research. A unit does not need to have its full maximum complement of RSC representatives; the level of representation seated by a unit is at the discretion of the VPR.

(5) The RSC evaluates and authorizes new Responsible Users, new uses of licensed material, and new laboratories. Evaluation by the Radiation Safety Committee consists of the following:

- (a) Evaluation of the training of new Responsible Users to ensure that they meet ISU license requirements.
- (b) Review of the responsible user's request to ensure that proper handling procedures will be used when working with radionuclides.
- (c) Review of the responsible user's laboratory for safety adequacy considering the radionuclide(s) to be used. At a minimum, the following will be verified:
 - a. Appropriateness of laboratory facilities and available equipment
 - b. User's proposed procedures are appropriate for the task(s)
 - c. Survey instruments are appropriate for the radionuclide(s) used
 - d. Method for inventory control of the radionuclide(s) is adequate
 - e. Signs and labels are posted as required

(6) The RSC currently reviews administrative changes to the following aspects of the radiation safety program that can be made without amending the license: (a) changes dictated by NRC rule changes, (b) changes in contractors for bioassay, waste disposal,

dosimetry services, radiation survey instrumentation, and other equipment required to administer the Broad-Scope license, and (c) administrative changes to the radiation safety program.

§4.3 *Radiation Safety Officer (RSO)*

(1) The RSO is the individual appointed and empowered by the Vice-President of Research (VPR) and approved by the NRC to establish and enforce such rules and regulations as are necessary to assure compliance with applicable regulations and license conditions, and to ensure effective implementation of the policies and rules established by the Radiation Safety Committee. The RSO works in conjunction with the RSC and reports directly to the Vice-President for Research. The RSO is also the Director of the University's Technical Safety Office and its staff.

(2) The RSO is responsible for the proper performance of the following activities:

(a) Surveillance of overall activities involving radioactive sources, including routine monitoring and special surveys of areas in which radioactive sources are used.

(b) Compliance with rules and regulations, license conditions, and the conditions of project approvals specified by the Radiation Safety Committee.

(c) Monitoring and maintaining any special equipment associated with the use, storage, or disposal of radioactive materials.

(d) Furnishing consulting services to ISU personnel about radiation protection.

(e) Authorization of ordering, receiving, opening, and delivering shipments of radioactive material arriving at ISU to authorized University personnel and packaging and shipping radioactive materials pursuant to the operation of the University's Broad-Scope nuclear materials license.

(f) Distributing and processing personnel monitoring dosimeters, determining the need for and evaluation of bioassays, monitoring personnel exposure and bioassay records, notifying individuals and their supervisors of exposures approaching the maximum permissible amounts and recommending appropriate remedial actions.

(g) Conducting training programs and otherwise instructing personnel in the proper procedures for radioactive material before use, at periodic intervals conducting refresher training, and as required by changes in procedures, regulations, and equipment, etc.

(h) Supervising and coordinating the radioactive waste disposal program, including

maintenance of waste storage and disposal records.

(i) Storing radioactive materials not in current use, including radioactive wastes.

(j) Performing or arranging for required leak tests on sealed sources and calibration of radiation survey instruments.

(k) Maintaining an inventory of radionuclides for ISU and limiting the quantity of radionuclides at the University to the amounts authorized by the license.

(l) Immediately terminating any activity that is a threat to health or property.

(m) Decontamination and recovery operations.

(n) Records, such as receipt, transfer, and survey records (as required by 10 CFR 30.51).

(o) Serving as a voting member of the RSC.

(3) The RSO has the authority to act on behalf of the RSC and establish interim approval of all radiation safety actions as deemed appropriate, with full and final approval being considered at the next regular meeting of the RSC.

§4.4 Technical Safety Office (TSO)

(1) The RSO is assisted in the operation and maintenance of the Broad-Scope license by the Technical Safety Office. The Technical Safety Office is the organizational entity that provides administrative and technical services in support of the radiation protection program. The Director of the Technical Safety Office, who is also the RSO, reports to the Vice-President for Research. The TSO is located in the Physical Sciences Building Room 101B.

§4.5 Responsible User

(1) A Responsible User (RU) is an individual authorized by the Radiation Safety Committee to acquire and use specific radiation sources, and to supervise such use by others. An individual is designated to serve as a responsible user only after they provide the RSC with a detailed plan for the proposed use of radiation sources including secure storage, safe handling, control of exposures and appropriate waste disposal methods. The RU must update such information by means of periodic revisions or renewals of the authorization request as required by the Committee. In addition, the RU is required to demonstrate to the satisfaction of the RSO and the RSC

that he/she has had sufficient training and experience in the safe use of radiation sources, and must acknowledge and accept in writing responsibility for:

- (a) instruction in radiation protection practices for all personnel working with radiation sources and/or within facilities for which he or she is responsible
- (b) acquisition of equipment, supplies and services necessary for the safe use of radiation sources
- (c) security against misuse or theft of radiation sources as is consistent with established policy promulgated by the RSC
- (d) maintaining accurate inventory records for all radionuclides, including acquisitions, uses, transfers, records concerning disposals and records necessary for any decay estimation required. Only the TSO staff, with written approval from the RSO, may dispose of radioactive materials.
- (e) performing regular bioassays, exposure and/or contamination surveys and records as appropriate to the nature of the radiation use and as specified by the RSO
- (f) notification of the RSO of any accident, injury or abnormal incident related to radioactive materials or radiation producing machines.
- (g) arranging for authorization of another individual (alternate responsible user) to assume the preceding responsibilities, or to suspend or terminate all radiation uses, prior to any extended absence

§4.6 Radiation User

(1) A radiation user is any individual whose official duties or authorized activities include handling, operating or working in the presence of any type of radiation source. Each radiation user must understand and follow the general rules and procedures for working safely with radiation sources and must participate in radiation safety training as specified by the RSO.

(2) As a condition of employment, each radiation user for whom personal monitoring is required must provide certain personal information to the RSO. The required information includes (a) primary identification data, e.g. full name, birth date, sex, address and social security number; (b) previous training and experience with radiation sources; and (c) current employment status, including job title or description, department, supervisor, and work location. Individuals who require unescorted access to certain types and quantities of radioactive material may be required to provide

additional personal information as deemed necessary by the NRC.

(3) Personnel records for radiation users also contain the scores obtained on tests taken to demonstrate knowledge of radiation safety procedures, data obtained from monitoring of external and internal radiation exposures, and reports on any injuries or abnormal incidents related to the use of radiation sources. Radiation user records are treated as confidential and are available only to those with a legitimate need for the information. An individual may review the contents of his/her personal radiation user file at any time, and will be provided a summary of his/her radiation history annually if a 100 mrem threshold level is exceeded, upon request, and/ or upon termination of employment.

(4) Any radiation user may communicate directly, in confidence and without prejudice, with the RSO, any member of the RSC or TSO, the Idaho Department of Health and Welfare or the U.S. Nuclear Regulatory Commission on any matter concerning radiation protection.

§5 RADIATION USE AND APPLICATION

(1) The possession and use of radioactive materials and other sources of ionizing radiation are governed by regulations of several Federal and State agencies, and by conditions of specific licenses issued to ISU. The University permits the use of ionizing radiation sources for beneficial applications in teaching and research, if used in accordance with the policies, principles and rules contained in this manual. The protection of the health and welfare of each member of the faculty, staff, student body and general public is of primary importance; however, the financial, legal and societal obligations of the University are also considered in the implementation of practical radiation protection practices.

(2) Before a radiation user is allowed to use radiation sources or radiation producing machines, they must participate in the radiation safety training provided online by Idaho State University.

(3) All operable accelerators and x-ray generating machines used in Idaho State University facilities must be authorized by the Radiation Safety Committee and must be registered by the Idaho Radiation Control Agency (Idaho Department of Health and Welfare). All authorizations and registrations shall be submitted to the State of Idaho by the Radiation Safety Officer. The RSO must also be notified before moving, transferring or disposing of any radiation producing machine.

