TITLE 12. NATURAL RESOURCES

CHAPTER 1. RADIATION REGULATORY AGENCY

Authority: A.R.S. § 30-651 et seq.

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ARTICLE 1. GENERAL PROVISIONS

R12-1-101. Scope

A. Except as otherwise specifically provided, this Chapter applies to all persons who receive, possess, use, transfer, own, or acquire any source of radiation.

B. This Chapter does not apply to any person that is subject to regulation by the Nuclear Regulatory Commission.

C. State control of source material, byproduct material, and special nuclear material in quantities not sufficient to form a critical mass is subject to the provisions of the agreement between the state and the U.S. Nuclear Regulatory Commission, signed March 30, 1967, incorporated by reference in this rule and on file with the Office of the Secretary of State.

Historical Note

Former Rule Section A.1; Former Section R12-1-101 repealed, new Section R12-1-101 adopted effective June 30, 1977 (Supp. 77-3). Amended effective April 2, 1990 (Supp. 90-2). Amended effective August 10, 1994 (Supp. 94-3). Amended effective June 13, 1997 (Supp. 97-2). Amended by final rulemaking at 9 A.A.R. 1126, effective May 9, 2003 (Supp. 03-1).

R12-1-102. Definitions

Terms defined in A.R.S. § 30-651 have the same meanings when used in this Chapter. The following terms have the definitions below. Additional subject specific definitions are used in other Articles.

"A_1" means the maximum activity of special form radioactive material permitted in a Type A package.

"A_2" means the maximum activity of radioactive material, other than special form radioactive material, permitted in a Type A package. These values are either listed in 10 CFR 71.137, Appendix A, Table A-1, or may be derived in accordance with the procedure prescribed in 10 CFR 71.137, Appendix A, 2001 Edition, published January 1, 2001, incorporated by reference and on file with the Agency and the Office of the Secretary of State. This incorporation by reference contains no future editions or amendments.

"Absorbed dose" means the energy imparted by ionizing radiation per unit mass of irradiated material. The units of absorbed dose are the gray (Gy) and the rad.

"Accelerator" means any machine capable of accelerating electrons, protons, deuterons, or other charged particles in a vacuum and of discharging the resultant particulate or other radiation into a medium at energies usually in excess of 1 MeV. For purposes of this definition, "particle accelerator" is an equivalent term.

"Accelerator produced material" means any material made radioactive by irradiating it in a particle accelerator.

"Act" means A.R.S. Title 30, Chapter 4.

"Activity" means the rate of disintegration, transformation, or decay of radioactive material. The units of activity are the becquerel (Bq) and the curie (Ci).

"Adult" means an individual 18 or more years of age.

"Agency," or "ARRA" means the Arizona Radiation Regulatory Agency.

"Agreement State" means any state with which the United States Nuclear Regulatory Commission has entered into an effective agreement under Section 274(b) of the Atomic Energy Act of 1954, as amended (73 Stat. 689).

"Airborne radioactive material" means any radioactive material dispersed in the air in the form of aerosols, dusts, fumes, mists, vapors, or gases.

"Airborne radioactivity area" means a room, enclosure, or area in which airborne radioactive materials, composed wholly or partly of licensed radioactive material, exist in concentrations:

In excess of the derived air concentrations (DACs) specified in Appendix B, Table I of Article 4 of these rules, or

That an individual present in the area without respiratory protective equipment could exceed, during the hours an individual is present in a week, an intake of 0.6% of the annual limit on intake (ALI) or 12 DAC-hours.

"ALARA" means as low as is reasonably achievable, making every reasonable effort to maintain exposures to radiation as far below the dose limits in these rules as is practical, consistent with the purpose for which the licensed or registered activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed or registered sources of radiation in the public interest.

"Analytical x-ray equipment" means equipment used for x-ray diffraction or x-ray-induced fluorescence analysis.

"Analytical x-ray system" means a group of components utilizing x-rays to determine the elemental composition or to examine the microstructure of materials.

"Annual" means done or performed yearly. For purposes of Chapter 1 any required activity done or performed within plus or minus two weeks of the annual due date is considered done or performed in a timely manner.

"Background radiation" means radiation from cosmic sources; not technologically enriched naturally occurring radioactive materials, including radon, except as a decay product of source or special nuclear material less than 10 times the quantities listed in Article 4, Appendix B, Table II; and global fallout as it exists in the environment from the testing of nuclear explosive devices. "Background radiation" does not include sources of radiation from radioactive materials regulated by the Agency.

"Becquerel" (Bq) means the International System (SI) unit for activity and is equal to 1 disintegration per second (dps or tps).

"Bioassay" means the determination of kinds, quantities, or concentrations, and in some cases, the locations of radioactive material in the human body, whether by direct measurement, in vivo counting, or by analysis and evaluation of materials excreted or removed from the human body. For purposes of these rules, "radiobioassay" is an equivalent term.

"Brachytherapy" means a method of radiation therapy in which an encapsulated source or group of sources is utilized to deliver beta or gamma radiation at a distance of up to a few centimeters, by surface, intracavitary or interstitial application.

"Byproduct material" means:

Any radioactive material, except special nuclear material, yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material; and

The tailings or wastes produced by the extraction or concentration of uranium or thorium from ore processed primarily for its source material content, including discrete surface wastes resulting from uranium or thorium solution extraction processes. Underground ore bodies depleted by these solution extraction operations do not constitute "byproduct material" within this definition.

"Calendar quarter" means not less than 12 consecutive weeks nor more than 14 consecutive weeks. The first calendar quarter of each year shall begin in January and subsequent calendar quarters shall be so arranged such that no day is included in more than one calendar quarter and no day in any one year is omitted from inclusion within a calendar quarter. A licensee or registrant shall not change the method of determining calendar quarters for purposes of this Chapter except at the beginning of a calendar year.

"Calibration" means the determination of:

The response or reading of an instrument relative to a series of known radiation values over the range of the instrument or

The strength of a source of radiation relative to a standard.

"Certifiable cabinet x-ray system" means an existing uncertified x-ray system that meets or has been modified to meet the certification requirements specified in 21 CFR 1020.40, 2001 Edition, published April 1, 2001, incorporated by reference and on file with the Agency and the Office of Secretary of State. This incorporation by reference contains no future editions or amendments.

"Certified cabinet x-ray system" means an x-ray system that has been certified in accordance with 21 CFR 1010.2, as being manufactured and assembled on or after April 10, 1975, in accordance with the provisions of 21 CFR 1020.40, both references 2001 Edition, published April 1, 2001, incorporated by reference and on file with the Agency and the Office of Secretary of State. These incorporations by reference contain no future editions or amendments.

"CFR" means Code of Federal Regulations.

