RADIATION SAFETY MANUAL
Revision 12: June 2018

Prepared and issued under the authority of
The Idaho State University Radiation Safety Committee

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Table of Contents
SAFETY STATEMENT OF IDAHO STATE UNIVERSITY ......................................................... 4
§1 PURPOSE ............................................................................................................................. 5
§2.0 REGULATORY EXPOSURE LIMITS ................................................................................ 6
  §2.1 Introduction .................................................................................................................. 6
  §2.2 United States Nuclear Regulatory Commission ............................................................ 7
  §2.3 Idaho Radiation Control Rules ..................................................................................... 11
§3.0 ALARA ............................................................................................................................ 17
  §3.1 ALARA Policy ............................................................................................................. 17
  §3.2 Idaho State University’s ALARA Goals ...................................................................... 18
    §3.2.1 All Radiation Safety Programs ............................................................................. 18
    §3.2.2 Minors ................................................................................................................... 18
§4.0 EXECUTIVE MANAGEMENT ROLES and RESPONSIBILITIES ......................... 19
  §4.1 Vice-President of Research (VPR) .............................................................................. 19
  §4.2 Radiation Safety Committee (RSC) and Chairperson (RSCC) ........................................ 19
    §4.2.1 Radiation Safety Committee Chairperson (RSCC) .............................................. 19
    §4.2.2 Radiation Safety Committee (RSC) ...................................................................... 20
  §4.3 Radiation Safety Officer (RSO) .................................................................................. 23
  §4.4 Environmental Health & Safety (EH&S) .................................................................... 25
  §4.5 Authorized User ......................................................................................................... 25
  §4.6 Responsible User ....................................................................................................... 26
§5 RADIATION USE AND APPLICATION ........................................................................ 29
§6 RADIATION SAFETY TRAINING .................................................................................... 31
§7 RADIATION SAFETY PROGRAM AUDITS .................................................................... 33
§8 LABORATORY CLASSIFICATIONS .................................................................................. 33
§9 CONTROL AND MONITORING OF RADIATION SOURCES .................................... 35
§9. 1 Surveys, Evaluation and Monitoring.................................................................35

§9. 2 Control of Radiation Sources ........................................................................37
§9. 2.1 Single Barrier sources ................................................................................37
§9. 2.2 Additional Controls ....................................................................................37
§9. 2.3 Sources exceeding IAEA Category 4 require Double Barrier Control........38

§10 CONTROL AND MONITORING OF EXTERNAL EXPOSURE TO RADIATION..40

§10.1 Radiation Producing Machines ......................................................................40

§10.2 Radioactive Materials ....................................................................................40

§10.3 Exposure Evaluation and Monitoring ............................................................40
§10.3.1 The Choice and Appropriate Use of Exposure Evaluation Instrumentation ...42
§10.3.2 Exposure Evaluation and Monitoring Documentation ..................................42

§10.4 Personal Dosimeters .....................................................................................43

§11 CONTROL AND MONITORING OF THE INTAKE OF RADIOACTIVE MATERIALS........................................................................................................45

§11.1 Control of Radioactive Contamination ............................................................45
§11.1.1 Classifications of Areas Relative to Radioactive Contamination..............49
§11.1.2 The Choice and Appropriate Use of Contamination Monitoring Instrumentation..............................................................................................................51

§11.2 Airborne Radioactivity ....................................................................................54

§11.3 Bioassays .......................................................................................................54

§11.4 General Hygiene and control practices to limit intake of radioactive material ......55

§12 DOSIMETRY RECORDS .....................................................................................57

§13 NUCLEAR INSTRUMENTATION .........................................................................58

§14 SOURCE PROCUREMENT, MANAGEMENT/INVENTORY AND LEAK TESTS ....59

§15 MATERIAL RECEIPT AND ACCOUNTABILITY ..................................................61
§15.1 Radioactive Material Inventory And Accountability ..........................................62
§16 TRANSPORTATION AND SHIPMENT OF RADIOACTIVE MATERIALS .............. 63

§16.1 Receipt of Radioactive Materials ................................................................. 65

§17 RADIOACTIVE WASTE MANAGEMENT ....................................................... 67

§18 SERVICE FEES .......................................................................................... 69

§18.1 Extraordinary Costs ................................................................................ 69

§18.2 Optional Services ................................................................................... 69

§19 EMERGENCY PREPAREDNESS AND RESPONSE .................................... 70

§20 RADIATION PRODUCING DEVICES ....................................................... 70

§20.1 Particle Accelerators .............................................................................. 71

§20.1.1 ISU Definition of an Accelerator .......................................................... 71

§20.1.2 New and Modified Existing Accelerator Approval ............................... 72

§20.2 X-Ray Devices ...................................................................................... 73

ACRONYMS ..................................................................................................... 75

GLOSSARY ......................................................................................................... 76

BIBLIOGRAPHY ................................................................................................ 80
SAFETY STATEMENT OF IDAHO STATE UNIVERSITY

Idaho State University’s administration holds the operational philosophy that every employee is entitled to work under the safest conditions reasonably feasible.

Idaho State University personnel are committed to continuously developing and fostering a comprehensive safety culture. The University leadership highly values, and will endeavor to maintain, a safe and healthful workplace where free and open communication is encouraged, and open discussions of safety concerns are an expected responsibility of all employees. To further accomplish this objective, they will also provide mechanisms for reporting, investigating and ultimately the resolution of safety concerns.

The University will provide a safe working environment, appropriate personnel protection equipment along with comprehensive safety programs. To this end, ISU leadership will make every reasonable effort to promote accident prevention and health preservation.

Accidents are avoidable. They can and should be prevented by actions predicated on knowledge of the physical agents in the environment and wise decision-making that holds as a core value safety in the workplace and beyond. Avoiding accidents requires that every employee, student, and visitor understand potential hazards in their environment, questions practices to assure they understand risks and safety protocol and exercises their own common sense that motivates them to take precautions such as:

- Identifying safety problems and reporting them immediately,
- Taking personal accountability for their workplace, it’s condition and it’s safety,
- Effectively communicating safety concerns to their supervisor and management,
- Being respectful of their work environment and the people within it,
- Continuing to educate themselves formally and informally about safety issues and
- By adopting a questioning attitude when in new working environments or when working around hazards.

We all need to do our part in providing a safe work environment.
§1 PURPOSE

(1) This manual conveys the official protocol 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), 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.

(4) Regarding the control of all sources of, and exposures to, ionizing radiation that are within the jurisdiction of the University, no internal policies of Schools, Departments, Colleges and Research Centers may supersede the policies set forth in this manual. Internal policies may be more prohibitive or protective of personnel but cannot be less restrictive.
§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. Rules regarding radiation producing machines that have been adopted by the State of Idaho may be found in IDAPA 16.02.27 as the Idaho Radiation Control Rules. These rules specify license requirements for radiation producing machines. They also outline the expectation for radiation safety by incorporating by reference the *Suggested State Regulations for Control of Radiation, Volume 1*, which is published by the Conference of Radiation Control Program Directors, Inc., 1030 Burlington Lane, Suite 4B, Frankfort, Kentucky 40601. This document is also available online at: http://www.crcpd.org/page/SSRCRs

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1 This web site has been updated to reflect the intent of the State of Idaho. The link referred to in 16.02.27 is no longer functioning.
§2.2 United States Nuclear Regulatory Commission

The United States Nuclear Regulatory Commission 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/](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)).

§ 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.


§ 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 of 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.

(e) 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.

(f) 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, 1991]
§2.3 Idaho Radiation Control Rules

The rules for compliance in the state of Idaho are found at:

http://www.crcpd.org/page/SSRCRs

The reader must be aware that the state of Idaho regulates radiation producing machines but does not regulate radioactive materials. Radioactive materials are under the jurisdiction of the United States Nuclear Regulatory Commission.

(Readers need to view the original document to review appendices and certain tabular information not reproduced in this manual.)