(4) The responsible user for each accelerator or x-ray machine shall ensure that written operating and emergency procedures are available, that each operator has received appropriate specific training and that all users understand and follow the correct procedures. Responsible Users should obtain a copy of IDAPA 16, DOCKET No. 16-0227-9701 and be familiar with its contents.

(4) Each proposed new use of radioactive materials, x-ray or other radiation generating machines must be submitted to the RSC via the RSO for review before implementation. Descriptions of facilities and equipment, training and experience of the user, and operating or handling procedures shall be provided in sufficient detail to permit the RSC to evaluate the safety of the proposed use.

(5) Radioactive material and radiation-producing machine permits are issued by the RSO upon RSC approval. These permits are valid for two years and will be reviewed on a two year basis. Permits will be mailed to the responsible user and a copy will be kept in the TSO files.

- (6) Radioactive material permits will generally contain:
- (a) the responsible user information
 - (b) expiration date
 - (c) permitted use locations
 - (d) permitted radionuclides or machines and activity limits
 - (e) permitted uses and restrictions
 - (f) conditions for all users
 - (g) additional conditions for users of dispersible sources, if applicable

§6 RADIATION SAFETY TRAINING

(1) Each individual working with or in the presence of radioactive materials or other radiation sources is required to receive documented 10 CFR Part 19.12 radiation safety training as provided online by the TSO. The extent of the training is to be commensurate with the potential risk of radiation exposure to the individual.

(2) Responsible users shall have their prior training evaluated by the RSO or TSO, or shall be trained by the TSO. Responsible users shall ensure that subordinate radiation-users or students working in their facilities are properly trained and as appropriate that subordinates complete all tests that may be required as a part of radiation safety training. This is accomplished by requiring them to participate in the training offered online by the TSO and supplementing this training as appropriate with laboratory-specific, hands-on training.

(3) The following subject areas are included within the ISU-general training for radiation users:

- (a) Characteristics of ionizing radiation
- (b) Units of radiation dose and quantities
- (c) Biological effects of exposure to ionizing radiation
- (d) Safe handling of radioactive materials
- (e) External exposure limitation (time/distance/shielding)
- (f) Internal exposure limitation (contamination control/bioassays)
- (g) Classification of facilities and postings
- (h) Individual dose limits including special limits for declared pregnant workers
- (i) Mathematics pertaining to the use and measurement of radioactivity
- (j) The ALARA principle
- (k) Emergency procedures

(4) ISU-specific training topics for radiation users includes:

- (a) ISU radiation protection authority structure.
ISU broad scope license conditions as appropriate for each Program.
- (b) Areas where radionuclides are used at ISU as appropriate for each Program.
- (c) The obligation to report unsafe conditions.
- (d) Operating and emergency procedures as appropriate for each Program.
- (f) Hands-on simulation that reinforces selected topics as appropriate for each Program
- (g) ISU Radiation Safety Policy Manual
- (h) Workers right to be informed of occupational radiation exposure and bioassay results

(5) Minimally exposed personnel (e.g. students who use small, non-dispersible radiation sources) shall receive appropriate training by the laboratory instructor provided that:

(a) The use of the source is a part of a scheduled laboratory course under the supervision of an instructor who is either a qualified Responsible User or designated by the Responsible User for use of the source, and;

(b) The student will not receive more than 10% of the public dose limit of 100 mrem from the use of the source.

(6) Radiation safety training outlines and training dates are maintained both in personnel files and in an online database and constitute a record of training in accordance with the requirements in 10 CFR 20.2102. In addition, annual refresher training will be provided online to Responsible Users and to radiation users. This training will consist of new local and NRC requirements and a brief overview of radiation safety basics.

§7 RADIATION SAFETY PROGRAM AUDITS

(1) The ISU Radiation Safety Program will be formally audited annually by the RSO and by the chairman and/or members of the RSC acting on behalf of management. The model audit program outlined in Appendix M of NUREG 1556, Volume 11, "Program-Specific Guidance About Licenses of Broad Scope" will be used as a guide for management audits. The RSO and the Chair of the RSC will brief the Vice President for Research on the compliance status of the ISU radiation safety program, new NRC regulations, audits, and license provisions at least annually. Copies of these audits and management briefings will be kept on file in the TSO.

§8 LABORATORY CLASSIFICATIONS

- (1) ISU currently classifies facilities (laboratories) as “sealed sources only,” “radiation-producing machine” or “dispersible” radionuclide laboratories. Laboratories that use dispersible radionuclides are further sub-classified according to the average amount of material that they have in stock over a one month period expressed in multiples of the most restrictive ingestion or inhalation annual limit of intake (ALI).
- (2) The licensed material programs currently operating at ISU include sealed source programs, radiation-producing machine programs, nuclear gauge programs, and dispersible radionuclide research laboratories. These programs are located in several buildings on the ISU Pocatello and Idaho Falls Campus. Additionally, ISU temporarily stores radioactive waste at a central storage facility near the ISU Temporary Accumulation Area (TAA) on the Pocatello campus and in a storage room of the Center for Higher Education in Idaho Falls.
- (3) ISU has several, small-use laboratories, using less than 10 mCi of dispersible radioactive materials at any one time. These are located in the Gale Life Sciences, Leonard Hall Pharmacy and the Physical Sciences buildings. The laboratories consist of locked rooms where the radionuclides are used primarily on controlled area bench tops or in hoods. Sealed sources are used at several locations on the Pocatello campus, at the Pocatello Airport ITRDL facility and at the Idaho Falls facilities including the CAES facility. Those laboratories using dispersible sources of radioactive material other than those located on the main campus include the Idaho Accelerator Center (IAC), and center for Advanced Energy Studies (CAES) in Idaho Falls.
- (4) Radiation-producing machines, such as x-ray machines and accelerators, are present in Pocatello around the ISU campus. These locations include the Idaho Accelerator Center, the ITRDL facility at the Pocatello Airport, the Physical Sciences Building, Radiographic Sciences, Dental Hygiene and Student Health.
- (5) Portable gauges are used on the ISU campus and at temporary job sites throughout the State of Idaho. These portable gauges are licensed for use at temporary job sites within states that are subject to the NRC's regulatory authority. ISU will package and transport portable gauges in accordance with subpart E of 49 CFR Part 172 and Subpart I of 49 CFR Part 173. ISU stores portable gauges in locked rooms on the ISU Pocatello Campus and/or the Experimental Field Station at the Idaho National Laboratory (INL) when not in use. At other times these portable gauges are under direct surveillance of a Responsible User.

(6) New facilities and equipment for licensed material use at ISU are evaluated by the RSO and approved by the RSC prior to commissioning. The criteria used to determine the acceptability of a proposed facility for radioactive materials depends on the proposed use of the facility. New facilities at ISU must successfully satisfy the requirements associated with the specific classification scheme(s) for the use of a facility as dispersible, sealed-source only, radiation-producing machine or a combination of dispersible and sealed source facility. Facilities that classify as combination facilities must satisfy the requirements associated with both dispersible and sealed source classification schemes.

§9 CONTROL AND MONITORING OF RADIATION SOURCES

(1) The RSO shall ensure that all areas where radiation sources of any kind are stored or used are evaluated at appropriate intervals with respect to potential radiological exposures and risks, and that appropriate exposure control and monitoring measures are used. Radiation surveys shall be performed, when necessary, by technically qualified personnel using instruments appropriate to the nature of the radioactive materials to be detected or radiation exposures to be measured. A pre-start evaluation is required before radionuclides may be initially introduced into a laboratory, or before a radiation-generating machine may be installed.

(2) A routine evaluation may consist of only a survey for contamination or it may be a complete audit of all radiation protection devices, procedures and records. A special evaluation may be required as a result of an accident or unusual incident. When use of a room or facility for radiation work is terminated, a close-out evaluation is required to assure that all conditions for an unrestricted area are met, with particular emphasis on removable contamination. In addition to surveys conducted by responsible users, laboratory evaluations shall be performed by Technical Safety Office personnel.