"Chelating agent" means amine polycarboxylic acids, hydroxycarboxylic acids, gluconic acid, and polycarboxylic acids.

"Civil penalty" means the monetary fine which may be imposed on licensees by the Agency, pursuant to A.R.S. § 30-

687, for violations of the Act, this Chapter, or license conditions.

"Collective dose" means the sum of the individual doses received in a given period of time by a specified population from exposure to a specified source of radiation.

"Committed dose equivalent" ($H_{T,50}$) means the dose equivalent to organs or tissues of reference (T) that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.

"Committed effective dose equivalent" ($H_{E,50}$) is the sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to each of these organs or tissues ($H_{E,50} = \Sigma w_T H_{T,50}$).

"Curie" means a unit of quantity of radioactivity. One curie (Ci) is that quantity of radioactive material which decays at the rate of $3.7E + 10^{10}$ transformations per second (tps).

"Current license or registration" means a license or registration issued by the Agency and for which the licensee has paid the license or registration fee for the current year according to R12-1-1304.

"Deep-dose equivalent" (H_d), which applies to external whole body exposure, is the dose equivalent at a tissue depth of 1 centimeter (1000 mg/cm^2).

"Depleted uranium" means the source material uranium in which the isotope uranium-235 is less than 0.711 weight percent of the total uranium present. Depleted uranium does not include special nuclear material.

"Dose" is a generic term that means absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, total organ dose equivalent, or total effective dose equivalent. For purposes of these rules, "radiation dose" is an equivalent term.

"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 sievert (Sv) and rem.

"Dose limits" means the permissible upper bound of radiation doses established in accordance with these rules. For purposes of these rules, "limits" is an equivalent term.

"Dosimeter" (see "Individual monitoring devices").

"Effective dose equivalent (H_E)" means the sum of the products of the dose equivalent to each organ or tissue (H_T) and the weighting factor (w_T) applicable to each of the body organs or tissues that are irradiated ($H_E = \Sigma w_T H_T$).

"Effluent release" means any disposal or release of radioactive material into the ambient atmosphere, soil, or any surface or subsurface body of water.

"Embryo/fetus" means the developing human organism from conception until the time of birth.

"Enclosed beam x-ray system" means an analytical x-ray system constructed in such a way that access to the interior of the enclosure housing the x-ray source during operation is precluded except through bypassing of interlocks or other safety devices to perform maintenance or servicing.

"Enclosed radiography" means industrial radiography conducted by using cabinet radiography or shielded room radiography.

"Cabinet radiography" means industrial radiography conducted by using an x-ray machine in an enclosure not designed for human admittance and which is so shielded that every location on the exterior meets the conditions for an "unrestricted area."

"Shielded room radiography" means industrial radiography conducted using an x-ray machine in an enclosure designed for human admittance and which is so shielded that every location of the exterior meets the conditions for an "unrestricted area."

"Entrance or access point" means any opening through which an individual or extremity of an individual could gain access to radiation areas or to licensed radioactive materials. This includes entry or exit portals of sufficient size to permit human entry, irrespective of their intended use.

"Exhibit" for purposes of these rules, is equivalent in meaning to the word "Schedule" as found in previously issued rules, current license conditions, and regulation guide.

"Explosive material" means any chemical compound, mixture, or device which produces a substantial instantaneous release of gas and heat spontaneously or by contact with sparks or flame.

"Exposure" means:

Being subjected to ionizing radiation or radioactive materials.

The quotient of dQ by dm where "dQ" is the absolute value of the total charge of the ions of one sign produced in air when all the electrons (negatrons and positrons) liberated by photons in a volume element of air having mass "dm" are completely stopped in air. The special unit of exposure is the roentgen (R).

"Exposure rate" means the exposure per unit of time.

"External dose" means that portion of the dose equivalent received from any source of radiation outside the body.

"Extremity" means hand, elbow, arm below the elbow, foot, knee, and leg below the knee.

"Fail-safe characteristics" means a design feature which causes beam port shutters to close, or otherwise prevents emergence of the primary beam, upon the failure of a safety or warning device.

"Field radiography" means industrial radiography, utilizing a portable or mobile x-ray system, which is not conducted in a shielded enclosure.

"Field station" means a facility where radioactive sources may be stored or used and from which equipment is dispatched to temporary job sites.

"Former U.S. Atomic Energy Commission (AEC) or U.S. Nuclear Regulatory Commission (NRC) licensed facilities" means nuclear reactors, nuclear fuel reprocessing plants, uranium enrichment plants, or critical mass experimental facilities where AEC or NRC licenses have been terminated.

"Generally applicable environmental radiation standards" means standards issued by the U.S. Environmental Protection Agency (EPA), 40 CFR 190 and 191, 2001 Edition, published July 1, 2001, incorporated by reference and on file with the Agency and the Office of the Secretary of State, under the authority of the Atomic Energy Act of 1954, as amended, that impose limits on radiation exposures or levels, or concentrations or quantities of radioactive material, in the general environment outside the boundaries of locations under the control of persons possessing or using radioactive material. This incorporation by reference contains no future editions or amendments.

"Gray" (Gy) means the International System (SI) unit of absorbed dose and is equal to 1 joule per kilogram. One Gray equals 100 rad.

"Hazardous waste" means those wastes designated as hazardous in A.R.S. § 49-921(5).

"Healing arts" means the practice of medicine, dentistry, osteopathy, podiatry, chiropractic, and veterinary medicine.

"Health care institution" means every place, institution, or building which provides facilities for medical services or other health-related services, not including private clinics or offices which do not provide overnight patient care.

"High radiation area" means an area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving a dose equivalent in excess of 1 mSv (0.1 rem) in one hour at 30 centimeters from the radiation source or 30 centimeters from any surface that the radiation penetrates.

"Human use" means the internal or external administration of radiation or radioactive materials to human beings.

"Impound" means to abate a radiological hazard. Actions which may be taken by the Agency in impounding a source of radiation include seizing the source of radiation, controlling access to an area, and preventing a radiation machine from being utilized.

"Individual" means any human being.

"Individual monitoring" means the assessment of:

Dose equivalent

By the use of individual monitoring devices, or

By the use of survey data; or

Committed effective dose equivalent

By bioassay; or

By determination of the time-weighted air concentrations to which an individual has been exposed, that is, DAC-hours. (See the definition of DAC-hours in Article 4).

"Individual monitoring device" means a device designed to be worn by a single individual for the assessment of dose equivalent. For purposes of this Chapter, "dosimeter" and "personnel dosimeter," are equivalent terms. Examples of individual monitoring devices are film badges, thermoluminescence dosimeters (TLDs), pocket ionization chambers, optical stimulation devices, and personal ("lapel") air sampling devices.

"Individual monitoring equipment" means one or more individual monitoring devices. For purposes of this Chapter, "personnel monitoring equipment" is an equivalent term.