This document verbatim for external exposures (without all tables and appendices) is as follows:

Occupational Dose Limits
Sec. D.1201 - Occupational Dose Limits for Adults.
a. The licensee or registrant shall control the occupational dose to individual adults, except for planned special exposures pursuant to D.1206, to the following dose limits:
   i. An annual limit, which is the more limiting of:
      (1) The total effective dose equivalent being equal to 0.05 Sievert (5 rem); or
      (2) 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 0.5 Sievert (50 rem).
   ii. The annual limits to the lens of the eye, to the skin, and to the extremities which are:
      (1) A lens dose equivalent of 0.15 Sievert (15 rem); and
      (2) A shallow dose equivalent of 0.5 Sievert (50 rem) to the skin or to any extremity.

b. Doses received in excess of the annual limits, including doses received during accidents, emergencies, and planned special exposures, shall be subtracted from the limits for planned special exposures that the individual may receive during the current year and during the individual's lifetime. See D.1206e.i. and ii.
c. The assigned deep dose equivalent and shallow dose equivalent shall be for the portion of the body receiving the highest exposure:

i. 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; or

ii. When a protective apron is worn while working with medical fluoroscopic equipment and monitoring is conducted as specified in D.1502a.v., the effective dose equivalent for external radiation shall be determined as follows:

   (1) When only one individual monitoring device is used and it is located at the neck (collar) outside the protective apron, the reported deep dose equivalent shall be the effective dose equivalent for external radiation; or

   (2) When only one individual monitoring device is used and it is located at the neck (collar) outside the protective apron, and the reported dose exceeds 25 percent of the limit specified in D.1201a., the reported deep dose equivalent value multiplied by 0.3 shall be the effective dose equivalent for external radiation; or

   (3) When individual monitoring devices are worn, both under the protective apron at the waist and outside the protective apron at the neck, the effective dose equivalent for external radiation shall be assigned the value of the sum of the deep dose equivalent reported for the individual monitoring device located at the waist under the protective apron multiplied by 1.5 and the deep dose equivalent reported for the individual monitoring device located at the neck outside the protective apron multiplied by 0.04.

Sections of CRCPD document D. 1201 through D. 1206 (not inclusive) relating to internal exposure control are omitted from this document as they are not applicable under the jurisdiction of the State of Idaho.

Sec. D.1206 - Planned Special Exposures.
A licensee or registrant may authorize an adult worker to receive doses in addition to and accounted for separately from the doses received under the limits specified in D.1201 provided that each of the following conditions is satisfied:
a. The licensee or registrant 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 or registrant, and employer if the employer is not the licensee or registrant, specifically authorizes the planned special exposure, in writing, before the exposure occurs

Before a planned special exposure, the licensee or registrant ensures that each individual involved is:

i. Informed of the purpose of the planned operation; and

ii. 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

iii. Instructed in the measures to be taken to keep the dose ALARA considering other risks that may be present;

c. Prior to permitting an individual to participate in a planned special exposure, the licensee or registrant ascertains prior doses as required by D.2104b. during the lifetime of the individual for each individual involved;

Subject to D.1201b., the licensee or registrant shall 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:

i. The numerical values of any of the dose limits in D.1201a. in any year; and

ii. Five times the annual dose limits in D.1201a. during the individual's lifetime;

d. The licensee or registrant maintains records of the conduct of a planned special exposure in accordance with D.2105 and submits a written report in accordance with D.2204;

e. The licensee or registrant 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 shall not be considered in controlling future occupational dose of the individual pursuant to D.1201a. but shall be included in evaluations required by D.1206d. and e.
Sec. D.1207 - Occupational Dose Limits for Minors.

The annual occupational dose limits for minors are 10 percent of the annual occupational dose limits specified for adult workers in D.1201.

Sec. D.1208 - Dose Equivalent to an Embryo/Fetus.

a. The licensee or registrant shall ensure that the dose equivalent to an embryo/fetus during the entire pregnancy, due to occupational exposure of a declared pregnant woman, does not exceed 5 millisieverts (0.5 rem). See D.2106d. for recordkeeping requirements.

b. The licensee or registrant 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 D.1208a.

c. The dose equivalent to the embryo/fetus is the sum of:

i. The deep dose equivalent to the declared pregnant woman; and

ii. The dose equivalent 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 5 millisieverts (.5rem), or is within 0.5 millisieverts (0.05 rem) of this dose, by the time the woman declares the pregnancy to the licensee or registrant, the licensee or registrant shall be deemed to be in compliance with D.1208a. if the additional dose to the embryo/fetus does not exceed 0.5 millisievert (0.05 rem) during the remainder of the pregnancy.

Radiation Dose Limits for
Individual Members of the Public

Sec. D.1301 - Dose Limits for Individual Members of the Public.

a. Each licensee or registrant shall conduct operations so that:

i. The total effective dose equivalent to individual members of the public from the licensed or registered operation does not exceed 1 millisievert (0.1 rem) in a year, exclusive of the dose contribution from background radiation, from any
medical administration the individual has received, from exposure to individuals administered radioactive material and released in accordance with [Part G of these regulations], from voluntary participation in medical research programs, and from the licensee's or registrant's disposal of radioactive material into sanitary sewerage in accordance with D.2003; and

ii. The dose in any unrestricted area from external sources exclusive of the dose contributions from patients administered radioactive material and released in accordance with [cite appropriate reference to Part G of these regulations], does not exceed 0.02 millisievert (0.002 rem) in any one hour; and

iii. The total effective dose equivalent to individual members of the public from infrequent exposure to radiation from radiation machines does not exceed

The National Council on Radiation Protection and Measurements recommended in NCRP Report No. 91 "Recommendations on Limits for Exposure to Ionizing Radiation" (June 1, 1987) that no more than 0.5 millisievert (0.05 rem) to the embryo/fetus be received in any one month.

Retrofit shall not be required for locations within facilities where only radiation machines existed prior to [the effective date of these regulations] and met the previous requirements of 5 millisievert (0.5 rem) in a year.

b. If the licensee or registrant permits members of the public to have access to restricted areas, the limits for members of the public continue to apply to those individuals.

c. A licensee, registrant, or an applicant for a license or registration may apply for prior Agency authorization to operate up to an annual dose limit for an individual member of the public of 5 millisievert (0.5 rem). This application shall include the following information:

i. Demonstration of the need for and the expected duration of operations in excess of the limit in D.1301a.; and

ii. The licensee's or registrant's program to assess and control dose within the 5 millisieverts (0.5 rem) annual limit; and

iii. The procedures to be followed to maintain the dose ALARA.

d. In addition to the requirements of Part D, a licensee or registrant subject to the
provisions of the Environmental Protection Agency's generally applicable environmental radiation standards in 40 CFR 190 shall comply with those standards.]

e. The Agency may impose additional restrictions on radiation levels in unrestricted areas and on the total quantity of radionuclides that a licensee or registrant may release in effluents in order to restrict the collective dose.]

Sec. D.1302 - Compliance with Dose Limits for Individual Members of the Public.

a. The licensee or registrant shall make or cause to be made surveys of radiation levels in unrestricted areas and radioactive materials in effluents released to unrestricted areas to demonstrate compliance with the dose limits for individual members of the public in D.1301.

b. A licensee or registrant shall show compliance with the annual dose limit in D.1301 by:

i. Demonstrating by measurement or calculation that the total effective dose equivalent to the individual likely to receive the highest dose from the licensed or registered operation does not exceed the annual dose limit; or

ii. Demonstrating that:

   (1) The annual average concentrations of radioactive material released in gaseous and liquid effluents at the boundary of the unrestricted area do not exceed the values specified in Table II of Appendix B; and

   (2) If an individual were continuously present in an unrestricted area, the dose from external sources would not exceed 0.02 millisievert (0.002 rem) in an hour and 0.5 millisievert (0.05 rem) in a year.

c. Upon approval from the Agency, the licensee or registrant may adjust the effluent concentration values in Appendix B, Table II, for members of the public, to take into account the actual physical and chemical characteristics of the effluents, such as aerosol size distribution, solubility, density, radioactive decay equilibrium, and chemical form.
§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 level,
(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

§3.2.1 All Radiation Safety Programs

(1) The ALARA goals for Idaho State University are set by the Radiation Safety Committee. The RSC reviews the University’s goal periodically 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.

(2) The ISU ALARA total effective dose equivalent (TEDE) is equal to 1000 mrem/year for radiation workers with a 300 mrem/calendar quarter notification level. This does not apply to declared pregnant workers.

(3) The Environmental Health & Safety (EH&S) reviews all exposure records to ensure that the ALARA goals are appropriate for the particular activity. If an ALARA goal is exceeded, the EH&S will perform an investigation. The EH&S'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 EH&S'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).

§3.2.2 Minors

(1) The ISU ALARA total effective dose equivalent (TEDE) is equal to 100 mrem/year for minors with a 30 mrem/calendar quarter notification level.

(2) For the purpose of occupational dose limits, minors (individuals under the age of 18) are permitted to enter or have access to areas authorized for the use, storage or disposal of radioactive materials or with radiation producing devices only if they are doing so as part of an established, supervised course of study, established, supervised facility tour or as an employee of Idaho State University.