(3) Regulations governing the use of radioactive materials require that they be secured from unauthorized removal by one or two barriers, depending on source activity (10 CFR 30 Schedule B and 10 CFR 20 Appendix C). Sources above the 10 CFR 30 Schedule B activity level must be secured behind one barrier, and source above 100 times the 10 CFR 20 Appendix C activity limit must be secured behind two barriers. Examples of appropriate barriers include a locked laboratory entrance door and locks on cabinets, refrigerators or freezers in which radioactive materials are stored. It is permissible for radiation laboratory doors to be left unlocked only when the lab is constantly attended.

§10 CONTROL AND MONITORING OF EXTERNAL EXPOSURE TO RADIATION

(1) External exposures must be controlled by appropriate shielding and by limiting the time spent in close proximity to the source. Radiation generating machines and radioactive materials shall be controlled by responsible users to prevent unauthorized use.

§10.1 Radiation Producing Machines

(1) X-ray machines and particle accelerators shall be surveyed to verify adequacy of shielding, alarms, interlocks, and other safety-related apparatus or equipment. During the survey, the potential exposure rates to operators are evaluated to assure that they are ALARA and that operators are monitored appropriately.

§10.1.2 ISU Definition of an Accelerator

(1) The ISU RSC has with the concurrence of Idaho Department of Health & Welfare – Laboratory Improvement & X-ray Certification Sections Idaho Bureau of Laboratories in a letter dated 17 August, 2009, has defined an accelerator as follows:

A **working device** that is **capable of producing ionizing radiation** and is used to impart kinetic energy to electrically charged particles such as electrons, protons, deuterons, and helium ions and is referred to herein to designate devices that accelerate particles to energies greater than approximately one (1) MeV, or to neutron generators which operate with a potential of about one hundred fifty (150) kv. Such accelerators as cyclotrons, betatrons, linear accelerators, Van de Graaff accelerators, Cockcroft-Walton type neutron generators, and resonant transformers are included.

§10.2 Radioactive Materials

(1) Sealed radionuclide sources that emit penetrating radiations should be stored and handled within appropriate shielding. Dispersible sources should be accessed only when in fume hoods or as appropriate glove boxes to the extent feasible.

§10.3 Exposure Evaluation and Monitoring

(1) Potential radiation exposures from any source, or within any facility, are evaluated by the RSO or his/her designee to determine protection and monitoring requirements. In some cases, exposures are evaluated for groups of individuals engaged in similar activities and exposed to comparable sources. In other situations, monitoring of individual exposures may be necessary.

(2) External radiation surveys of radioactive material or radiation-producing machine

laboratories should be performed where gamma or neutron producing radionuclides and sources are used that are greater than 10 times the quantities listed in Appendix C of 10 CFR 20, or when radiation-producing machines are in use. Radiation field surveys are also necessary whenever unusual conditions or large changes in radiation levels are expected. Examples include new source acquisitions or new experimental configurations. Unrestricted areas adjacent to restricted areas will also be surveyed.

(3) The frequencies of routine radiation field surveys to be performed by the Responsible User are shown in Table 1. Radiation field surveys will also be conducted by the TSO in conjunction with routine contamination surveys. The Responsible User must ensure that the necessary surveys are performed, recorded and reported for their particular laboratory as based on the laboratory classification.

Table 1. Radiation Field Survey Frequencies

Laboratory Classification	TSO Surveys	User Laboratory Surveys
< 1 ALI ¹	Semi-Annually	Monthly when radionuclides are in use.
1-30 ALI(s)	Quarterly	Weekly when radionuclides are in use.
> 30 ALI(s)	Monthly	Daily when radionuclides are in use.
Sealed Sources Only	Semi-Annually	N/A
Radiation-Producing Machines	Semi-Annually	When machine in use

¹ The ALI is referring in this case to the number or multiplies of ALI (s) of dispersible material available on average in the laboratory's inventory.

- (4) Radionuclide work and storage areas should be surveyed for external exposure rates whenever changes are made in the quantities, locations or shielding of radiation sources. The results of such surveys must be provided to all individuals working in the area to help them to control their own exposures.

§10.3.1 The Choice and Appropriate Use of Exposure Evaluation Instrumentation

- (1) It is essential that survey meter chosen is capable of detecting the types of radiation emitted by the sources used in a laboratory and that this equipment has the appropriate sensitivity to accomplish the objectives of the survey.
 - a. The RSO is a resource for answering any questions that may arise concerning the detection capability or sensitivity requirements of survey meters proposed for use at ISU.
- (2) Prior to and following each survey, survey meters must be response checked. This is accomplished by observing the response produced by a known check source.
 - a. This response should be within 20% of the predetermined mean response of the instrument in question to a designated check source.
 - b. The outcome of the response check should be documented in a way that indicates:
 - i. Who performed the response check,
 - ii. The date and time of the response check,
 - iii. The status of a battery check, if appropriate for the type of instrument.
 - iv. The date of the last instrument calibration and the calibration due date of the instrument,
 - v. The quantitative results observed,
 - vi. And the acceptability of the response check.

§10.3.2 Exposure Evaluation and Monitoring Documentation

- (1) Radiation surveys that measure the magnitude of the radiation field present in a facility must be documented. It is recommended that they are documented on form RPR-11 or in a similar style. The Appendix to this document provides a copy of Form RPR-11. The documentation of the survey performed must include the following information:
 - a. The name of the individual who performed the survey
 - b. The date and time the survey was performed

- c. The model and serial number of the survey instrument used
- d. The calibration due of the instrument used.
- e. An indication that an instrument response check was performed.
- f. The measured back ground exposure rate in the vicinity
- g. Results of the survey performed in the appropriate units

§10.4 Personal Dosimeters

(1) ISU uses a National Voluntary Laboratory Accreditation Program (NVLAP) accredited dosimetry service for external radiation monitoring. Personal dosimeters are exchanged on a quarterly basis and exposure results are reviewed during the quarterly RSC meetings to ensure proper oversight of the University's ALARA program.

(2) The primary purposes for performing individual monitoring are:

- (a) to monitor the individual's radiation environment and to evaluate the adequacy of the radiation control program and ALARA policy
- (b) to promote safe radiation working habits by individuals
- (c) to document radiation accidents
- (d) to satisfy medical and legal requirements as are necessary to protect the employee and the employer
- (e) to comply with pertinent Federal, State and local regulations

(3) According to 10 CFR Part 20.1502 and IDAPA 16.02.27, ISU is required to monitor the occupational external exposure of the following individuals, as appropriate:

- (a) Adults likely to receive greater than 10% of the annual allowable limits specified in 10 CFR 20.1201(a) and/or they are likely to receive a quarterly dose greater than 25% of the values specified in IDAPA 16.02.27 (110.01.a).
- (b) Minors who might receive a deep dose equivalent greater than 0.1 rem, a lens dose equivalent greater than 0.15 rem or a shallow dose equivalent greater than 0.5 rem. For Idaho, a minor who is likely to receive a quarterly dose in excess of 5% of the specified values in IDAPA 16.02.27 (110.01.a) must be monitored for external exposure.
- (c) Declared pregnant women likely to receive a deep dose equivalent in excess of 0.1 rem during the entire pregnancy.
- (d) Individuals entering high or very high radiation areas.

(3) All radiation users - whose potential radiation exposure is required to be monitored by the Technical Safety Office - are required to wear one or more personal dosimeters. Users subject to general whole-body exposures are issued "whole body dosimeters," which are to be worn on the front of the torso at all times while working with radiation sources, or on the collar if a lead apron is worn.

(4) Declared Pregnant Women subject to significant radiation exposures may be issued a second dosimeter to be worn on the front of the abdomen and if appropriate under the lead apron. The purpose of the second dosimeter is to monitor the potential dose to the embryo-fetus. To formally declare herself pregnant, a female radiation worker must notify the RSO in writing. This is accomplished by completing the form: Letter For Declaring Pregnancy that may be found in the Appendix of this document or on-line on the TSO web-page.

(5) The TSO will work with the employee's supervisor to ensure that the dose to a declared pregnant woman will be maintained under 500 mrem for the entire gestation period (10 CFR 20.1208).