"Industrial radiography" means the examination of the macroscopic structure of materials by non-destructive methods utilizing sources of ionizing radiation.

"Injection tool" means a device used for controlled subsurface injection of radioactive tracer material.

"Inspection" means an examination or observation by a representative of the Agency, including but not limited to tests, surveys, and monitoring to determine compliance with rules, orders, requirements and conditions of the License or certificate of registration.

"Interlock" means a device arranged or connected such that the occurrence of an event or condition is required before a second event or condition can occur or continue to occur.

"Internal dose" means that portion of the dose equivalent received from radioactive material taken into the body.

"Irradiate" means to expose to radiation.

"Laser" (light amplification by the stimulated emission of radiation) means any device which can produce or amplify electromagnetic radiation with wave lengths in the range of 180 nanometers to 1 millimeter primarily by the process of controlled stimulated emission.

"Lens dose equivalent" (LDE) means the external exposure of the lens of the eye and is taken as the dose equivalent at a tissue depth of 0.3 centimeters (300 mg/cm^2).

"License" means the grant of authority, issued pursuant to Article 3 and 14 of this Chapter and A.R.S. §§ 30-671, 30-672, and 30-721 et seq., to acquire, possess, transfer, and use sources of radiation. The types of licenses issued by the Agency are described in R12-1-1302.

"Licensed material" means radioactive material received, possessed, used, transferred, or disposed of under a general or specific license issued by the Agency.

"Licensed practitioner" means a person licensed or otherwise authorized by law to practice medicine, dentistry, osteopathy, chiropractic, podiatry, or naturopathy in this state.

"Licensee" means any person who is licensed by the Agency under this Chapter to acquire, possess, transfer, or use sources of radiation.

"Licensing State" means any state having regulations equivalent to this Chapter relating to, and an effective program for the regulation of, naturally occurring and accelerator-produced radioactive material (NARM).

"Limits" ("See Dose limits").

"Local components" means those parts of an analytical x-ray system that are struck by x-rays, including radiation source housings, port and shutter assemblies, collimator, sample holders, cameras, goniometer, detectors and shielding but not including power supplies, transformers, amplifiers, readout devices, and control panels.

"Logging supervisor" means the individual who provides personal supervision of the utilization of sources of radiation at the well site.

"Logging tool" means a device used subsurface to perform well logging.

"Lost or missing licensed or registered source of radiation" means licensed or registered source of radiation the location of which is unknown. Included are licensed radioactive material or a registered radiation source that has been shipped but has not reached its planned destination and whose location cannot be readily traced or ascertained in the transportation system.

"Low-level waste" means waste material which contains radioactive nuclides in concentrations or quantities which exceed applicable standards for unrestricted release but does not include:

High-level waste, such as irradiated reactor fuel, liquid waste from reprocessing irradiated reactor fuel, or solids into which any such liquid waste has been converted;

Waste material containing transuranic elements with contamination levels greater than 10 nanocuries per gram (370 kilobecquerels per kilogram) of waste material;

The tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content.

"Major processor" means a user processing, handling, or manufacturing radioactive material exceeding Type A quantities as unsealed sources or material or exceeding four times Type B quantities as sealed sources but does not include nuclear medi-

cine programs, universities, industrial radiographers, or small industrial programs. Type A and B quantities are defined in 10 CFR 71.4, 2001 Edition, published January 1, 2001, incorporated by reference and on file with the Agency and the Office of the Secretary of State. This incorporation by reference contains no future editions or amendments.

"Medical dose" means a radiation dose intentionally delivered to an individual for medical examination, diagnosis, or treatment.

"Member of the public" means any individual except when that individual is receiving an occupational dose.

"MeV" means Mega Electron Volt which equals 1 million volts (10^6 eV).

"Mineral logging" means any well logging performed in a borehole drilled for the purpose of exploration for minerals other than oil or gas.

"Minor" means an individual less than 18 years of age.

"Monitoring" means the measurement of radiation, radio active material concentrations, surface area activities, or quantities of radioactive material, and the use of the results of these measurements to evaluate potential exposures and doses. For purposes of these rules, "radiation monitoring" and "radiation protection monitoring" are equivalent terms.

"Multiplier" means a letter representing a number. The use of a multiplier is based on the code given below:

Prefix	*Multiplier Symbol*	*Value*
eka	E	10^{18}
peta	P	10^{15}
tera	T	10^{12}
giga	G	10^{9}
mega	M	10^{6}
kilo	k	10^{3}
milli	m	10^{-3}
micro	u	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}
femto	f	10^{-15}
atto	a	10^{-18}

"NARM" means any naturally occurring or accelerator-produced radioactive material. It does not include byproduct, source, or special nuclear material. This term should not be confused with "NORM" which is defined as naturally occurring radioactive material.

"Normal operating procedures" means the entire set of instructions necessary to accomplish the intended use of the source of radiation. These procedures shall include, but are not limited to, sample insertion and manipulation, equipment alignment, routine maintenance by the licensee, and data recording procedures which are related to radiation safety.

"Natural radioactivity" means the radioactivity of naturally occurring radioactive substances.

"NRC" means Nuclear Regulatory Commission, the U.S. Nuclear Regulatory Commission, or its duly authorized representatives.

"Nuclear waste" means any highway route controlled quantity (defined in 49 CFR 173.403, 2001 Edition, published October 1, 2001, incorporated by reference and on file with the Agency and the Secretary of State, containing no future editions or amendments) of source, byproduct, or special nuclear material required to be in NRC-approved packaging while transported to, through, or across state boundaries to a disposal site, or to a collection point for transport to a disposal site. Additional requirements associated with transportation of radioactive material can be found in Article 15.

"Occupational dose" means the dose received by an individual in the course of employment in which the individual's assigned duties involve exposure to sources of radiation, whether in the possession of a licensee, registrant, or other person. Occupational dose does not include a dose received from background radiation, medical administration of radiation to the individual, exposure to an individual who has been administered radioactive material and released in accordance with R12-1-719, voluntary participation in a medical research program, or as a member of the public.

"Open beam system" means an analytical x-ray system in which an individual could place some body part in the primary beam path during normal operation.

"Package" means the packaging together with its radioactive contents as presented for transport.

"Particle accelerator" (see "Accelerator").

"Permanent radiographic installation" means a fixed, shielded installation or structure designed or intended for industrial radiography and in which industrial radiography is regularly performed.

"Personnel dosimeter" (see "Individual monitoring devices").

"Personnel monitoring equipment" (see "Individual monitoring devices").

"Personal supervision" means supervision in which the supervising individual is physically present at the site where sources of radiation and associated equipment are being used, watching the performance of the supervised individual and in such proximity that immediate assistance can be given if required.