All other minors are not permitted in these areas. Those minors permitted in these areas but who will not work with radioactive material must attend a radiation safety awareness course provided by the University prior to their entering or having access to these areas. In no case shall a minor be permitted to receive a radiation dose in excess of the limits set forth in this section.
§4.0 EXECUTIVE MANAGEMENT ROLES and RESPONSIBILITIES

§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 chairperson 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) and Chairperson (RSCC)

§4.2.1 Radiation Safety Committee Chairperson (RSCC)

(1) The Radiation Safety Committee Chairperson (RSCC) shall be approved by the NRC and named on the radioactive materials license as that individual responsible to fulfill the statutory requirements of that position on behalf of Idaho State University.

(2) The RSCC shall call a meeting of the Radiation Safety Committee at least four (4) times per calendar year and additionally whenever he/she deems it necessary.

(a) The RSCC conducts meetings in a fashion that is essentially in agreement with Robert's Rules of Order.

(b) The RSCC has final authority over ruling of points of order that may arise during meetings.
(c) The RSCC has authority at their discretion to ask attendees who are thought to be disruptive to leave the meeting.

(3) The RSCC may act on behalf of the RSC. The RSCC should be apprised of radiation safety actions taken by the Radiation Safety Officer or his/her staff. All such actions shall be noted and recorded in the minutes of the next following radiation safety committee meeting.

§4.2.2 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 academic and research areas that use ionizing radiation at ISU. RSC members are appointed to the Committee by the VPR for renewable 3-year terms. Changes to RSC membership are recommended by the RSO and RSCC 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 four (4) times per calendar year. Minutes are kept and maintained by the EH&S or a designee for each RSC meeting. Approved minutes are held on file by the EH&S Department.

(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 by the EH&S Department. The committee must also ensure that appropriate university policies and procedures incorporate elements of the NRC’s most current Safety Culture Policy Statement.

a. 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 voting RSC membership is based upon the interest of providing representation to those institutional administrative units that have radiation sources. The membership should as feasible include at least one person whom meets the requirements of a Authorized User of each type of use permitted by ISU’s broad scope license, the Radiation Safety Officer, and a representative of management.
i. The minimum qualifications for voting membership to the RSC is:

ii. to meet the requirements to be an Authorized User.

iii. to have at least 40-clock hours of training and experience in the safe use of radiation, safe handling of radioactive materials, and in the characteristics of ionizing radiation.

(4) Representatives of groups or functions such as management,

i. Additions or replacements shall be appointed by the Vice President for Research as current member’s terms expire, the member requests withdrawal from the committee, the VPR terminates their appointment, or the member terminates their affiliation with the University.

b. The RSC evaluates and authorizes new Authorized Users, new uses of licensed material, and new laboratories. Evaluation by the Radiation Safety Committee consists of the following:

i. Evaluation of the training of new Authorized Users to ensure that they meet ISU license requirements.

ii. Review of the Authorized User's request to ensure that proper handling procedures will be used when working with radioactive materials or radiation producing machines.

iii. Review of the responsible user's laboratory for safety adequacy considering the radionuclide(s) or radiation producing machines to be used. At a minimum, the following will be verified:

1. Appropriateness of laboratory facilities and available equipment
2. User’s proposed procedures are appropriate for the task(s)
3. Survey instruments are appropriate to detect and quantify the types of radiation anticipated.
4. Procedures for inventory control of radioactive material is adequate.
5. Signs and labels are posted as required

(5) The RSC currently reviews administrative changes to the following aspects of the radiation safety program that can be made without amending the license:

i. Changes dictated by NRC rule changes,

ii. Changes in contractors for bioassay, waste disposal, dosimetry services, radiation survey instrumentation, and other equipment
required to administer the Broad-Scope license, and

iii. Administrative changes to the radiation safety program.

b. The radiation safety committee will review and approve/disapprove all amendments and changes to the Broad scope and Production licenses. A letter signed by the RSCC and the Radiation Safety Officer will be forwarded to the Vice President of Research detailing the amendment and the record of the committee’s votes.


d. The Radiation Safety Committee or the Radiation Safety Officer will have the authority to suspend or terminate any operations involving radioactive materials or radiation producing machines if such action is deemed necessary to protect health and/or minimize danger to public health, safety and/or property.

e. If the intentional bypass of a safety interlock on an accelerator is required, only the Radiation Safety Committee or the Radiation Safety Officer will have the authority to authorize intentional bypass of a safety interlock or interlocks on an accelerator.

f. No voting member of the committee or responsible user may vote on matters involving their own projects or responsible user status, as this involves a real or perceived conflict of interest.

(6) All RSC members or guests are required to declare to the committee upon initiation of the discussion any matters in which they may have real or perceived conflicts of interest and if they are RSC members they must abstain from voting on matters that involve these real or perceived conflicts of interest.

(7) At the discretion of the RSCC, it is expected that any individuals with real or perceived conflicts of interest excuse themselves from any debate involving the item(s) in question and leave the room prior to debate, only providing information for clarification prior to debate or voting takes place.
(8) At the discretion of the RSCC, anyone in attendance at a RSC meeting who may have real or perceived conflicts of interest may be asked to leave the room during debate, discussion or voting on items for which the real or perceived conflict of interest exists. They may re-attend the meeting after the business in concluded: i.e. vote is tallied and finalized.

(9) If real or perceived conflicts of interest involves the RSCC then the RSO or is designate will preside over the portion of any meeting of the RSC involving this subject. The RSC or his delegate assumes the authority of the RSCC under these conditions.

§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.

(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) Consulting with ISU personnel about radiation protection.
(e) Authorizing procurement, 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 and Production nuclear materials licenses.
(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 licenses.

(l) Immediately terminating any activity involving radioactive materials of radiation producing machines 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.


(q) Identify and communicate to its workers (including contractors) who are engaged in NRC licensed activities the different options that individuals can use to raise radiation safety concerns.

(r) Suspend or terminate the operations at a particle accelerator facility if such action is deemed necessary to protect health and/or minimize danger to public health and safety and/or property.

(4) The RSO has the authority to establish interim approval of all radiation safety actions as deemed appropriate with the collaborative knowledge of the RSCC. Full and final approval will be considered at the next regular meeting of the RSC.
§4.4 Environmental Health & Safety (EH&S)

(1) The RSO is assisted in the operation and maintenance of the Broad-Scope and Production licenses and with the regulation of radiation producing machines by the Environmental Health & Safety Department. The Environmental Health & Safety Department is the organizational entity that provides administrative and technical services in support of the radiation protection program. The Director of the Environmental Health & Safety Department, who may also be the RSO, reports to the Vice-President for Research. The EH&S Department is located in the Physical Sciences Building Room 101B.

(2) The staff from the Environmental Health & Safety Department will have unfettered and unrestricted access to any university facility using licensed radioactive material, including the Idaho Accelerator Center, and the CAES facility, etc. to conduct unannounced radiation safety reviews, audits, inventory, radiation surveys and monitoring, and to conduct any other radiation safety duties.

§4.5 Authorized User

(1) An Authorized User (AU) is:

(a) A faculty or staff member,
(b) The Idaho State University Radiation Safety Officer (by default),
(c) The named principal investigator for a funded project who is responsible for the direct supervision of radiation users and radioactive materials or
(d) A person responsible for the direct supervision of users and ionizing radiation equipment authorized by the Radiation Safety Committee to acquire, use specific radiation sources.

(2) An individual is designated to serve as an Authorized 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.

(a) The AU must update such information by means of periodic revisions or renewals of the authorization request as required by the Committee.

(3) The AU 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 protocol promulgated by the RSC

(d) Maintaining accurate inventory records for all radioactive materials, including acquisitions, uses, transfers, records concerning disposals and records necessary for any decay estimation required. Only the EH&S staff, with written approval from the RSO, may dispose of radioactive materials.

(e) Performing regular bioassays (as instructed by the EH&S Department), 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 Responsible User

(1) A Responsible User is any individual whose official duties or authorized activities include handling, operating or working in the presence of any type of radiation source.

(a) All Authorized Users must also meet the qualifications established for Responsible Users.

(2) Each Responsible 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. The Radiation Safety Training
relative to Responsible Users involves:

(a) Initial Institutional specific Radiation Safety Training,
(b) Annual refresher training.
(c) Radiation Safety Training must meet all training requirements specified in 10 CFR19 and include discourse on the appropriate topics from 10 CFR 20. This training must be consistent with recommendations and standards supporting these federal regulations. All specifications required of the training program by the state of Idaho must also be met.

(3) 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.

   i. 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.

(4) Records maintained with respect to 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.

(5) Responsible User records are treated as confidential and are available only to those with a legitimate need for the information.

   (a) 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 request at termination of employment.