(6) Extremity dosimeters (finger or ring badges) are required when significant quantities of radioactive materials that emit radiation must be directly handled routinely, or when the hands or fingers could be accidentally exposed to a high intensity source of radiation such as that anticipated in an x-ray diffraction unit or certain known or anticipated high intensity radiation sources. Extremity dosimeters are employed at the discretion of the RSO, generally when it is feasible that extremity exposures may exceed 10% of the extremity annual limit of 50 rem (10 CFR 20.1201). Typically, if it is anticipated that the extremities of a worker may exceed twice the whole body dose then extremity badges will be issued.

§11 CONTROL AND MONITORING OF THE INTAKE OF RADIONUCLIDES

(1) Each responsible user who handles unsealed sources of radiation is responsible for the control and containment of these materials and for performing regular surveys of personnel, personal effects, equipment and work areas using methods that will assure the detection of contamination before significant exposures occur. It is the responsibility of each radiation user to follow safe work practices, to be aware of actual or potential radiation exposures, and to keep all exposures at levels that are ALARA.

§11.1 Contamination Control

(1) In research facilities, application of the ALARA principle dictates that no removable contamination shall be tolerated indefinitely. Whenever contamination is detected, it must be removed promptly to prevent its spread and the possible exposure of other individuals.

(2) The frequency of routine contamination surveys in radionuclide laboratories performed by the users and those performed by the TSO are based on the total number of ALI's present in the designee's laboratory. The responsible user must ensure that the necessary surveys are performed, recorded and reported for their particular laboratory as based on the average monthly inventory available. The routine evaluation frequencies for various average monthly inventories are shown in Table 2.

Table 2. Contamination Survey Frequencies

Laboratory Classification	TSO Surveys	User Personal Surveys	User Laboratory Surveys
< 1 ALI	Semi-Annually	Daily when radionuclides are in use.	Monthly when radionuclides are in use.
1-30 ALIs	Quarterly	Daily when radionuclides are in use.	Weekly when radionuclides are in use.
> 30 ALIs	Monthly	Daily when radionuclides are in use.	Daily when radionuclides are in use.
Sealed Sources Only	Semi-Annually	N/A	N/A
Radiation Producing Machines ²	Semi-Annually	N/A	N/A

² Capable of producing radioactive materials.

(3) The Technical Safety Office at Idaho State University's employs a removable contamination swipe-sample action level of 70 dpm/100cm² unidentified beta or gamma emissions or 7 dpm/100 cm² alpha emissions. However, any radioactive contamination detected which demonstrates a quantity of radioactive material present that is greater than Lc³, will be brought to the attention of the RSO. The operational goal in accordance with good practice and ALARA is to not tolerate detectable removable contamination at any ISU facility.

- a. If values greater than Lc are identified after a recount of the sample, then the RSO based upon experience and judgment, will determine if further remediation is appropriate.
- b. If the results of analysis for a swipe show activity above 70 dpm/100cm² unidentified beta or gamma emissions or 7 dpm/100 cm² alpha emissions and reanalysis of the removable contamination sample does not demonstrate that the activity is below the action level, then a series of decontaminations of the area must be performed until the contamination surveys show activities less than 70 dpm/100cm² unidentified beta or gamma emissions or 7 dpm/100 cm² alpha emissions. This action level ensures that all sources of removable contamination, even low levels of contamination, are investigated and decontaminated.
 - i. The value of 70 dpm/100cm² unidentified beta or gamma emissions or 7 dpm/100 cm² alpha emissions represents those levels of radioactivity that can be reliably detected with readily available bench top laboratory analyses devices such as liquid scintillation counters or gas flow proportional counters during an analysis of 2 to 10 minutes. It is consistent with a level that is about twice the Lc value for most of the devices in current use at ISU – a value near the minimum detectable activity (MDA)⁴ for most analysis methods.
- c. Should it prove impossible to decontaminate a particular surface then the following actions will be considered:
 - i. Disposal of the item as a contaminated radioactive item.

³ Lc or critical level is a term associated with a statistically valid detection of radioactive material during analysis controlling the probability of a Type I error (i.e. a false positive) at the 95% confidence interval. NUREG/CR-4007 August 1984 may be reviewed for a more detailed discussion of this topic. As applied to paired sampling, the value of Lc = 2.33(uncertainty in background)

⁴ MDA is an acronym for minimum detectable activity. A variant on this is minimum detectable concentration or MDC. These values also arise from NUREG/CR-4007. $MDA = Ld / (\text{unit conversion factors} * \text{volume or area} * \text{analysis time etc.})$
 $Ld = 2.71 + 4.66$ (uncertainty in background).

- ii. Sealing the surface of the item with paint or epoxy to prevent accidental ingestion of the radioactive material.
 - iii. Isolating the item in a controlled access room or area or in a sealed container depending on the circumstance.
- (4) It is understood that not all ISU laboratories in which radioactive materials are used have access to the types of radiation detection equipment that can perform the high quality analyses described in Section (3). It is anticipated that the best feasible quality of analysis will be performed given the type of equipment available with the goal of achieving the detection capability described in Section (3). The type of equipment used must:
- i. Be capable of detecting the kinds or radiations emitted by the radioactive materials in question. (See Section *§10.1.1 The Choice and Appropriate Use of Contamination Monitoring Instrumentation*)
 - ii. Be of a quality commensurate with the resources available to the laboratory and consistent with the quantity of radioactive material authorized. High quality analysis as described in Section (3) shall be conducted when the quantity of dispersible activity available for an experiment exceeds $0.25 \cdot \text{ALI}$.
 - iii. Arrangements can and should be made to conduct analyses on TSO equipment or other analytical equipment available on campus if the appropriate radioanalytical equipment is not available in a given laboratory.
- b. To emphasize the perspective of the Radiation Safety Committee, a portable G-M tube survey meter is anticipated to display a background count rate of between about 20 to 70 cpm depending on the device and location around campus. A removable contamination sample demonstrating twice the background count rate for these devices should clearly be considered a positive response for which action, such as contacting the TSO, should be taken. However, it is observed that such a device lacks sufficient sensitivity when used as anything else but a screening tool.
- i. The anticipated detection efficiency for this type of instrument ranges from 5% to about 25% (with a 10% rule of thumb average) depending on the type and energy of radiation being detected. Such a crude device has a (2 times background) detection capability from 160 to 800 dpm/100cm² on the low side up around 560 to 2,800 dpm/100cm² on the high side of background for a standard removable contamination swipe sample surveying an area of 100 cm². When higher backgrounds are encountered such a device performs even more poorly. Therefore, such

a device would be appropriate as a rapid screening tool, but far too crude to provide adequate radiation detection capability. Much better analysis would be expected and anticipated.

- (5) In cases where continuing contamination problems are found, the interval between surveys will be shortened. If survey results obtained over a period of a year indicate no contamination or exposure problems, the routine survey interval may be increased. In no case, however, will the interval be more than double the nominal interval. To assure a realistic and independent evaluation of typical conditions, the schedule for surveys may be varied arbitrarily.

§11.1.1 The Choice and Appropriate Use of Contamination Monitoring Instrumentation

- (1) It is essential that the instrumentation used to detect and quantify the presence of removable radioactive material contamination be capable of detecting the types of radiation emitted by the sources used in a laboratory and that this equipment has the appropriate sensitivity to accomplish high quality performance.
 - a. The RSO is a resource for answering any questions that may arise concerning the detection capability or sensitivity requirements of radiation detection instrumentation proposed for use at ISU.