"Pharmacist" means an individual licensed by this state to compound and dispense drugs, prescriptions, and poisons.

"Physician" means an individual licensed pursuant to A.R.S. Title 32, Chapters 13 or 17.

"Primary beam" means radiation which passes through an aperture of the source housing by a direct path from the x-ray tube or a radioactive source located in the radiation source housing.

"Public dose" means the dose received by a member of the public from radiation from radioactive material released by a licensee or registrant, or exposure to a source of radiation used in a licensed or registered operation. It does not include an occupational dose or a dose received from background radiation, medical administration of radiation to the individual, exposure to an individual who has been administered radioactive material and released in accordance with R12-1-719, or voluntary participation in a medical research program.

"Pyrophoric liquid" means any liquid that ignites spontaneously in dry or moist air at or below 130° F (54.4° C).

"Pyrophoric solid" means any solid material, other than one classed as an explosive, which under normal conditions is liable to cause fires through friction, retained heat from manufacturing or processing, or which can be ignited readily and, when ignited, burns so vigorously and persistently that it creates a serious transportation, handling, or disposal hazard. Included are spontaneously combustible and water-reactive materials.

"Qualified expert" means an individual certified in the appropriate field by the American Board of Radiology or the Ameri-

can Board of Health Physics, or having equivalent qualifications which provide the knowledge and training to measure ionizing radiation, to evaluate safety techniques, and to advise regarding radiation protection needs; or an individual certified in Therapeutic Radiological Physics or X-ray and Radium Physics by the American Board of Radiology, or having equivalent qualifications that provide training and experience in the clinical applications of radiation physics to radiation therapy, to calibrate radiation therapy equipment. The detailed requirements for a particular qualified expert are provided in the respective Articles of these rules.

"Quality Factor" (Q) means the modifying factor, listed in Tables I and II of this Article, that is used to derive dose equivalent from absorbed dose.

"Quarter" (see "calendar quarter").

"Rad" means the special unit of absorbed dose. One rad equals 100 ergs per gram, or 0.01 Gray.

"Radiation" means alpha particles, beta particles, gamma rays, x-rays, neutrons, high-speed electrons, high-speed protons, and other particles capable of producing ions. For purposes of these rules, this term is synonymous with ionizing radiation. Equivalent terminology for non-ionizing radiation is defined in Article 14.

"Radiation area" means any area accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.05 mSv (0.005 rem) in one hour at 30 centimeters from the source of radiation or from any surface that the radiation penetrates.

"Radiation dose" (see "Dose").

"Radiation machine" means any device capable of producing radiation except those devices with radioactive material as the only source of radiation.

"Radiation safety officer" (RSO) means the individual designated by the licensee or registrant who has the knowledge, authority, and responsibility to apply appropriate radiation protection principles to ensure radiation safety and compliance with the Act, this Chapter and any license, or registration conditions.

"Radioactive marker" means radioactive material placed subsurface or on a structure intended for subsurface use for the purpose of depth determination or direction orientation.

"Radioactive material" means any solid, liquid, or gas which emits radiation spontaneously.

"Radioactivity" means emission of electromagnetic energy or particles or both during the transformation of unstable atomic nuclei.

"Radiographer" means any individual who performs or personally supervises industrial radiographic operations and who is responsible to the licensee or registrant for assuring compliance with the requirements of this Chapter and all conditions of the license or certificate of registration.

"Radiographer's assistant" means any individual who, under the personal supervision of a radiographer, uses sources of radiation, radiographic exposure devices, related handling tools, or survey instruments in industrial radiography.

"Radiographic exposure device" means any instrument containing a sealed source, in which the sealed source or its shielding may be moved or otherwise changed from a shielded to unshielded position for purposes of making an industrial radiographic exposure.

"Registrant" means any person who is registered with the Agency and is legally obligated to register with the Agency pursuant to these rules and the Act.

"Registration" is the process by which a person becomes a registrant pursuant to Article 2 of this Chapter. With the exception of registration of persons who install or service radiation machines, the types of registrations issued by the Agency are described in R12-1-1302.

"Regulations of the U.S. Department of Transportation" means the federal regulations in 49 CFR 100 through 199, 1995 Edition, published October 1, 1995, incorporated by reference and on file with the Agency and the Office of the Secretary of State. This incorporation by reference contains no future editions or amendments.

"Rem" means the special unit of dose equivalent (see "Dose equivalent"). The dose equivalent in rem is equal to the absorbed dose in rad multiplied by the quality factor (1 rem - 0.01 sievert).

"Research and Development" means exploration, experimentation, or the extension of investigative findings and theories of a scientific or technical nature into practical application for experimental and demonstration purposes, including the experimental production and testing of models, devices, equipment, materials, and processes. Research and Development does not include the internal or external administration of radiation or radioactive material to human beings.

"Restricted area" means any area where the licensee or registrant controls access for purposes of protecting individuals from exposure to radiation and radioactive material. A restricted area does not include any areas used for residential quarters, although a room or separate rooms in a residential building may be set apart as a restricted area.

"Roentgen" (R) means the special unit of exposure and is equal to the quantity of x or gamma radiation which causes ionization in air equal to 258 microcoulomb per kilogram (see "Exposure").

"Safety system" means any device, program, or administrative control designed to ensure radiation safety.

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

"Shallow dose equivalent" (H_S), which applies to the external exposure of the skin or an extremity, means the dose equivalent at a tissue depth of 0.007 centimeter (7 mg/cm^2) averaged over an area of 1 square centimeter.

"Shielded position" means the location within a radiographic exposure device or storage container which, by manufacturer's design, is the proper location for storage of the sealed source.

"Sievert" means the SI unit of dose equivalent (see "Dose equivalent"). The dose equivalent in sievert is equal to the absorbed dose in gray multiplied by the quality factor (1 Sv = 100 rem).

"Site boundary" means that line beyond which the land or property is not owned, leased, or otherwise controlled by the licensee or registrant.

"Source changer" means a device designed and used for replacement of sealed sources in radiographic exposure devices, including those also used for transporting and storage of sealed sources.

"Source holder" means a housing or assembly into which a radioactive source is placed for the purpose of facilitating the handling and use of the source in well-logging operations.

"Source material" means:

Uranium or thorium, or any combination of uranium or thorium, in any physical or chemical form; or

Ores that contain by weight 1/20 of 1% (0.05%) or more of uranium, thorium, or any combination of uranium and thorium.

Source material does not include special nuclear material.

"Source material milling" means any activity that results in the production of byproduct material as defined by the second subsection under the definition of "Byproduct material."

"Source of radiation" or "source" means any radioactive material or any device or equipment emitting, or capable of producing, radiation.