(6) Any radiation user may communicate directly, in confidence and without prejudice, with:

   (a) Their Supervisor
   (b) The Authorized User
   (c) The RSO
(d) The RSCC
(d) Any member of the RSC,
(f) Any member of the EH&S Department
(g) The Idaho Department of Health and Welfare (Radiation Producing equipment) or
(h) The U.S. Nuclear Regulatory Commission

In addition, the user may also anonymously report safety concerns or non-compliance by calling 1-800-716-9007 or by visiting

www.MySafeCampus.com

A service that is available 24 hours a day, seven days a week, 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 the conditions of specific licenses issued to ISU.

(a) The University permits the use of ionizing radiation sources for beneficial applications in teaching and research, if used in accordance with the protocol, principles and rules contained in this manual.

(b) 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, or his designee. 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.

(5) 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.

(6) 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 by the EH&S Department.
(7) 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

(8) A shielding design with accompanying calculations must be submitted with
    each application for radiation sources capable of (unshielded) creating a high
    radiation area (100 mrem/hr) at 30 cm from the source.

(9) A detailed security plan must be submitted to and approved by the Radiation
    Safety Officer and Chairperson of the Radiation Safety Committee prior to
    submitting an application for possession and use of any radioactive source
    requiring safeguards as listed in 10 CFR part 37.

(10) The applicant must also submit with the application details of other hazards or
     situations in the proposed radiation use area, such as:

     (a) BioSafety Level (BSL) 2 or BSL 3 agents
     (b) Research Animals
     (c) Storage of > 20 gallons of flammable liquids
     (d) Storage and use of air reactive or peroxide forming chemicals
     (e) Storage and/or use of flammable gasses in cylinders
     (f) High voltages (> 600 V ac or dc)
     (g) High pressure or other high hazard operations
     (h) Large numbers of transient or peripheral personnel in the area
     (i) Class IV lasers

     that may affect the security, use and control of radioactive materials or
     exposures to workers to radiation sources.
§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 EH&S Department. The extent of the training is to be commensurate with the potential risk of radiation exposure to the individual.

(2) Authorized users shall have their prior training evaluated by the RSO and RSC, or shall be trained by the EH&S. Authorized 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 EH&S Department 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
   (l) Worker's rights to raise radiation safety concerns without being retaliated against.
   (m) A discussion of the university’s policies on safety culture.
   (n) A discussion of the university’s policies on safety conscious work environment.
   (o) How to respond to workers who raise safety concerns.
   (p) The university’s process for prioritizing and evaluating radiation safety concerns including providing feedback to the individual who raised the concern.
   (q) The options that individuals have for raising safety concerns, including the option to raise concerns anonymously or to the NRC.
(4) ISU-specific training topics for radiation users include:
   (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.
   (e) Hands-on simulation that reinforces selected topics as appropriate for each Program
   (f) ISU Radiation Safety Manual
   (g) Workers right to be informed of occupational radiation exposure and bioassay results
   (h) Prenatal effects of radiations, the declared pregnancy program and administrative controls to reduce radiation doses to pregnant workers.

(5) Minimally exposed personnel (e.g. students who use small, non-dispersible or not readily 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 Authorized User or designated by the Authorized 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 Authorized Users and to Responsible 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 RSCC 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 by the EH&S Department.

§8 LABORATORY CLASSIFICATIONS

ISU currently classifies facilities (laboratories) as using:
(a) “sealed sources or not readily dispersible sources only,”
(b) “radiation-producing machine” or
(c) “dispersible sources”

Or some appropriate combination of these three classes. Laboratories that use dispersible radioactive materials 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 and not-readily-dispersible source programs, radiation-producing machine programs, nuclear gauge programs, dispersible radioactive material research laboratories, and radioactive material manufacturing facilities.

(3) ISU has several, small-use laboratories, using less than 10 mCi of dispersible radioactive materials at any one time in its Science Buildings in Pocatello and other ISU Science facilities around Idaho. The laboratories consist of locked rooms where the radioactive materials are used primarily on controlled area bench tops, in hoods, or in glove boxes.

(4) Sealed sources and not-readily-dispersible sources are used at several locations on the Pocatello campus and in facilities located in Pocatello Idaho Falls, and Meridian.
(5) 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 Physical Sciences Building, Radiographic Sciences, Dental Hygiene and Student Health, and at the Meridian Campus.

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 or an agreement states’ 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.

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 or not-readily-dispersible sources only, radiation-producing machine or a combination of dispersible and sealed/ not-readily-dispersible source facility. Facilities that classify as combination facilities must satisfy the requirements associated with both dispersible and sealed/not-readily-dispersible source classification schemes.
§9 CONTROL AND MONITORING OF RADIATION SOURCES

§9. 1 Surveys, Evaluation and Monitoring

(1) The RSO shall ensure that all areas where radiation sources of any kind are stored or used are routinely monitored and holistically evaluated at appropriate intervals with respect to potential radiological exposures, risks, and security.

a. These evaluations need to consider regulatory compliance in all aspects of the endeavor.

b. Such comprehensive evaluations should minimally consider:
   i. pre-existing and evolving conditions,
   ii. the adequacy of proposed shielding when applicable,
   iii. the degree of security exercised over sources and machines,
   iv. the posting and other signage, and
   v. the periodicity and appropriateness of the type of monitoring employed to verify that it can demonstrate compliance with laws and standards.

c. An initial evaluation is required before radioactive materials may be introduced into a laboratory, or before a radiation-generating machine may be installed.

(2) A key component of this monitoring program includes radiation surveys.

a. Technically qualified personnel using instruments appropriate to the nature of the radioactive materials present or radiation exposures to be measured shall perform radiation surveys.

b. All surveys conducted must be fully documented.

(3) Under the auspicious of the Authorized User’s responsibility: routine radiological surveys evaluating both the strength of any radiation fields present and as appropriate, the potential presence of radioactive material contamination need to be conducted:

a. At a regular periodicity, no less than monthly in labs where dispersible radioactive material is used.

b. Following the use of dispersible radioactive materials when there is a potential for generating areas or equipment that is radiologically
(4) Under the auspicious of the RSO’s responsibility: routine radiological surveys evaluating both the strength of any radiation fields present and as appropriate the potential presence of radioactive material contamination need to be conducted by EH&S personnel:

   a. In all laboratories using dispersible radioactive materials at a minimum periodicity not to exceed semi-annually.

   b. When changes that could potentially affect radiological health and safety are encountered.

(5) Under the auspicious of the RSO’s responsibility and concurrent with routine radiological surveys, routine evaluations may additionally be conducted that involve:

   a. A complete audit of all radiation protection devices, procedures and records.

(6) Under the auspicious of the RSO’s responsibility: special evaluations concurrent with radiological surveys may be required:

   a. At a periodicity not to exceed semiannually.

   b. As a result of an accident or unusual incident.

   c. When use of a room or facility for radiation work is terminated. Such an evaluation and radiological survey is referred to as decommissioning survey.

      i. The purpose of the decommissioning survey is to assure that all conditions for an unrestricted area are met. Therefore, this special evaluation puts particular emphasis on fixed and removable contamination surveys.

      ii. The design of a decommissioning survey is based upon professional judgement and should be consistent with the approaches described in NUREG-1575 the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM).

      iii. Decommissioning surveys de facto lead to the generation of standalone decommissioning reports that become controlled documents that should be maintained for the duration of the license authorizing use of radioactive materials and transferred to the regulatory authority at license termination.
§9. 2 Control of Radiation Sources

(1) It is a regulatory necessity under 10 CFR § 20.1801 regarding the security and storage of radioactive materials that the licensee shall secure from unauthorized removal or access all licensed materials that are stored in controlled or unrestricted areas. These sources should be controlled using at least one barrier. Any source exceeding the 10 CFR 30 Schedule B activity level, which is therefore not regarded as an exempt source must be controlled and stored by at least one barrier.

(2) All sources must be secured and controlled under the responsibility of the Authorized User to whom they are assigned. At the discretion of the RSC, failure of an Authorized User to control sources of radioactive material may result in revocation of Authorized User Status. Control must be maintained during source storage, use, and at every phase of disposal.