- (2) Prior to and following each survey endeavor, survey meters must be response checked. This is accomplished by observing the response produced by a known check source.
 - a. This response should be within 20% of the predetermined mean response of the instrument in question to a designated check source.
 - b. The outcome of the response check should be documented in a way that indicates:
 - i. Who performed the response check,
 - ii. The date and time of the response check,
 - iii. The status of a battery check, if appropriate for the type of instrument.
 - iv. The date of the last instrument calibration and the calibration due date of the instrument,
 - v. The quantitative results observed,
 - vi. And the acceptability of the response check

- (3) If a laboratory device such as a liquid scintillation counter or high purity germanium detector is used to evaluate the quantity of radioactive material in a sample for regulatory purposes (such as the quantification of irradiated accelerator targets or ancillary components, or items being evaluated for disposal, or to evaluate environmental emission, etc.) other than simple routine surveys, *regardless if the activity measured is removable contamination, or an integral component of some arbitrary apparatus that may have been activated by nuclear techniques*, then an appropriate quality assurance program which establishes the validity of the measurements made must be in place. The quality assurance program should include the following:
- a. Documented efficiency calibrations with NIST traceable sources that have geometries reasonably similar to the unknown samples being analyzed.
 - b. As appropriate, documented energy calibrations that bracket the energy of radiation emitted from the unknown radioactive material being quantified.
 - c. Should any other control parameters or operational functions of the instrument that are necessary in the calculation of the activity present {such as the Quench Indicating Parameter (QIP) versus the detection efficiency function of a liquid scintillation counter or a Full Width Half-Maximum (FWHM) versus energy function describing the response of a high purity germanium semi-conductor detector} then the development of these functions must be documented.
 - d. Documented control chart information that demonstrates that the device was responding within acceptable statistical uncertainty to a check source both before and after the measurement was made.
 - e. Written procedures providing instruction on the appropriate and approved method(s) of analysis.

§11.2 Airborne Radioactivity

(1) Airborne radioactivity will be sampled and quantified in laboratories where airborne radioactive material exists or may potentially exist in concentrations exceeding 25% of the derived air concentrations (DACs) for the particular radionuclide or mixture of radioactive material used. Because the levels of dispersible radioactive materials used at ISU are small, ISU does not currently monitor routinely for airborne radioactive materials. There may be special situations, such as during a large spill of dispersible radioactive material, when sampling for airborne radioactive materials will be required.

(2) Inhalation of radioactive materials must be prevented by performing all operations that release or generate gases, vapors or dusts in fume hoods or glove boxes. Whenever the probability of airborne contamination is significant, the RSO should be notified and air sampling may be required.

§11.3 Bioassays

(1) Although the emphasis of radiation protection is primarily on prevention of exposures, measurement and evaluation of exposures is also necessary. Bioassays are an important tool for evaluating actual or suspected internal contamination with radioactive materials.

(2) Bioassay measurements used for demonstrating compliance with the occupational dose limits should be conducted to identify and quantify potential exposures and resultant intakes that, during any year, are likely to collectively exceed 0.1 times the ALI. Routine measurements should be conducted to confirm that appropriate controls exist and to assess doses to radioactive material users (if intakes occur). Routine measurements include: baseline measurements, periodic measurement and termination measurements.

(3) Any radiation user who handles a cumulative quantity of radioactive materials in dispersible form of more than 1 ALI per month, averaged over the bioassay interval, is considered to be potentially exposed to an annual intake of more than 0.1 ALI and must undergo bioassays routinely while this radioactive material is available in active inventory. If an occupationally exposed minor, or declared pregnant woman, are involved with this sort of situation, the threshold values listed above are considered to be ten times lower.

(2) Individuals who handle dispersible radioiodine compounds may be required to undergo in vivo measurements, arranged by the Technical Safety Office, of radioiodine in the thyroid. Individuals who handle other radionuclides in dispersible form may be required to submit to assays of radioactivity in urine on a routine basis to verify the absence of radioactivity in the body or to determine the magnitude of any exposure. Other types of assays may be used at the discretion of the RSO if, in the judgment of the RSO, such assays will meet the intent of this policy more effectively.

(5) The RSO or his/her designee will notify the responsible users, if requested, when a routine bioassay is due, but it is the responsibility of the user to complete the bioassay promptly. Routine bioassays may be waived at the discretion of the RSO if the records of contamination surveys of both the user and the RSO verify that there was no exposure to unconfined radioactive materials exceeding the levels specified above and no incidents of personal contamination since the last bioassay.

§12 DOSIMETRY RECORDS

- (1) All dosimetry records are considered to be confidential documents that are normally to be maintained indefinitely.
- (2) Document storage, security, and retention shall be in compliance with university, federal and state requirements.
- (3) Dosimetry records include as appropriate items such as:
 - a. Records from external exposure monitoring
 - b. Bioassay results and analyses
 - c. Documentation of any special investigation into incidents involving radioactive materials or radiation producing machines
 - d. Training records
 - e. Medical records as appropriate
 - f. Other documents as directed by the RSO that are deemed to be important or pertinent to recording events associated with health and safety.
- (4) An individual may formally request copies of their own dosimetry records at any time.
 - a. Normally upon such a request an individual is supplied with external dosimetry data and any available bioassay data as appropriate.
 - b. The information provided is consistent with that indicated within NRC Form 5 (See the appendices of this document).
 - c. A formal request is accomplished by completing RPR 1B. Request for Radiation Exposure History and/or Training Verification and providing this completed and signed form either to the RSO or the TSO.
 - d. All individuals who exceed an exposure to ionizing radiation or from radioactive materials exceeding 100 mrem CEDE will be provided a letter at the end of the calendar year that documents this event.
 - e. Copies of any dosimetric information in the possession of Idaho State University will be provided to the appropriate Federal or State authorities upon request.

§13 NUCLEAR INSTRUMENTATION

(1) Pursuant to 10 CFR 20.1501(b), ISU must possess and periodically calibrate radiation monitoring instruments that are necessary to protect health and minimize danger to life or property. ISU must possess an adequate number of radiation detection and measurement instruments and ensure they are calibrated periodically for the radiation being measured. Contamination and exposure rate instruments will be approved by the RSO prior to use in facilities that use radioactive materials or radiation producing machines at ISU. The ISU program has a full complement of commercially manufactured instruments suitable for performing surveys for alpha, beta, photon and neutron radiation.

(2) Radiation and contamination survey instruments by administrative goal will be calibrated on a semi-annual basis, after maintenance has been performed (excluding maintenance which does not effect the accuracy of the instrument, i.e. battery replacement, glass meter face replacement etc.), and upon purchase if the manufacturer has not performed a calibration. Instruments for measuring exposure rates are calibrated for linearity of response on all useful ranges. Instruments used for contamination surveys are calibrated for detection efficiencies for various radionuclides, as well as for linearity of response. The detection efficiency is recorded on the instrument probe.

(3) Although the administrative goal is to calibrate instruments semi-annually, instruments are considered out of calibration only after they have not been calibrated for a period exceeding one year. Instruments must be response-checked prior to and after use, and the user of the instrument should document that a response check was successfully performed.

§14 SEALED SOURCE LEAK TESTS

- (1) As stated in the Idaho State University NRC Radioactive Materials License, sealed sources of qualifying radioactive material shall be tested for leakage at regular intervals to verify the integrity of the source containment and, in the unlikely event of failure, to detect the escape of radioactive material before serious contamination of facilities, equipment or personnel occurs.
 - a. Leak checks will be performed by the Technical Safety Office (TSO) on a semi-annual basis consistent with 10 CFR 32.210 and records of the leak checks will be maintained by the TSO.
 - i. A leak-check at a frequency not to exceed 3-months will be conducted for those special sealed sources and detector cells designed to emit alpha particles.
- (2) Sealed sources **do not** need to be leak checked if
 - a. They are composed of only ^3H or a radioactive gas
 - b. They have a half-life less than or equal to 30 days
 - c. They contain less than 100 μCi of beta and/or gamma emitting material, or they contain less than 10 μCi of alpha emitting material
 - d. They are in storage and are not being used, however, when they are removed from storage for use or transferred to another person, and have not been tested within the required leak test interval, they shall be tested before use or transfer.
 - i. No sealed source shall be stored for a period of more than 10 years without being tested for leakage and or contamination.
- (3) A leak test shall be capable of detecting the presence of 0.005 μCi (185 Bq) of radioactive material on the removable contamination test sample; this usually is a "swipe paper".
 - a. If swipe analysis reveals the presence of 0.005 μCi or more of removable contamination the following actions must be taken:
 - i. A report shall be filed with the NRC in accordance with 10 CFR 30.50(c)(2) as specified in the ISU Byproduct Material License within 5 days of when the results of the analysis are known.
 - ii. The source shall be removed immediately from service and decontaminated, disposed of or repaired.