"Special form radioactive material" means radioactive material that satisfies all of the following conditions:

It is either a single solid piece or is contained in a sealed capsule that can be opened only by destroying the capsule;

The piece or capsule has at least one dimension not less than 5 millimeters (0.2 inch); and

It satisfies the test requirements specified in 10 CFR 71, 2000 Edition, published January 1, 2000, incorporated by reference in this rule and on file with the Agency and the Office of the Secretary of State. This incorporation by reference contains no future editions or amendments. A special form encapsulation designed in accordance with the U.S. Nuclear Regulatory Commission requirements in effect on June 30, 1983, and constructed prior to July 1, 1985, may continue to be used. A special form encapsulation constructed after June 30, 1985, shall meet requirements of this definition applicable at the time of its construction.

"Special nuclear material in quantities not sufficient to form a critical mass" means Uranium enriched in the isotope U-235 in quantities not exceeding 350 grams of contained U-235; Uranium-233 in quantities not exceeding 200 grams; Plutonium in quantities not exceeding 200 grams; or any combination of them in accordance with the following formula: for each kind of special nuclear material, determine the ratio between the quantity of that special nuclear material and the quantity specified above for the same kind of special nuclear material. The sum of such ratios for all of the kinds of special nuclear material in combination shall not exceed 1. For example, the following quantities in combination would not exceed the limitation and are within the formula:

$$\frac{XgmsU235}{350} + \frac{YgmsU233}{200} + \frac{ZgmsPu}{200} \leq I$$

"Storage area" means any location, facility, or vehicle which is used to store, transport, or secure a radiographic exposure device, storage container, sealed source, or other source of radiation when it is not in use.

"Storage container" means a device in which sealed sources are transported or stored.

"Subsurface tracer study" means the release of a substance tagged with radioactive material for the purpose of tracing the movement or position of the tagged substance in the well-bore or adjacent formation.

"Survey" means an evaluation of the production, use, release, disposal, or presence of sources of radiation or any combination thereof under a specific set of conditions to determine actual or potential radiation hazards. Such evaluations include, but are not limited to, tests, physical examination and measurements of levels of radiation or concentration of radioactive material present.

"TEDE" means Total Effective Dose Equivalent, the sum of the deep-dose equivalent for external exposures and the committed effective dose equivalent for internal exposures.

"Teletherapy" means therapeutic irradiation in which the source of radiation is at a distance from the body.

"Temporary job site" means any location where sources of radiation are used other than the specified locations listed on a license document. Storage of sources of radiation at a temporary jobsite shall not exceed six months unless the Agency has granted an amendment authorizing storage at that jobsite.

"Test" means the process of verifying compliance with an applicable rule, order, or license condition.

"These rules" means all Articles of 12 A.A.C. 1.

"Total Effective Dose Equivalent" (TEDE) means total effective dose equivalent, the sum of the deep-dose equivalent for external exposures and the committed effective dose equivalent for internal exposures.

"Total Organ Dose Equivalent" (TODE) means total organ dose equivalent, the sum of the deep-dose equivalent and the committed dose equivalent to the organ receiving the highest dose as described in R12-1-419(D)(1)(d) of these rules.

"Unrefined and unprocessed ore" means ore in its natural form prior to any processing, such as grinding, roasting, beneficiating, or refining.

"Unrestricted area" means any area access to which is not controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive material. Any area used for residential quarters is an unrestricted area.

"U.S. Department of Energy" means the Department of Energy established by Public Law 95-91, August 4, 1977, 91 Stat. 565, 42 U.S.C. 7101 et seq., to the extent that the Department exercises functions formerly vested in the U.S. Atomic Energy Commission, its Chairman, members, officers, and components; and transferred to the U.S. Energy Research and Development Administration and to the administrator of that agency under Sections 104(b), (c), and (d) of the Energy Reorganization Act of 1974 (Public Law 93-438, October 11, 1974, 88 Stat. 1233 at 1237, 42 U.S.C. 5814, effective January 19, 1975) and retransferred to the Secretary of Energy under Section 301(a) of the Department of Energy Organization Act (Public Law 95-91, August 4, 1977, 91 Stat. 565 at 577-578, 42 U.S.C. 7151, effective October 1, 1977).

"Waste" (see "Low-level waste").

"Waste handling licensees" means persons licensed to receive and store radioactive wastes prior to disposal and persons licensed to dispose of radioactive waste.

"Week" means seven consecutive days starting on Sunday.

"Well-bore" means a drilled hole in which wireline service operations and subsurface tracer studies are performed.

"Well-logging" means the lowering and raising of measuring devices or tools which may contain sources of radiation into well-bores or cavities for the purpose of obtaining information about the well and adjacent formations.

"Whole body" means, for purposes of external exposure, head, trunk including male gonads, arms above the elbow, or legs above the knee.

"Wireline" means an armored cable containing one or more electrical conductors which is used to lower and raise logging tools in the well-bore.

"Wireline service operation" means any evaluation or mechanical service which is performed in the well-bore using devices on a wireline.

"Worker" means any individual engaged in work under a license issued by the Agency and controlled by employment or contract with a licensee.

"WL" means working level, any combination of short-lived radon daughters in 1 liter of air that will result in the ultimate emission of 1.3E + 5 MeV of potential alpha particle energy. The short-lived radon daughters are -- for radon-222: polonium-218, lead-214, bismuth-214, and polonium-214; and for radon-220: polonium-216, lead-212, bismuth-212, and polonium-212.

"WLM" means working level month, an exposure to one working level for 170 hours (2,000 working hours per year divided by 12 months per year is approximately equal to 170 hours per month).

"Workload" means the degree of use of an x-ray or gamma-ray source per unit time.

"Year" means the period of time beginning in January used to determine compliance with the provisions of these rules. The licensee or registrant may change the starting date of the year used to determine compliance by the licensee or registrant provided that the change is made at the beginning of the year and that no day is omitted or duplicated in consecutive years.