§9. 2 . 1 Single Barrier sources

i. Examples of appropriate barriers include a locked laboratory entrance door or locks on cabinets, safes, refrigerators or freezers in which radioactive materials are stored.

ii. Operationally, rooms containing sources exceeding the Schedule-B activity-level should normally be locked. It is permissible to unlock doors when the room is being continuously occupied and controlled by a Responsible User who is cognizant of their own immediate security responsibility. **Before this person leaves the area, the room must be locked, the security of radioactive material assured and the security of both the room and the material verified.**

§9. 2 . 2 Additional Controls

Depending on the type and quantity of radioactive materials present, radioactive material sources may require additional special controls. Sources of Radioactive material that require special control at ISU are controlled at one of three additional levels. This includes those sources exceeding the IAEA Category 4 - Aggregate A/D threshold, and those sources listed in 10 CFR 37 as Category 1 and Category 2.
§9. 2.3 Sources exceeding IAEA Category 4 require Double Barrier Control

iii. Sources taken individually existing in any form - including sealed sources - that exceed the IAEA Category 4 Aggregate A/D threshold of 0.01 must be secured behind two barriers.

iv. The IAEA aggregate concept considers a ratio of the quantity of activity in use (the A values) and an IAEA index or potential hazard (the D values) to determine the value IAEA calls the Aggregate Activity Ratio. The Aggregate Activity Ratio (Aggregate A/D) will only be applied at special request of the RSO or RSC.

v. The Aggregate Activity Ratio is Given by the following expression:

\[
\text{Aggregate } \frac{A}{D} = \sum_{i=1}^{k} \sum_{n=1}^{\infty} \frac{A_{i,n}}{D_n}
\]

Where:

- \(A_{i,n}\) - The numerator in this expression is the sum of all specific radionuclides of a particular type.
- \(D_n\) - the IAEA hazard index D for the radionuclide in question. The IAEA values for D for each radionuclide may be obtained from the RSO.

Authorized Users can delegate the use and control of sources to Responsible Users during the course of their work.

All sources or aggregates of sources requiring two-barrier security, when not in use, will be stored in a safe, locked cabinet or other secure, locking container that is physically immobilized. Immobilization may consist of being bolted, chained or otherwise secured to a permanent building structure.

A double barrier source log must be maintained. The log must be completed each time the source is removed from final barrier storage and when it is returned.

For each removal of the source, the log must contain:

- a. A unique identifier of the source (HPassist number, serial number, etc.)
- b. The source Isotope and Activity
- c. The printed name of the radiation worker to use the source
- d. The date and time of removal from storage
- e. The use location
f. Initials of the custodian at time of removal  
g. The date and time of return to storage  
h. Signature of radiation worker  
i. Initials of the Responsible User

Responsible Users using the source cannot leave the source unattended and must return it to double barrier storage unless either:

a. The experimental apparatus or use station that the source is being used on meets double barrier security or

b. The experimental area is secured with a lock and is either interlocked or is remotely monitored by a security system.

c. The Radiation Safety Committee highly encourages the use of swipe card controlled locks on doors as this provides a better ability to delete persons who no longer need access, provides a record of those accessing the area and eliminates the need to rekey a lock in the event of a lost key.

d. Idaho State University is committed to following all requirements specified for Category 1 and Category 2 sources or aggregates of sources meeting this description as specified in 10 CFR 37. Programs and procedures developed to assure compliance are maintained as confidential and may be accessed by authorized individuals on a need to know basis only. The RSO has the authority and responsibility for determining who meets the need to know criteria associated with these documents.
§10 CONTROL AND MONITORING OF EXTERNAL EXPOSURE TO RADIATION

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 Authorized Users to prevent unauthorized use.

§10.1 Radiation Producing Machines

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.

§10.2 Radioactive Materials

Sealed radioactive sources that emit penetrating radiation 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

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.

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 EH&S Department in conjunction with routine contamination surveys.

The Authorized User must ensure that the necessary surveys are performed, recorded and reported for their particular laboratory based on the following laboratory classification.
Work areas where radioactive materials have been used and storage areas for these materials should be surveyed for external exposure rates whenever changes are made in the quantities, locations or shielding. The results of such surveys must be provided to all individuals working in the area to help them to control their own exposures.

Table 1. Radiation Field Survey Frequencies

<table>
<thead>
<tr>
<th>Source Classification</th>
<th>EH&amp;S Surveys</th>
<th>User Laboratory Surveys</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispersible radioactive</td>
<td>Field surveys are conducted simultaneously with</td>
<td>Daily when radioactive materials are in use</td>
</tr>
<tr>
<td>materials</td>
<td>removable contamination surveys</td>
<td>or as otherwise specified by EH&amp;S</td>
</tr>
<tr>
<td>Sealed Sources Only</td>
<td>Semi-Annually</td>
<td>N/A</td>
</tr>
<tr>
<td>Radiation-Producing Machines²</td>
<td>Semi-Annually</td>
<td>When Machine is in use</td>
</tr>
</tbody>
</table>

² Excluding health care x-ray machines..
§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.

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) Daily prior to use, 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

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 documentation of the survey performed must include the following information:

(1) The name of the individual who performed the survey
(2) The date and time the survey was performed
(3) The model and serial number of the survey instrument used
(4) The calibration due date of the instrument used.
(5) An indication that an instrument response check was performed.
(6) The measured background exposure rate in the vicinity
(7) 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:

   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 SSRCR Section D.1502.

   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.

   Declared pregnant women likely to receive a deep dose equivalent in excess of 0.1 rem during the entire pregnancy.

   Individuals entering high or very high radiation areas.

(4) All radiation users - whose potential radiation exposure is required to be monitored by the Environmental Health & Safety Department - 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.
(2) Declared Pregnant Women subject to radiation exposures may be issued a second dosimeter to be worn on the front of the abdomen and if appropriate under the lead apron.
   a. The purpose of the second dosimeter is to monitor the potential dose to the embryo-fetus.
   b. To formally declare herself pregnant, a female radiation worker must notify the RSO in writing.
      i. This is accomplished by completing the form: Letter For Declaring Pregnancy that may be found online on the EH&S web-page.

(6) The EH&S Department 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).

(7) Extremity dosimeters (finger or ring badges) are required 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). Extremity dosimeters are assigned by EH&S. Typically, if it is anticipated that the extremities of a worker may exceed twice the whole body dose then extremity badges may be issued by EH&S.
§11 CONTROL AND MONITORING OF THE INTAKE OF RADIOACTIVE MATERIALS

Each Authorized User who has been assigned sources of radioactive material is responsible for the security, control and containment of these materials. Special emphasis is placed on the control and containment of dispersible sources of radioactive materials but this responsibility is extended to all sources of radioactive materials even if these materials are nominally referred to as sealed or not readily dispersible.

Control and containment involves performing regular surveys and monitoring 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 considered to be ALARA.

§11.1 Control of Radioactive Contamination

(1) In University facilities, the application of the ALARA principle dictates that removable contamination shall be tolerated indefinitely.

(2) Whenever contamination is detected, it must be removed promptly to prevent its spread.

(3) The frequency of routine radioactive contamination surveys in laboratories using radioactive material is provided in Table 2. Table 2 is based on the total number of ALIs present in a particular laboratory.

   i. It is the responsibility of the Authorized User to make certain that radioactive contamination surveys are performed minimally at the frequency designated in Table 2.

   ii. Additionally, as an oversite function, the EH&S Department under the direction of the RSO will conduct radioactive contamination surveys at the frequency indicated in Table 2.
Table 2. Contamination Survey Frequency

<table>
<thead>
<tr>
<th>Laboratory Classification</th>
<th>EH&amp;S Surveys</th>
<th>User Personal Surveys</th>
<th>User Laboratory Surveys</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1 ALI</td>
<td>Semi-Annual</td>
<td>Daily when radioactive materials are in use</td>
<td>Monthly when radioactive materials are in use</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Daily when radioactive materials are in use</td>
<td></td>
</tr>
<tr>
<td>1 - 30 ALI</td>
<td>Quarterly</td>
<td>Daily when radioactive materials are in use</td>
<td>Weekly when radioactive materials are in use</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Daily when radioactive materials are in use</td>
<td></td>
</tr>
<tr>
<td>&gt; 30 ALI</td>
<td>Monthly</td>
<td>Daily when radioactive materials are in use</td>
<td>Daily when radioactive materials are in use</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Daily when radioactive materials are in use</td>
<td></td>
</tr>
<tr>
<td>Sealed Source Only</td>
<td>Semi-Annually</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Radiation Producing Machines capable of producing radioactive materials</td>
<td>Function of inventory following Table 2 laboratory classification</td>
<td>Daily when radioactive materials are in use</td>
<td>Function of inventory following Table 2 laboratory classification</td>
</tr>
</tbody>
</table>
The Environmental Health & Safety Department at Idaho State University employs a removable contamination swipe-sample action level of 70 dpm/100 cm² 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 Lc\textsuperscript{1}, should be brought to the attention of the Authorized User and as appropriate the RSO.

The operational goal in accordance with good practice and ALARA is to not tolerate detectable removable contamination at any ISU facility.

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.

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.

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)\textsuperscript{2} for most analysis methods.