§15 MATERIAL RECEIPT AND ACCOUNTABILITY

(1) Radioactive materials may be used for any legitimate educational, clinical or research purpose. However, radioactive materials or machines shall be purchased, or obtained, by individuals only after specifically authorized by the Radiation Safety Committee (RSC). The use of radioactive materials is conditional upon compliance with specific procedures established by the RSC. The permission of the Radiation Safety Officer or a designated alternate shall be obtained before any radioactive materials or radiation-producing machines can be obtained by any ISU faculty or staff. Radioactive material purchases can only be authorized by the RSO. Radioactive materials are ordered by purchasing services following approval by the RSO.

(a) Any and all acquisitions of radioactive materials including those materials that are obtained from other entities such as ISU licensed programs (e.g. the reactor program or the Idaho Accelerator Center) regardless if they are specifically purchased or not, must be initiated on a "Radioactive Material Purchase Authorization" form and submitted to the TSO. The Radioactive Material Purchase Authorization form is designated as Form RPR-13F. Copies of this form are included in the Appendix of this document and may be found on-line on the TSO web page.

If the request is for an authorized radionuclide and quantity, it will be processed promptly. If the user is not authorized to possess the radionuclide type or quantity ordered, the request will be held by the TSO until proper authorization is obtained. The requisition shall contain the name of the responsible user and an accurate description of the radioactive material, including the radionuclide and the total activity, e.g. mCi, not just a catalog number. A brief description of the intended use must also be provided.

(3) The receipt of any radioactive material or radiation-producing machine that is not obtained through the TSO must be reported promptly to the RSO.

(4) Each user of radioactive materials (RAM) shall maintain a complete record of all acquisitions, uses, transfers and disposals of such materials and provide this data to the TSO in a timely manner upon request. Before any radioactive materials can be transferred to another responsible user, or to another organization, authorization shall be obtained from the RSO. Only the TSO is authorized to dispose of radioactive material.

§16 TRANSPORTATION AND SHIPMENT OF RADIOACTIVE MATERIALS

- (1) Radioactive materials of any kind may be transported on public roads either on or off University property but only after this has been authorized by the University's Certified Shipper of Radioactive Material. All shipments must be approved by the RSO.
- (2) To request a shipment of radioactive material a Responsible User must complete form RPR 14 (which may be found in the appendices of this document) and submit it to either the RSO or the TSO.
- (3) After receiving a completed and signed copy of Form RPR 14, the University's Certified Shipper of Radioactive Material is responsible for verifying that all licensing, transfer, packaging, labeling and transportation requirements have been met prior to shipment.
 - a. Packages and labels should be in compliance with U.S. Department of Transportation (DOT) regulations.
 - b. A written authorization form and one or more checklists must be approved by the University's Certified Shipper of radioactive materials for the shipment in question and approved by the RSO.
 - c. The Certified Shipper is an individual(s) who reports to the RSO and who has successfully completed a documented shipping course consistent with DOT and NRC requirements.
 - i. Copies of all training records with respect to certified shippers are maintained by the Technical Safety Office.
- (4) Only exempt quantities of radioactive materials may be transported in private vehicles.
- (5) To ensure that all requirements for shipment are met, and that appropriate records are maintained,
 - a. The TSO is the only organization on campus authorized to conduct the inspection and receipt of radioactive materials.
 - b. It is the responsibility of the authorized user who receives radioactive materials to **promptly** notify the RSO that radioactive material has been received on campus.

§17 RADIOACTIVE WASTE MANAGEMENT

(1) Radioactive wastes (radwastes) shall be collected, stored, packaged, shipped and disposed of in accordance with all pertinent State and Federal regulations. The RSO shall prepare and maintain procedures for handling radwastes that will ensure the protection of the employees involved in such duties and keep all radiation exposures ALARA. Specifications for segregation and packaging of radwastes shall be based on specific regulations or regulatory guidance, and include a record-keeping system that will allow complete tracking and accounting for all radwastes shipped to a disposal site or disposed of locally.

(2) *Radionuclides shall not be mixed with hazardous materials as this creates "mixed waste." ISU has no storage capability for such waste.*

(3) When responsible users have no further use for radioactive materials, they should contact the TSO and arrange for a waste pick-up. A radwaste tag must be filled out by the responsible user indicating the *radionuclide, activity and volume or weight*, if appropriate. The TSO will verify that the waste is safely contained and the radwaste form is properly completed before accepting custody of the waste. Radwaste tags can be obtained from the TSO upon request and constitute a record of radwaste inventory for the University.

(4) Only the ISU Technical Safety Office is authorized to dispose of Radioactive Waste. Radioactive wastes shall be disposed of in the ways described below:

(a) Radionuclides with half-lives less than or equal to 120 days will be held for at least ten half-lives after being transferred to the TSO as waste. They will then be disposed of as solid waste after meeting the requirements of 10 CFR 35.92.

(b) Liquid radioactive wastes will be disposed of into the sanitary sewer in accordance with 10 CFR 20.2003. Sanitary sewer disposal is to be done by the RSO or his designee only.

(c) Radionuclides with half-lives greater than 120 days will be transferred to a licensed disposal company.

(d) ISU will not incinerate any radioactive wastes.

(5) Radioactive wastes are stored pending disposal on the Pocatello Campus in a designated facility located near the Temporary Accumulation Area (TAA) facility. Solid waste in storage should be double bagged in plastic bags. Liquid waste should be in a liquid-tight container and stored in a secondary container, such as a plastic tub, garbage can, etc.

(6) Biological waste containing radionuclides with a half-life <120 days will be held in the designated radioactive waste storage building at the Temporary Accumulation Area (TAA) facility for 10 half-lives and then transferred to the Biological Science Animal Care Facility for disposal. Biological waste with radionuclide half-life >120 days will be packaged for shipment to a licensed disposal facility.

(7) Any radioactive wastes not included in the above categories, or exhibiting unusual hazards, or requiring special precautions of any kind, should be handled according to special arrangements made with the TSO.

§18 SERVICE FEES

(1) Routine radiation protection services are provided by ISU to all radiation users. However, services that are not routine and that involve extraordinary costs are charged to the user incurring the costs. Optional services, not recommended or required for radiation protection, but provided upon request, will be charged to the requesting user. The fees for non-routine and optional services are intended to reimburse the actual service costs and to remove these items from the University's TSO base budget.

§18.1 Extraordinary Costs

(1) Any major cost item incurred unexpectedly by a single radiation user may fall into this category. One example would be the disposal of exceptionally large volumes or activities of radioactive wastes involving special handling or disposal surcharges. Another example would be a fine levied against the University as a result of gross negligence or willful violation of procedures by a user. The method of reimbursement will depend upon the circumstances.

§18.2 Optional Services

(1) Any supplies or services that are not recommended or required for radiation protection, or that are normally the responsibility of the user but are provided by the TSO as a convenience to the user, will be billed to the user at cost plus handling expenses. One example of an optional service is furnishing personal dosimeters to individuals who do not require personal monitoring under the criteria contained in this Radiation Safety Policy Manual. Protective clothing, equipment, instrument repairs, etc. are other examples of services or supplies that may be provided for the convenience of users.

§19 EMERGENCY PREPAREDNESS AND RESPONSE

(1) Each person who is exposed to radiation must be informed of the risks and of appropriate protection methods, and must accept personal responsibility for the safe use of all radioactive materials and radiation-producing machines. The proper response to any radiation emergency depends upon a thorough understanding of the magnitude of risks, priorities for action, and the application of common sense. Each user of radiation sources should be familiar with basic radiological emergency responses and methods for applying them in his/her work area.