Historical Note

Former Rule Section A.2. Former Section R12-1-102 repealed, new Section R12-1-102 adopted effective June 30, 1977 (Supp. 77-3). Amended effective November 19, 1982 (Supp. 82-6). Amended effective February 25, 1985 (Supp. 85-1). Amended by adding a new paragraph (31), subparagraph (w) and renumbering the former paragraph (31), subparagraphs (w) through (z) accordingly effective November 28, 1986 (Supp. 86-6). Amended by adding a new paragraph (34) and renumbering the former paragraphs (34) through (68) accordingly effective June 26, 1987 (Supp. 87-2). Amended effective April 2, 1990 (Supp. 90-2). Amended effective November 5, 1993 (Supp. 93-4). Amended effective February 18, 1994 (Supp. 94-1). Amended effective August 10, 1994 (Supp. 94-3). Amended effective January 2, 1996 (Supp. 96-1). Amended effective June 13, 1997 (Supp. 97-2). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Amended by final rulemaking at 9 A.A.R. 1126, effective May 9, 2003 (Supp. 03-1). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-103. Exemptions

A. Common and contract carriers, freight forwarders, and warehousemen who are subject to 49 CFR 107.109, 107.111, 107.113, 171.2, 171.3, 172.200, 173.1, 173.3, 173.4, 173.401, 175.3, 175.5, 175.10, 176.3, 176.5, 176.11, 176.24, 176.27, and 177.801, 2000 Edition, published October 1, 2000, of the U.S. Department of Transportation, or 39 CFR 111.1 of the U.S. Postal Service, 2001 Edition, published January 1, 2001, incorporated by reference and on file with the Agency and the Office of the Secretary of State, are exempt from this Chapter. In addition, they are exempt from this Chapter to the extent that they store radioactive material, for periods of less than 72 hours, in the regular course of their carriage for another. Private carriers who are subject to the regulations of the U.S. Department of Transportation are exempt from this Chapter to the extent that they transport radioactive material. Common, contract, and private carriers who are not subject to the regulations of the U.S. Department of Transportation or the U.S. Postal Service are subject to this Chapter. The above incorporation by reference contains no future editions or amendments.

B. Any U.S. Department of Energy contractor or subcontractor and any U.S. Nuclear Regulatory Commission contractor or subcontractor of the following categories operating within this state are exempt from this Chapter to the extent that such contractor or subcontractor under the contract receives, possesses, uses, transfers, or acquires sources of radiation:

1. Prime contractors performing work for the Department of Energy at U.S. Government-owned or controlled sites, including the transportation of sources of radiation to or from such sites and the performance of contract services during temporary interruptions of such transportation;
2. Prime contractors of the Department of Energy performing research or development, manufacture, storage, testing or transportation of nuclear weapons or components thereof;
3. Prime contractors of the Department of Energy using or operating nuclear reactors or other nuclear devices in a United States Government-owned vehicle or vessel; and
4. Any other prime contractor or subcontractor of the Department of Energy or of the Nuclear Regulatory Commission when the state and the Nuclear Regulatory Commission jointly determine:
   a. That the exemption of the prime contractor or subcontractor is authorized by law; and
   b. That under the terms of the contract or subcontract, there is adequate assurance that the work thereunder can be accomplished without undue risk to the public health and safety.

C. Any licensee who delivers to a carrier for transport any package which contains radioactive material having a specific activity of 74 kBq/kg (2 nanocuries per gram) or less, is exempt from the provisions of this Chapter with respect to that package.

Historical Note

Former Rule Section A.3; Former Section R12-1-103 repealed, new Section R12-1-103 adopted effective June 30, 1977 (Supp. 77-3). Amended effective April 2, 1990 (Supp. 90-2). Amended effective August 10, 1994 (Supp. 94-3). Amended effective June 13, 1997 (Supp. 97-2). Amended by final rulemaking at 9 A.A.R. 1126, effective May 9, 2003 (Supp. 03-1).

R12-1-104. Prohibited Uses

A. A person shall not use the following fluoroscopic devices:

1. Hand-held fluoroscopic screens,
2. Shoe-fitting fluoroscopic devices.

B. Except as specifically authorized by law, a person shall not use sources of ionizing radiation for the purpose of screening an individual or inspecting an individual for:

1. Concealed weapons,
2. Hazardous materials,
3. Stolen property, or
4. Contraband.

C. Unless there is a medical or dental indication for the exposure and the exposure is prescribed by a licensed practitioner, a per-

son shall not deliberately expose an individual to the useful beam from:

1. An ionizing radiation machine; or
2. A non-ionizing radiation source, having a radiation beam known to be harmful to human tissue.

Historical Note

Former Rule Section A.4; Former Section R12-1-104 repealed, new Section R12-1-104 adopted effective June 30, 1977 (Supp. 77-3). Former Section R12-1-104 repealed, new Section R12-1-104 renumbered from R12-1-112 and amended effective April 2, 1990 (Supp. 90-2). Amended effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 9 A.A.R. 1126, effective May 9, 2003 (Supp. 03-1).

R12-1-105. Quality Factors for Converting Absorbed Dose to Dose Equivalent

A. As used in these rules, the quality factors for converting absorbed dose to dose equivalent are shown in Table I.

TABLE I
QUALITY FACTORS AND ABSORBED DOSE EQUIVALENCIES

TYPE OF RADIATION	Quality Factor (Q)	Absorbed Dose Equal to a Unit Dose Equivalent[a]
X, gamma, or beta radiation and high-speed electrons		1
Alpha particles, multiple-charged particles, fission fragments, and heavy particles of unknown charge	20	0.05
Neutrons of unknown energy	10	0.1
High-energy protons	10	0.1

[a]The absorbed dose in gray is equal to 1 Sv or the absorbed dose in rad is equal to 1 rem.

B. If it is more convenient to measure the neutron fluence rate than to determine the neutron dose equivalent rate in sievert per hour or rem per hour, 0.01 Sv (1 rem) of neutron radiation of unknown energies may, for purposes of these rules, be assumed to result from a total fluence of 25 million neutrons per square centimeter incident upon the body. If sufficient information exists to estimate the approximate energy distribution of the neutrons, the licensee or registrant may use the fluence rate per unit dose equivalent or the appropriate Q value from Table II to convert a measured tissue dose in gray or rad to dose equivalent in sievert or rem.

TABLE II
MEAN QUALITY FACTORS, Q, AND FLUENCE PER UNIT DOSE EQUIVALENT FOR MONOENERGETIC NEUTRONS

	Neutron Energy (meV)	Quality Factor (Q)	Fluence per Unit Dose Equivalent[b] (neutrons cm^{-2} $^{r}em^{-1}$)	Fluence per Unit Dose Equivalent[b] (neutrons cm^{-2} $^{S}v^{-1}$)
(thermal)	2.5E-8	2	980E+6	980E+8
	1E-7	2	980E+6	980E+8
	1E-6	2	810E+6	810E+8
	1E-5	2	810E+6	810E+8
	1E-4	2	840E+6	840E+8
	1E-3	2	980E+6	980E+8
	1E-2	2.5	1010E+6	1010E+8
	1E-1	7.5	170E+6	170E+8
	5E-1	11	39E+6	39E+8
	1	11	27E+6	27E+8
	2.5	9	29E+6	29E+8
	5	8	23E+6	23E+8
	7	7	24E+6	24E+8
	10	6.5	24E+6	24E+8
	14	7.5	17E+6	17E+8
	20	8	16E+6	16E+8
	40	7	14E+6	14E+8
	60	5.5	16E+6	16E+8
	1E+2	4	20E+6	20E+8
	2E+2	3.5	19E+6	19E+8
	3E+2	3.5	16E+6	16E+8
	4E+2	3.5	14E+6	14E+8

[a] Value of quality factor (Q) at the point where the dose equivalent is maximum in a 30-centimeter diameter cylinder tissue-equivalent phantom.
[b] Monoenergetic neutrons incident normally on a 30-centimeter diameter cylinder tissue-equivalent phantom.