\textsuperscript{1} 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)

\textsuperscript{2} 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/(unit conversion factors * volume or area * analysis time etc.) Ld = 2.71 + 4.66 (uncertainty in background)
Should it prove impossible to decontaminate a particular surface then the following must be considered

Disposal of the item as a contaminated radioactive item must be considered.

Sealing the surface of the item with paint or epoxy to Isolating the item in a controlled access room or area or in a sealed container depending on the circumstance.

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:

Be capable of detecting the kinds or radiations emitted by the radioactive materials in question. (See Section §11.1.1 The Choice and Appropriate Use of Contamination Monitoring Instrumentation).

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*ALI.

Arrangements can and should be made to conduct analyses on EH&S equipment or other analytical equipment available on campus if the appropriate radioanalytical equipment is not available in a given laboratory.

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 EH&S Department, should be taken. However, it is observed that such a device lacks sufficient sensitivity when used as anything else but a screening tool. 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/100 cm² on the low side up to around 560 to 2,800 dpm/100 cm² 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.

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 Classifications of Areas Relative to Radioactive Contamination

As described above, the operational goal of Idaho State University is to have no areas where removable radioactive contamination is allowed. However, it is recognized that certain areas are designed and intended to handle, indeed manufacture, substantial quantities of dispersible radioactive materials. Continuously maintaining such areas in pristine conditions is not practical. The following classification scheme is intended to address the practicality of contamination control. The Idaho State University Radiation Safety Committee has approved a 3-category control system.

(1) CLEAN AREAS: The vast majority of areas on campus including those in which dispersible radioactive materials are to be employed are designated as clean areas. No posting is required in a clean area.

a. The designation implies that removable contamination levels are below 70 dpm/100cm² beta gamma emissions and 7 dpm/100cm² alpha.

1. It is understood that naturally occurring radiation emitted by radon and radon progeny may on occasion exceed these levels. Normally delayed recounting of samples will verify such conditions. As appropriate, the RSO should be notified of such occurrences.

(2) CONTAMINATION CONTROLLED AREAS:

a. A controlled area designation implies that the levels of radioactive contamination in an area may readily exceed 70 dpm/100cm² beta gamma emissions and 7 dpm/100cm² alpha. Therefore, such an area is controlled in a fashion to control the spread or accidental intake of radioactive materials.
b. This area must be prominently posted as a contamination controlled area.

c. Entry into the area involves the use of shoe-covers

d. Egress from the area involves engagement of step-off-pads

e. Egress from the area involves minimally frisking of hands and feet – before leaving the area.

1. Representatives of the EH&S Department must be contacted if radioactive contamination is detected during the egress monitoring (or frisking).

2. Personal items that are found to be contaminated maybe confiscated for either decontamination or disposal.

(3) CONTAMINATION AREAS:

a. A Contamination Area designation implies that the levels of radioactive contamination in an area may readily exceed 1,000 dpm/100cm² beta gamma emissions and 100 dpm/100cm² alpha.

1. Such an area is known to be contaminated with radioactive materials in a dispersible or readily dispersible form.

   i. Designation of a Contamination Area must be approved in writing by the RSO and RSCC.
   ii. The total area under such designated must be minimized to the extent feasible.
   iii. Upon establishing such an area, responsibility for eventual decontamination and decommissioning (D&D) must be established. At the discretion of the VPR fiscal preparation for the eventual D&D may be established including a designation of the magnitude of resources set aside and the establishment of a local account where these resources are sequestered.

   iv. This designation applies to areas large enough to physically enter, It does not include simple bench top areas where dispersible materials are well control using a tray and absorbent paper having a temporary nature. Such areas
that may be appropriate for this designation involve rooms or sections of rooms, glove boxes, or in some cases fume hoods.

(e) Access to such an area is permissible only when under the supervision of senior EH&S department personnel.

(f) Work in a contaminated area is conducted under the guidelines established within a written a Radiation Work Permit (RWP).

i. The RWP is a written document prepared by senior EH&S personnel and approved by the RSO.

ii. The RWP outlines the radiological conditions that will be encountered by workers entering the area.

iii. The RWP prescribes the protective measures that will be taken to protect workers from the intake of radioactive materials in conjunction with protection relative to the holistic health and safety of the worker.

iv. A record of all personnel entering a contamination area under the auspicious of a RWP must be maintained for all entries. This should record any exposures received, the results of air sampling when applicable, and a documentation of any events involving radioactive contamination. Any surveys conducted as part of the RWP must also be maintained as record of this endeavor.

§11.1.2 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.

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) Daily prior to use, 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 With 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.
(4) Individuals who handle dispersible radioiodine compounds may be required to undergo in vivo measurements, arranged by the Environmental Health & Safety Department, of radioiodine in the thyroid. Individuals who handle other radionuclides in dispersible form may be required to submit 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.

(6) 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.

(7) Assessment of internal exposure may be performed by lapel air sampling. In these cases EH&S personnel will collect and analysis the samples. If the lapel results indicate a significant exposure the data will be forwarded to the RSO and follow-on bioassay samples may be collected.

§11.4 General Hygiene and control practices to limit intake of radioactive material

(1) Eating, drinking and smoking or evidence thereof are not permitted in any laboratories or rooms where radioactive materials are authorized.

(2) If radioactive materials are in use, all injuries, no matter how slight shall be monitored to determine if the wound is contaminated.

(3) Protective clothing appropriate to the conditions shall be worn at all times when working with loose radioactive materials. At minimum, this means

a. When using dispersible radioactive materials workers should wear appropriate:

1. Gloves,
2. Eye Protection
3. Laboratory Coats
b. Disposable gloves must be worn when handling sealed sources of activity 
   > 10 microCuries.

(3) All equipment which might come in contact with radioactive material shall be 
   considered potentially contaminated and shall be labeled with a “radioactive 
   materials” decal and monitored for contamination before being removed 
   from the laboratory or used for non-radioactive processes.

(5) All persons shall monitor themselves for contamination before leaving a 
   laboratory where dispersible radioactive material is used. The EH&S 
   Department must be contacted immediately if personal contamination is found.

(8) Radioactive solutions shall not be pipetted by mouth.

(9) Remote equipment (long-handed tongs, remote pipettes, etc.) shall be used 
   routinely when handling highly radioactive materials (any materials creating 
   gamma/x-ray radiation levels > 30 mrem/hr at 1 meter or high energy beta 
   sources of an activity of 1 mCi or greater).

(10) The average face velocity into a ventilation fume hood at its opening, where 
     unsealed radioactive materials are actively in use, shall be between 80 and 130 
     linear feet per minute. Fume hoods are to be tested at least annually.

(11) Appropriate safety glasses, face shields, or personal eyeglasses should be 
     worn when exposure is from high energy beta particles.

(10) Radioactive materials that can become volatile are prohibited from being used 
     in ductless fume hoods and in Class I, Class IIA, Class IIB1 and Class IIB3 
     biosafety cabinets without separate special review and approval of the RSO and 
     RSC.
§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.
   (a) The information provided is consistent with that indicated within NRC Form 5.
   (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 EH&S Department Personnel.
   (d) All individuals who exceed a dose from 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

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 should as an operational goal be calibrated on a semi-annual basis, after maintenance has been performed (excluding maintenance which does not affect 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.

(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. No instrument may be used if it has not been calibrated within the last 12±2 months as consistent with industrial standard.

(4) 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.

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 SOURCE PROCUREMENT, MANAGEMENT/INVENTORY AND 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.

(2) Leak checks will be performed by the Environmental Health & Safety Department (EH&S):

   a. on a semi-annual basis consistent with 10 CFR 32.210 and records of the leak checks will be maintained by the EH&S.
   
   b. 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.

(3) Sealed sources **do not** need to be leak checked if

   a. They are composed of only $^3$H 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.

   **No sealed source shall be stored for a period of more than 10 years without being tested for leakage and or contamination.**

(4) 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”. If swipe analysis reveals the presence of 0.005 µCi or more of removable contamination the following actions must be taken

   a. 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.
   
   b. The source shall be removed immediately from service and decontaminated, disposed of or repaired.
Effective 01 July 2018, (and specifically excluding items obtained prior to this date) any university organization that intends to procure radioactive material for any purpose,

   a. including equipment with induced radioactivity, or other contaminated components with a total volume of greater than one cubic foot,

   b. or an activity 100 times the 10 CFR 30 Schedule B table,

   c. or consisting of source or special nuclear material

must demonstrate the existence of a responsible path for the ultimate disposal of this item.

(a) The administrator in charge of an academic unit interested in procuring or receiving such an item must send a letter to the Radiation Safety Committee copied to the Vice President of Research that assures that funds will be made available in a timely manner

   i. for the disposal of the radioactive material when it becomes obsolete,

   ii. no longer has a use,

   iii. when the project it was procured for has ended or

   iv. the authorized user has left the University with no users to continue his/her work that directly relates to the source.