(2) In case of a spill of radioactive material, radiation users must respond in a timely manner to minimize exposures and the potential spread of radioactive contamination. Employees are expected to clean up, survey and document their own spills if it is within their capability. The TSO offers assistance in spill clean-up upon request. If a radiation worker enters a lab with a spill and has no knowledge of the material or feels uncomfortable with decontamination procedures, he/she should contact the TSO for assistance.

(3) Contact the Technical Safety Office at extension 2310 during normal working hours OR call Public Safety, at 282-2515 during off duty hours. Public Safety will contact TSO personnel.

ACRONYMS

ALARA: As Low As Reasonably Achievable

ALI: Annual Limit on Intake

ANSI: American National Standards Institute

BEIR: Committee on the Biological Effects of Ionizing Radiation

CFR: The Code of Federal Regulations

DAC: Derived Air Concentration

DOT: U.S. Department of Transportation

IAC: Idaho Accelerator Center

ICRP: International Commission on Radiation Protection

INL: Idaho National Laboratory

ISU: Idaho State University

ITRDL: Inspection Technology Research & Development Lab

MDA: Minimum Detectable Activity

NCRP: National Council on Radiation Protection

NRC: U.S. Nuclear Regulatory Commission

NVLAP: National Voluntary Laboratory Accreditation Program

RSC: Radiation Safety Committee

RSO: Radiation Safety Officer

RU: Responsible User

TAA: Temporary Accumulation Area

TEDE: Total Effective Dose Equivalent

TSO: Technical Safety Office

VPR: Vice-President of Research

GLOSSARY

Activity: A quantity of a radionuclide specified by the mean rate of spontaneous nuclear transformations which it undergoes. The common unit of activity is the **Curie (Ci)** or the quantity of radioactivity which decays at the rate of 3.7×10^{10} disintegrations per second.

Quantities of radioactivity of biological or environmental interest are commonly expressed in submultiples of the curie:

1 millicurie (mCi) = $3.7 \times 10^7 \text{ s}^{-1}$ 1 microcurie (μCi) = $3.7 \times 10^4 \text{ s}^{-1} = 2.2 \times 10^6 \text{ min}^{-1}$
(dpm)

1 nanocurie (nCi) = $37 \text{ s}^{-1} = 2,220 \text{ dpm}$

1 picocurie (pCi) = $0.037 \text{ s}^{-1} = 2.22 \text{ dpm}$

The international standard unit for activity is the **Becquerel (Bq)**. One Bq equals one transformation per second.

Bioassay Interval: The bioassay interval for a particular radionuclide is the maximum time that may elapse between bioassays that will assure detection of the verification level for a given assay method. The bioassay interval for a particular radionuclide is determined by its physical and metabolic characteristics, and by the instrumentation used for the measurement.

Committed Effective Dose Equivalent ($H_{E,50}$): The sum of the products of the weighing factors applicable to each of the body organs or tissues that are irradiated, and the dose equivalent received in each organ or tissue during the next 50 years.

Contamination Survey: A systematic investigation to determine the presence, or to verify the absence, of radioactive materials in unwanted locations, e.g. on the body or personal clothing, on surfaces of objects that may be touched or handled, on equipment or materials to be removed from a restricted area, etc.

Controlled Area: Any area, outside of the restricted area but inside the site boundary, access to which can be limited by the licensee for any reason. X-ray rooms and accelerator rooms are controlled administratively by the personnel who operate the equipment. Radioactive material laboratories are controlled by posting and locking for the purpose of preventing unauthorized removal of radioactive materials. Exposure to radioactive materials is prevented by controlling the materials, not by limiting normal access to the laboratory when it is open and attended.

Deep dose equivalent (H_d): The dose equivalent at a tissue depth of 1 cm

(1000 mg/cm²).

Dose: Refers either to absorbed dose or to dose equivalent, depending upon the context and the units used.

Dose equivalent (H_T): means the product of the absorbed dose in tissue, quality factor, and all other necessary modifying factors at the location of interest. The units of dose equivalent are the **rem** and **Sievert (Sv)**.

Exposure: usually refers to any condition which creates the potential for any individual to receive a radiation dose, either from external irradiation or from internal contamination with radioactive materials. For radiation measurements, "exposure" refers to the intensity of x or gamma irradiation, specified by the ionization produced in air. The common unit of exposure is the **Roentgen (R)**. An exposure of 1 R delivers almost 1 rad (0.869 rad in air or 0.93 rad in soft body tissues). Submultiples of the Roentgen are normally combined with time units to express exposure rates, e.g., milliRoentgen per hour (mR/hr), etc.

Exposure Survey: A systematic investigation to determine external radiation exposure rates at specific locations where individuals may be present and potentially exposed.

Extremity: A hand, elbow or foot, or any region below the elbow or knee.

Eye dose equivalent: Applies to the external exposure of the lens of the eye and is taken as the dose equivalent at a tissue depth of 0.3 centimeter (300 mg/cm²).

High Radiation Area: Any accessible area in which an individual could receive a dose equivalent exceeding 100 mrem in 1 hour at 30 cm (1 ft) from the source or from any surface the radiation penetrates.

Interval Inventory: The total quantity of radioactive material introduced into a laboratory each month, averaged over the bioassay interval, expressed in ALIs.

Minimally exposed personnel: Individuals who are unlikely to receive one-tenth (10%) of the ISU occupational radiation dose limit. This category includes individuals who routinely handle only small quantities of radioactive materials (e.g. students that use small, non-dispersible radiation sources as part of a scheduled laboratory course under the supervision of an instructor).

Potentially exposed personnel: Individuals who have a need to enter the Controlled or even the Restricted Areas as part of their job description or have a potential of exposure to a radiation source but do not normally work in the presence of a radiation field. This category includes janitorial, receiving and security personnel. The potentially exposed personnel should not enter into a High Radiation Area. A potential exposed individual is very unlikely to receive one-tenth (10%) of the ISU occupational radiation dose limit.

Radiation-Producing Machine: Any device capable of producing ionizing radiation except those which produce radiation only from radioactive material. These include accelerators and various x-ray machines.

Radioactive Material: Any material having a specific activity greater than 70 Bq/g (0.002 mCi/g), in accordance with 49 CFR 173.403. Also, any non-radioactive material (activity less than 70 Bq/gm) with surface contamination (both fixed and non-fixed/removable) that, when averaged over each 300 cm² (46.5 in²) of all surfaces, is equal to or greater than 0.4 Bq/cm² (10⁻⁵ mCi/cm²) for beta and gamma emitters and low-toxicity alpha emitters; and equal to or greater than 0.04 Bq/cm² (10⁻⁶ mCi/cm²) for all other alpha emitters.

Radiation Source: Any radiation-producing machine or radioactive material emitting or capable of producing ionizing radiation.

Radiation User: Any individual whose official duties or authorized activities include handling, operating, or working in the presence of any type of radiation source, whether or not such use is confined to a restricted area. Radiation user includes all the badged personnel as well as the minimally exposed personnel.

Radionuclide: Any radioactive nuclide used in unsealed or dispersal form. This terminology is used primarily to characterize the form of the material and the nature of the use.

Responsible user: An individual authorized by the Radiation Safety Committee to acquire and use specific radiation sources and to supervise their use by others, in compliance with pertinent regulations and under conditions approved by the Committee. Responsible users must demonstrate, to the satisfaction of the Committee, competence in the safe use of radiation sources by virtue of appropriate training and experience. Responsible users must assume full responsibility for all radiation sources under their control.

Restricted Area: Any area to which access is limited for the purpose of protecting individuals against undue risks from exposure to radiation and/or radioactive material. The mere presence of any radiation source, if adequately controlled to limit potential exposures, does not necessitate a restricted area designation. Areas containing sources with the potential for producing significant exposures require specific authorizations and procedures or posting for access control and are designated as restricted areas (10CFR20, Idaho State Regulations). An area must be posted as a Restricted Area if the dose rate is >2 mrem/hr or it contains >0.02 ALI of dispersible contamination. A Restricted Area will have some type of marked or physical boundary so that untrained personnel will be prevented from accessing the area.