Historical Note
Former Rule Section A.5; Former Section R12-1-105 repealed, new Section R12-1-105 adopted effective June 30, 1977 (Supp. 77-3). Section repealed effective April 2, 1990 (Supp. 90-2). New Section adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 9 A.A.R. 1126, effective May 9, 2003 (Supp. 03-1).

R12-1-106. Units of Activity
For purposes of these rules, activity is expressed in the SI unit of becquerel (Bq) or in the special unit of curie (Ci), or their multiples, or disintegrations or transformations per unit of time. The definitions for these units are located in R12-1-102.

Historical Note
Former Rule Section A.6; Former Section R12-1-1-6 repealed, new Section R12-1-106 adopted effective June 30, 1977 (Supp. 77-3). Section repealed effective April 2, 1990 (Supp. 90-2). New Section adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 9 A.A.R. 1126, effective May 9, 2003 (Supp. 03-1).

R12-1-107. Misconduct

A. A licensee, registrant, applicant for a license or certificate of registration, or employee of a licensee, registrant, or applicant; or any contractor (including a supplier or consultant), subcontractor, or employee of a contractor or subcontractor of any licensee or certificate of registration holder who provides to any licensee, registrant, applicant, contractor, or subcontractor, any components, equipment, materials, or other goods or services that relate to a licensee's, registrant's, or applicant's activities in this Chapter, shall not:
1. Knowingly engage in conduct that violates or will result in a violation by a licensee, registrant, or applicant, of any statute, rule, regulation, or order; or any term, condition, or limitation of any license or registration issued by the Agency; or
2. Knowingly submit to the Agency, or a licensee, registrant, or applicant, or a licensee's, registrant's, or applicant's contractor or subcontractor, information that is incomplete or inaccurate.

B. The Board shall impose the applicable civil penalty listed in R12-1-1216 on a person who violates subsection (A)(1) or (A)(2). For this purpose the person is classified as a Division II licensee and the violation is classified as a Severity II violation.

C. For the purposes of this Section, "misconduct" means conduct prohibited under subsection (A).

D. A person who is not a licensee, registrant, or applicant and knowingly violates a rule for the safe use of radiation sources in 12 A.A.C.1 is subject to the enforcement actions in 12 A.A.C. 1, Article 12.

Historical Note
Former Rule Section A.7; Former Section R12-1-107 repealed, new Section R12-1-107 adopted effective June 30, 1977 (Supp. 77-3). Section repealed effective April 2, 1990 (Supp. 90-2). New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-108. Repealed

Historical Note
Former Rule Section A.8; Former Section R12-1-108 repealed, new Section R12-1-108 adopted effective June 30, 1977 (Supp. 77-3). Change of address (Supp. 85-6). Section repealed effective April 2, 1990 (Supp. 90-2).

R12-1-109. Repealed

Historical Note
Adopted effective June 30, 1977 (Supp. 77-3). Section repealed effective April 2, 1990 (Supp. 90-2).

R12-1-110. Repealed

Historical Note
Adopted effective June 30, 1977 (Supp. 77-3). Section repealed effective April 2, 1990 (Supp. 90-2).

R12-1-111. Repealed

Historical Note
Adopted effective June 30, 1977 (Supp. 77-3). Section repealed effective April 2, 1990 (Supp. 90-2).

R12-1-112. Renumbered

Historical Note
Adopted effective June 30, 1977 (Supp. 77-3). Former Section R12-1-112 renumbered to R12-1-104 effective April 2, 1990 (Supp. 90-2).

Appendix A. Repealed

Historical Note
Adopted effective June 30, 1977 (Supp. 77-3). Repealed effective August 10, 1994 (Supp. 94-3).

Appendix B. Repealed

Historical Note
Adopted effective June 30, 1977 (Supp. 77-3). Repealed effective August 10, 1994 (Supp. 94-3).

ARTICLE 2. REGISTRATION, INSTALLATION, AND SERVICE OF IONIZING RADIATION-PRODUCING MACHINES; AND CERTIFICATION OF MAMMOGRAPHY FACILITIES

R12-1-201. Exemptions

A. Electronic equipment that produces X-radiation incidental to its operation for other purposes is exempt from the registration and notification requirements of this Article, provided that an exposure rate, from any accessible surface, averaged over an area of 10 square centimeters (1.55 in.2) does not exceed 129µC/kg per hour (0.5 milliroentgen per hour) at 5 cm (2.0 in.). The production, testing, or factory servicing of electronic equipment that produces X-radiation incident to its operation is not exempt.

B. Radiation machines in storage or in transit to or from storage are exempt from the requirements of this Article.

C. Radiation machines rendered incapable of producing radiation are exempt from this Article.

Historical Note
Former Rule Section B.3. Former Section R12-1-203 repealed, new Section R12-1-203 adopted effective June 30, 1977 (Supp. 77-3). Former Section R12-1-201 repealed, former Section R12-1-203 renumbered as R12-1-201 and amended effective November 22, 1988 (Supp. 88-4). Amended effective January 2, 1996 (Supp. 96-1). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-202. Application for Registration of Ionizing Radiation Producing Machines

A. A person shall not use a radiation machine except as authorized in this Article.

B. A person possessing a nonexempt radiation machine shall apply for registration of the machine with the Agency within 30 days after its installation. The person applying for registration of a radiation-producing machine shall use the application forms provided by the Agency. The applicant shall provide the information identified in Appendix A of this Article.

C. In addition to the application form or forms, the applicant shall remit the appropriate registration or licensing fee in R12-1-1306 and provide other information required by R12-1-208.

D. Each applicant that applies for registration of a stationary x-ray system, with the exception of applicants from bone densitometry, cabinet radiography, podiatry, dental, bone mineral analyzer and mammography facilities, shall provide a scale drawing of the room in which the x-ray system is located, or provide measurements from the radiation source to the surrounding barrier surfaces. The drawing shall denote the type of materials and the thickness (or lead equivalence) of each barrier of the room (walls, ceilings, floors, doors, windows). The drawing shall also denote the type and frequency of occupancy in adjacent areas, including those above and below the x-ray room of concern (e.g., hallways, offices, parking lots, and laboratories). Estimates of workload shall also be provided with the drawing.

E. An applicant proposing to use a particle accelerator for medical purposes shall not use the particle accelerator until the Agency inspection required in R12-1-914 has been completed.