The funds in question at the discretion of the VPR are to be sequestered in a special local account set up specifically for the purpose in question.

(b) It can be demonstrated that the radioactive material to be obtained has a half-life of less than 120 days and therefore the item can be processed through the decay and storage procedures.

(c) It can be demonstrated that the radioactive material to be obtained is eligible for sewer disposal under 10CFR20.2003.
(d) There is written documentation from the individual or organization who provided the radioactive material to ISU will take the source back into their procession, and will explicitly pay for all packaging, shipping, and documentation associated with this endeavor.

(6) Sealed sources or other radioactive items with activities less than those prescribed in 10 CFR 30.71 Schedule B and less than those requiring leak tests that have no identifying serial numbers or other unique identifiers (commonly known as “button sources”) will not be required to be maintained on any inventory records nor will they be required to be received and inventoried by the EH&S.

§15 MATERIAL RECEIPT AND ACCOUNTABILITY

(1) Radioactive materials may be used for any legitimate educational, clinical or research purpose. Radioactive materials or machines shall be purchased, or obtained, by individuals only after specifically authorized by the RSO. Requests are reviewed in accordance with Authorized User permits and existing NRC licenses.

(2) 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.

(3) Normally radioactive materials are ordered by ISU Purchasing services following approval by the RSO. Purchasing must be diligent when buying equipment to assure that they are aware if a device is capable of producing a radiation field during operation, or if the device contains for whatever conceivable purpose a source of radioactivity. If any item is identified that is thought to be radioactive or capable of producing radiation than purchasing should consult with the RSO before progressing with the purchase. Periodically the RSO or a designee will provide familiarization training on recognizing likely items that can produce radiation.

(4) Purchases or transfers 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) must be initiated on a "Radioactive
Material Purchase Authorization" form that is submitted to the EH&S Department. The Radioactive Material Purchase Authorization form is designated as Form RPR-13F. Copies of this form may be found on-line on the EH&S web page.

(5) 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 EH&S Department 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 EH&S Department is authorized to dispose of radioactive materials.

§15.1 Radioactive Material Inventory And Accountability

(1) Sealed sources and other radioactive material items with activities less than those prescribed in 10 CFR 30.71 Schedule B and less than those requiring leak tests that have no identifying serial numbers or other unique identifiers (commonly known as “button sources”) will not be required to be maintained on any inventory records nor will they be required to be received and inventoried by the EH&S Department.

a. A record of all sealed and not-readily dispersible sources other than those exempted in item 15.1 (1) above shall be continuously maintained. Nominally, this record will be maintained as part of a digital software database.

b. Specifically because of discrepancies that have arisen between NMMSS and ISU’s data base the following rules are established:

i. All radioactive material that is brought to ISU and is placed in the jurisdiction of the Broad Scope or Production licenses must be added to the ISU data base within three working days of its receipt.

1. This action specified in 15.1(2) is the responsibility of the senior Health Physicists on staff of EH&S and this accomplishment must be reported to the RSO and RSCC for notice to the RSC at the next regularly scheduled meeting via an email note.
ii. No source of radioactive material may be removed from the ISU radioactive material data base unless its removal is authorized by the RSO.

2. Along with the removal from the Data Base the senior Health Physicists on staff of EH&S must in a memo describe the specifics of the path the source took in order to be removed from inventory so that specific information on either disposal, or transfer, etc., is provided clearly for future reference.

c. The Senior Health Physicist will complete a physical inventory of all accountable material twice per year normally in December and June of each year in conjunction with authorized users. Inventory verification forms for each Authorized User will be signed and dated by the Authorized User and the Senior Health Physicist.

d. Inventory results including signed inventory forms will be reported in a memorandum to the RSO and RSCC, filed with NMMSS inventory records, and presented at the next scheduled meeting of the RSC.

(3) EHS personnel will perform material balance and physical inventory reporting as specified in the NMMSS Users Guide each year by March 31.

(4) EHS personnel will complete 741 forms for all accountable nuclear material transactions as required by the NMMSS Users Guide.

(5) The RSO is responsible for assuring that sources not excluded by 15.1 (1) are inventoried semi-annually.

(6) Record of the semi-annual inventory is to be kept on file by the EH&S Department as specified by regulatory requirement.

§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 online at the EH&S web page.) and submit it to either the RSO or the EH&S Department staff.

(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 must be in compliance with U.S. Department of Transportation (DOT) and International Air Transport Association (IATA) 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/IATA and NRC requirements.
(d) Copies of all training records with respect to certified shippers are maintained by the Environmental Health & Safety Department.
(e) Preparation of all necessary documentation and shipping paperwork is the responsibility of the Certified Shipper and that individual must assure that these records are properly filed and maintained within the EH&S Department.

(4) Transportation of all radioactive materials by University personnel must take place in a State owned vehicle. Use of personal vehicles is strictly prohibited. Personnel who act as a carrier for radioactive materials must have a commercial driver license with HAZMAT endorsement or must have received training in accordance with 49 CFR 177.816. Any motor vehicle shipment that involves placarded radioactive material or more than 10,000 pounds of hazardous material must be driven by personnel with a commercial driver license and HAZMAT endorsement. No ISU personnel are authorized to ship Type B containers or fissile material containers that are not excepted under 49 CFR 173.453 without quality assurance program in accordance with 49 CFR 71.101.

(5) To ensure that all requirements for shipment are met, and that appropriate records are maintained,
(a) The EH&S Department is the only organization on campus authorized to conduct the inspection and receipt of radioactive materials.
§16.1 Receipt of Radioactive Materials

(1) It is the responsibility of the Authorized User who receives radioactive materials to **promptly** notify the RSO/EH&S Staff that radioactive material has been or will be received on campus.

(2) Since such communications from vendors are frequently not made, it is the responsibility of Shipping and receiving to **promptly** notify the RSO/EH&S staff that radioactive material has been received on campus.

(3) It is the responsibility of any EH&S staff member who is notified of a package to immediately either engage in the receipt or immediately engage in coordination of all necessary activities to assure the receipt is handled according to the criteria specified in this section.

(4) ISU will adhere to the specific requirements specified in 10 CFR 20.1906 for receiving and opening packages which are provided verbatim:

   (a) Each licensee who expects to receive a package containing quantities of radioactive material in excess of a Type A quantity, as defined in § 10CFR 71.4 and appendix A to part 10 CFR 71 of this chapter, shall make arrangements to receive—

      (1) The package when the carrier offers it for delivery; or

      (2) Notification of the arrival of the package at the carrier's terminal and to take possession of the package expeditiously.

   (b) Each licensee shall—

      (1) Monitor the external surfaces of a labeled\(^{3a}\) package for radioactive contamination unless the package contains only radioactive material in the form of a gas or in special form as defined in 10 CFR 71.4;

      (2) Monitor the external surfaces of a labeled\(^{3a}\) package for radiation levels unless the package contains quantities of radioactive material that are less than or equal to the Type A quantity, as defined in § 10 CFR 71.4 and appendix A to part 10 CFR 71 of this chapter; and
(3) Monitor all packages known to contain radioactive material for radioactive contamination and radiation levels if there is evidence of degradation of package integrity, such as packages that are crushed, wet, or damaged.

(c) The licensee shall perform the monitoring required by paragraph (b) of this section as soon as practical after receipt of the package, but not later than 3 hours after the package is received at the licensee's facility if it is received during the licensee's normal working hours, or not later than 3 hours from the beginning of the next working day if it is received after working hours.

(d) The licensee shall immediately notify the final delivery carrier and the NRC Operations Center (301-816-5100), by telephone, when—

(1) Removable radioactive surface contamination exceeds the limits of §10CFR71.87(i) of this chapter; or

(2) External radiation levels exceed the limits of §10CFR 71.47 of this chapter.

(f) Each licensee shall—

(1) Establish, maintain, and retain written procedures for safely opening packages in which radioactive material is received; and

(2) Ensure that the procedures are followed and that due consideration is given to special instructions for the type of package being opened.

(f) Licensees transferring special form sources in licensee-owned or licensee-operated vehicles to and from a work site are exempt from the contamination monitoring requirements of paragraph (b) of this section, but are not exempt from the survey requirement in paragraph (b) of this section for measuring radiation levels that is required to ensure that the source is still properly lodged in its shield. Labeled with a Radioactive White I, Yellow II, or Yellow III label as specified in U.S. Department of Transportation regulations, 49 CFR 172.403 and 172.436-440.
§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.