Sealed Source: Radioactive material that is permanently bonded or fixed in a capsule or matrix designed to prevent release and dispersal of the radioactive material under the most severe conditions which are likely to be encountered in normal use and handling.

Shallow Dose Equivalent (H_S): Applies to the external exposure of the skin or an extremity, is taken as the dose equivalent at a tissue depth of 0.007 centimeter (7 mg/cm²) averaged over an area of 1 square centimeter.

Swipe Test: The detection and evaluation of removable contamination by measurement of radioactive material wiped from the surface onto an absorbent material such as a filter paper.

Total Effective Dose Equivalent: The sum of the deep-dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

BIBLIOGRAPHY

NRC Material License 11-27380-01, valid until October 31, 2009.

NRC-NUREG 1556, Volume 11, "Program-Specific Guidance About Licenses of Broad Scope," April 1999.

The University of Utah, Radiation Safety Policy Manual, (11/1999).

International Commission on Radiological Protection (ICRP):

Recommendations of the ICRP, Publ. 26 (1977).

Limits for Intakes of Radionuclides by Workers, Publ. 30 (1979-88).

General Principles of Monitoring for Radiation Protection of Workers, Publ. 35 (1982).

Radionuclide Transformations: Energy and Intensity of Emissions, Publ. 38 (1983).

Individual Monitoring for Intakes of Radionuclides by Workers: Design and Interpretation, Publ. 54 (1988).

National Council on Radiation Protection and Measurements (NCRP):

Review of NCRP Radiation Dose Limit for Embryo and Fetus in Occupationally Exposed Women, Report 53 (1977).

Protection of the Thyroid Gland in the Event of Releases of Radioiodine, Report 55 (1977).

Operational Radiation Safety Program, Report 59 (1978).

Management of Persons Accidentally Contaminated with Radionuclides, Report 65 (1980).

Operational Radiation Safety - Training, Report 71 (1983).

Radiation Protection and Measurement for Low Voltage Neutron Generators, Report 72 (1983).

General Concepts for the Dosimetry of Internally Deposited Radionuclides, Report 84 (1985).

Use of Bioassay Procedures for Assessment of Internal Radionuclide Deposition, Report 87 (1986).

Recommendations for Limits for Exposure to Ionizing Radiation, Report 91 (1987).

U.S. Nuclear Regulatory Commission, Code of Federal Regulations, Title 10 (10 CFR):

Notices, Instructions and Reports to Workers; Inspections, Part 19.

Standards for Protection Against Radiation, Part 20.

*Rules of General Applicability to Domestic Licensing of Byproduct Material, Part 30.
Specific Domestic Licenses of Broad Scope for Byproduct Material, Part 33.*

Human Uses of Byproduct Material, Part 35.

Packaging of Radioactive Material for Transport and Transportation of Radioactive Material under Certain Conditions, Part 71.

Idaho Department of Health and Welfare, Rules and Regulations

Idaho Radiation Control Rules, IDAPA 16, Docket no. 16-0227-9701, (1997).

APPENDICES

RPR 11

RPR 13F

RPR 14

Dosimetry

 RPR 1B

 NRC Form 5

Pregnancy Declaration Form

**RPR 11 - RADIATION OR RADIOACTIVE MATERIALS LABORATORY -
RADIATION FIELD AND REMOVABLE CONTAMINATION SURVEY FORM**

<input type="checkbox"/>	Dose rate ($\mu\text{rem/h}$)	<input type="checkbox"/>	Smears ($\text{dpm}/100\text{cm}^2$)	<input type="checkbox"/>	Smears ($\text{dpm}/100\text{cm}^2$)
B					

Instrument used: _____ Serial: _____ Calibration Due: _____
 Instrument used: _____ Serial: _____ Calibration Due: _____
 Instrument used: _____ Model: _____ Serial: _____ MDA: _____ dpm _____

Date: _____ Performed by: _____

Bldg/Rm: _____ Program: # _____

Nuclides used: _____

RCL: _____ $\text{dpm}/100\text{cm}^2$

Comments: _____

Reviewed _____

RPR 13F. RADIOACTIVE MATERIAL PURCHASE AUTHORIZATION

1. All Radioactive Materials purchases requests **must** be cleared by the Technical Safety Office.
2. Radioactive material purchases must be submitted at least three working days in advance.
3. All Radioactive Material Purchase Orders are to be addressed as follows;

Responsible User's Name
c/o Technical Safety Office
Idaho State University
Shipping & Receiving Dept.
638 E. Dunn St.
Pocatello, ID. 83209

4. Forward the purchase request and this form to:

Technical Safety Office
 Box 8106

The attached requisition specifies the purchase of radioactive material under Idaho State Universities radioactive material license.

Responsible User: _____ Program #: _____
 Dept: _____ Supplier: _____

Authorized Isotope	Chemical/ physical form	Isotope Possession limit	Isotope Amount Requested

I certify I am allowed to possess this material and that this purchase will not exceed my radioactive material possession limit.

Responsible User Signature: _____ Date: _____

To be completed by TSO staff - This purchase request has been reviewed and verified by the TSO

Users Limit: _____ Users Current Inventory: _____

ISU Limit: _____ ISU Current Inventory: _____

Lab ALI's: _____ Bioassay Frequency: _____

Lab Survey Frequency: _____ Verified by: _____
TSO STAFF

I approve/disapprove this radioactive material purchase:

Radiation Safety Officer: _____ Date: _____

RPR 14 ISU-1 REQUEST FOR SHIPMENT OF RADIOACTIVE MATERIAL

This form is to be completed for **transportation of any quantities of radioactive materials**. The individual desiring transportation of the material shall complete the form and submit it to the TSO for approval **before the material is transported**. For repetitive intramural transfers of the same material, a generic form may be used repetitively. **THIS REQUEST IS VALID ONLY FOR MATERIALS POSSESSED BY IDAHO STATE UNIVERSITY** [References are to Department of Transportation regulations, Title 49, Code of Federal Regulations.]

For Transportation Between (Consignor/Consignee):

Name (RU): _____	Name (RU): _____
Address: _____	Address: _____
Phone: _____	Phone: _____

Package Contents and Hazardous Material Classification:

Description of Material (Solid/Liquid, Serial Number, Type of Packaging, ect.): _____

	Item Activity (Bq/Ci)	Package Activity (Bq/Ci)
Nuclide		
_____	_____	_____
_____	_____	_____
_____	_____	_____

Type of Request

One Time, One Way
 One Time, Round Trip (Same Day)
 Routine Shipment from _____ (date) to _____

_____ (Signature) _____ (Date)

RPR 1B. REQUEST FOR RADIATION EXPOSURE HISTORY
and/or TRAINING VERIFICATION
(Please type or print legibly)

Organization: _____

Address to send information: _____

Attention: _____
Radiation Safety Officer (if known) or Supervisor (indicate which).

To whom it may concern:

Please send the following to the address indicated below:

- _____ My radiation exposure history.
- _____ Verification that I received radiation safety training appropriate for independent work with radioactive materials and/or radiation sources.

Last name: _____ First names: _____

Soc. Sec. #: _____ Birth date: Mo: _____ Day: _____ Yr: _____

Inclusive dates of work with radiation (m/yr to m/yr): _____ to _____

Signature: _____ **Date:** _____

Letter for Declaring Pregnancy

This form letter is provided for your convenience. To make a declaration of pregnancy, you may fill in the blanks in this form letter, or you may write your own letter.

Declaration of Pregnancy

To: Technical Safety Office

In accordance with the NRC's regulations 10 CFR 20.1208, "Dose to an Embryo\Fetus," I am declaring that I am pregnant. I believe I became pregnant during the following approximate time: _____(mm/yy)

I understand the radiation dose to my embryo\fetus during my entire pregnancy will not be allowed to exceed 0.5 Rem (5mSv) unless that dose has been exceeded between the time of conception and submitting this letter. I also understand that meeting the lower dose limit may require a change in job responsibility during my pregnancy

Signature

Date

Printed Name