(2) 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 without the explicit written approval of the RSO and the RSC as this creates “mixed waste.” ISU has no long term storage capability for such waste.

(3) When responsible users have no further use for radioactive materials, they should contact the EH&S and arrange for a waste pick-up.

   a. A radwaste tag must be filled out by the responsible user indicating the radionuclide, activity and volume or weight, if appropriate.

   b. The EH&S Department will verify that the waste is safely contained and the radwaste form is properly completed before accepting custody of the waste.

   c. Radwaste tags can be obtained from the EH&S upon request and constitute a record of radwaste inventory for the University.

(4) **Only the ISU Environmental Health & Safety Department is authorized to dispose of Radioactive Waste.** Radioactive wastes shall be disposed of in the ways described below:

   (b) 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 EH&S as waste. They may then be disposed of as solid waste after meeting the requirements of 10 CFR 35.92.

   (c) Liquid radioactive wastes will be collected in appropriate containers and transferred to the Environmental Health & Safety. The EH&S may dispose of certain liquid wastes into the sanitary sewer in accordance with 10 CFR 20.2003 and all other applicable regulations. Sanitary sewer disposal is to be done
by the RSO or his/her designee only.

1. A record of all sewer disposals must be maintained and reported to the City of Pocatello on a quarterly basis.

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

(e) ISU will not compact solid radioactive waste by mechanical means.

(f) ISU will not incinerate any wastes on site containing any quantity of licensed radioactive materials without the written approval of the U.S.N.R.C.

(f) Radioactive animals will be placed in appropriate containment as not to cause contamination while in storage for disposal. Animals will be frozen in the generators facility until time of disposal.

(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 EH&S Department Staff.
§18 SERVICE FEES

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 EH&S base budget.

§18.1 Extraordinary Costs

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

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 EH&S 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 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 EH&S 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 EH&S for assistance.

a. To contact the Environmental Health & Safety Department call extension 2310 during normal working hours OR call Public Safety, at 282-2515 during off duty hours. Public Safety will contact EH&S personnel.

§20  RADIATION PRODUCING DEVICES

1. Radiation producing machines and facilities will, at minimum, comply with all applicable sections of the Idaho Administrative Code (IDAP 16.02.07 – Idaho Radiation Control rules) and the requirements regarding ALARA, Laboratory Classification, instrumentation, control & monitoring of radiation sources, internal radiation exposures, external radiation exposures and recordkeeping set forth in this document.

2. All training must be performed and documented to meet the requirements of the Idaho Administrative Code (IDAP 16.02.07 – Idaho Radiation Control rules) and University policy.

3. No new or modified radiation producing device may be operated or energized to produce radiation without the written approval of the radiation safety committee.

4. Shielding designs shall contain, as a minimum:
   a. Name and C.V. of the qualified expert who was consulted in the design of the accelerator installation layout and shielding;
b. A floor plan and/or blueprint indicating
   i. Shielding materials and thicknesses of all walls, ceilings, floors, barriers and doors,
   ii. Occupancies of all adjoining spaces
   iii. Maximum anticipated radiation dose rates both inside and outside of the shielding,

c. The calculation methods used and assumptions made to determine shielding materials, thickness and configuration.

5. The Radiation Safety Officer or Radiation Safety Committee may suspend or terminate the operations at a particle accelerator facility if such action is deemed necessary to protect health and/or minimize danger to public health and safety and/or property.

6. Only the Radiation Safety Committee or the Radiation Safety Officer will have the authority to authorize the intentional bypass of a safety interlock or interlocks. Such authorizations, if given, will be temporary in nature and will be documented in writing.

§20.1 Particle Accelerators

§20.1.1 ISU Definition of an Accelerator

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.
§20.1.2 New and Modified Existing Accelerator Approval

To start the approval process, the following must be submitted to the Environmental Health & Safety (See RPR 2C):

**For New Particle Accelerators:**

1. The RESPONSIBLE USER’S TRAINING & EXPERIENCE (RPR 2A),
2. The PERSONAL DATA form (RPR 1A),
3. State of Idaho X-Ray Registration form (EH&S can assist with this)

**For New and Modified Existing Accelerators:**

4. A filled in copy of the Form RPR 2C3 and all required documents as outlined in this RPR.
5. A completed copy of the “New Accelerator Compliance Checklist”
6. A research protocol that contains the following information:
   a. Brief description of experiment, types of radiation to be produced, expected dose rates in occupied areas, and any unusual safety concerns and, for existing machines, modifications, changes in use, and any other change that may affect safety and shielding.
   b. Brief description of any “NO” answers to the New Accelerator Compliance Checklist
   c. Brief description of administrative controls (operating procedures, warning signs, etc.) to be employed for safe operation of the experiment.
   d. Brief description of training and experience and of staff to be involved with the experiment.
   e. Explanation of how ISU ALARA goals will be met.
§20.2 X-Ray Devices

To start the approval process, the following must be submitted to the Environmental Health & Safety:

**For New X-Ray Devices:**

1. The RESPONSIBLE USER’S TRAINING & EXPERIENCE (RPR 2A),
2. The PERSONAL DATA form (RPR 1A),
3. The RADIATION MACHINE USE form (RPR 2C-1)
4. State of Idaho X-Ray Registration form (EH&S can assist with this)

**For New and Modified Existing X-Ray Devices:**

5. A filled in copy of *The Analytical X-Ray Machine Checklist*,
   or for radiographic usage, fill in a copy of the “X-ray Radiography Application Checklist RPR2C-4” that can be obtained through the Environmental Health & Safety.

6. A research protocol that contains the following information:
   a. Brief description of experiment, types of radiation to be produced, expected dose rates in occupied areas, and any unusual safety concerns and, for existing machines, modifications, changes in use, and any other change that may affect safety and shielding.
   b. Brief description of any “NO” answers to the Analytical X-Ray Machine Checklist or for radiographic uses the “X-ray Radiography Application Checklist RPR2C-4”
   c. Brief description of administrative controls (operating procedures, warning signs, etc.) to be employed for safe operation of the experiment.
   d. Brief description of training and experience and of staff to be involved with the experiment.
   e. Explanation of how ISU ALARA goals will be met.
§20.3 Industrial Radiography Operations

To start the approval process, the following must be submitted to the Technical Safety Office:

For New Industrial Radiography Operations:

1. The RESPONSIBLE USER’S TRAINING & EXPERIENCE (RPR 2A),
2. The PERSONAL DATA form (RPR 1A) for all operators if not already submitted,
3. The Radiation Machine Use Application (RPR2C-1)
4. State of Idaho X-Ray Registration form (EH&S can assist with this) Registration

For New and Modified Existing Industrial Radiography Operations

a. The X-ray Radiography Application Checklist RPR2C-4

b. A research protocol that contains the following information:

c. Brief description of experiment, types of radiation to be produced, expected dose rates in occupied areas, and any unusual safety concerns and, for existing machines, modifications, changes in use, and any other change that may affect safety and shielding.

d. Brief description of any “NO” answers to the X-ray Radiography Application Checklist

e. Brief description of administrative controls (operating procedures, warning signs, etc.) to be employed for safe operation of the experiment.

f. Brief description of training and experience and of staff to be involved with the experiment

e. Explanation of how ISU ALARA goals will be met.
ACRONYMS

**ALARA**: As Low As Reasonably Achievable

**ALI**: Annual Limit on Intake

**ANSI**: American National Standards Institute

**BSL**: BioSafety Level

**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 Detectible 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

**EH&S**: Environmental Health & Safety

**VPREC**: Vice-President of Research and Economic Development
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 $3.7 \times 10^{10}$ disintegrations per second.

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

- 1 millicurie (mCi) = $3.7 \times 10^{7}$ s$^{-1}$
- 1 microcurie (μCi) = $3.7 \times 10^{4}$ s$^{-1}$ = $2.2 \times 10^{6}$ min$^{-1}$ (dpm)
- 1 nanocurie (nCi) = 37 s$^{-1}$ = 2,220 dpm
- 1 picocurie (pCi) = 0.037 s$^{-1}$ = 2.22 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 \((1000 \text{ mg/cm}^2)\).

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 \((0.869 \text{ rad in air or 0.93 rad in soft body tissues})\). Submultiples of the Roentgen are normally combined with time units to express exposure rates, e.g., milliRoentgen per hour \((\text{mR/hr})\), 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 \((300 \text{ mg/cm}^2)\).

High Radiation Area: Any accessible area in which an individual could receive a dose equivalent exceeding 100 mrem in 1 hour at 30 cm \((1 \text{ ft})\) 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 pCi/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 pCi/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. This definition is not applicable for decommissioning activities or the unrestricted release of materials or property.

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 (Hs):** 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).
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