Historical Note
Former Rule Section B.4. Former Section R12-1-204 repealed, new Section R12-1-204 adopted effective June 30, 1977 (Supp. 77-3). Former Section R12-1-202 repealed, former Section R12-1-204 renumbered as R12-1-202 and amended effective November 22, 1988 (Supp. 88-4). Amended effective January 2, 1996 (Supp. 96-1). Amended effective June 13, 1997 (Supp. 97-2). Amended by final rulemaking at 5 A.A.R. 1817, effective June 11, 1999 (Supp. 99-2). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-203. Application for Registration of Servicing and Installation

A. Each person who is engaged in the business of installing or offering to install radiation machines or is engaged in the business of furnishing or offering to furnish radiation machine servicing or services in this state shall apply for registration. If registration is required, any subsequent application shall be submitted before furnishing or offering to furnish any radiation machine service or installation.

B. Application for registration shall be completed on forms furnished by the Agency and shall contain all information required by A.R.S. § 30-672.01.

Historical Note
Former Rule Section B.5. Former Section R12-1-205 repealed, new Section R12-1-205 adopted effective June 30, 1977 (Supp. 77-3). Former Section R12-1-205 renumbered as R12-1-203 and amended effective November 22, 1988 (Supp 88-4). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-204. Issuance of Notice of Registration

A. Upon determining that the application meets the requirements of the Act and this Article, the Agency shall issue a Notice of Registration.

B. All radiation machines located at the same facility may be registered using one Notice of Registration.

Historical Note
Former Rule Section B.6. Former Section R12-1-206 repealed, new Section R12-1-206 adopted effective June 30, 1977 (Supp. 77-3). Former Section R12-1-206 renumbered as R12-1-204 and amended effective November 22, 1988 (Supp. 88-4). Amended effective January 2, 1996 (Supp. 96-1). Amended effective June 13, 1997 (Supp. 97-2).

R12-1-205. Expiration of Notice of Registration or Certification

A Notice of Registration, or certificate issued according to R12-1-208, expires at the end of the day on the date stated in the Notice of Registration or certificate unless the registrant or certificate holder, not less than 30 days prior to the expiration of the Notice of Registration or certificate, files a complete application for renewal. If a timely application for renewal is filed, the Notice of Registration or certificate does not expire until the application status is finally determined by the Agency.

Historical Note
Former Rule Section B.7. Former Section R12-1-207 repealed, new Section R12-1-207 adopted effective June 30, 1977 (Supp. 77-3). Former Section R12-1-207 renumbered as R12-1-205 and amended effective November 22, 1988 (Supp. 88-4). Amended effective January 2, 1996 (Supp. 96-1). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-206. Assembly, Installation, Removal from Service, and Transfer

A. A person who assembles, or installs ionizing radiation machines in this state shall notify the Agency in writing within 15 days of:
1. The name and address of the person possessing the machine that was assembled or installed;
2. The manufacturer, model, and serial number of each radiation machine with the tube housing model number and serial number, maximum kVp, and maximum mA, assembled or installed; and
3. The date each machine was assembled or installed, or the first clinical procedure is performed.

B. Any person who possesses a radiation machine registered by the Agency shall notify the Agency within 15 days of the machine being taken out of service. The written notification shall contain the name and address of the person receiving the machine, if it is sold, leased, or transferred to another person; the manufacturer, model, and serial number of the machine; and the date the machine was taken out of service.

C. In the case of diagnostic x-ray systems that contain certified components, an assembler shall submit to the Agency a copy of the assembler's report (FDA Report No. 2579) prepared in compliance with requirements in 21 CFR 1020.30(d), 2000 Edition, published April 1, 2000 by the Office of the Federal Register, National Archives and Records Administration, incorporated by reference and on file with the Agency, containing no future editions or amendments, within 15 days following completion of the assembly. The report shall suffice in lieu of any other report by the assembler, if it contains the information required in subsection (A)(2).

D. A person shall not make, sell, lease, transfer, lend, assemble, service, or install radiation machines or the supplies used in connection with radiation machines unless the supplies and equipment when properly placed in operation and used, meet the requirements of these rules.

Historical Note
Adopted effective June 30, 1977 (Supp. 77-3). Former Section R12-1-209 renumbered as Section R12-1-206 and amended effective November 22, 1988 (Supp. 88-4). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-207. Reciprocal Recognition of Out-of-state Radiation Machines

A. If any radiation machine is to be brought into the state for temporary use, the person proposing to bring the radiation machine into the state shall provide written notice to the Agency at least three working days before the radiation machine is to be used in the State. The notice shall include the type of radiation machine; the nature, duration, and scope of use; and the exact location where the radiation machine is to be used. If, for a specific case, the three working-day period would impose an undue hardship, the person may upon application to the Agency, obtain permission to proceed sooner.

B. In addition, the owner of the radiation machine and the person possessing the machine while in the state shall:
1. Comply with all applicable rules of the Agency,
2. Upon request, supply the Agency with a copy of the machine's registration and other information regarding the safe operation of a machine while it is in the state; and
3. Upon request, supply the Agency with the work authorization from the Agency, machine registration, operating and emergency procedures, utilization log, survey instrument and associated calibration record, and training records for all users.

C. A radiation machine shall not be operated within the state on a temporary basis in excess of 180 calendar days per year.

Historical Note
Adopted effective June 30, 1977 (Supp. 77-3). Former Section R12-1-210 renumbered as Section R12-1-207 and amended effective November 22, 1988 (Supp. 88-4). Amended effective January 2, 1996 (Supp. 96-1). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-208. Certification of Mammography Facilities

An applicant seeking certification of a facility according to A.R.S. § 30-672(J) shall:
1. Provide evidence with the application that a quality assurance program has been established and is in use for the items listed in Appendix B of 12 A.A.C. 1, Article 6,
2. Provide evidence with the application that physicians reading mammographic images have the training and experience required in A.R.S. § 32-2842(A); and,
3. Provide evidence with the application that physicians reading mammographic images have met the minimum criteria established by their respective licensing boards, as required in A.R.S. § 32-2842(C).

Historical Note
Adopted effective June 30, 1977 (Supp. 77-3). Repealed effective November 22, 1988 (Supp. 88-4). New Section adopted effective January 2, 1996 (Supp. 96-1). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-209. Licensing Requirements for Nonionizing Radiation Machine Facilities

A. No person shall receive, possess, use, or transfer a nonexempt nonionizing radiation machine except as authorized pursuant to this Article.

B. The owner or persons having possession of any nonexempt nonionizing radiation machine shall apply for licensure with the Agency within 90 days following the effective date of this Article. Subsequent applications for license shall be submitted within 30 days after acquisition of a nonexempt nonionizing radiation producing machine. The application shall be on the form as prescribed in Appendix A in Article 2.

C. The licensee shall notify the Agency within 30 days of any change to the information contained in the license application.

D. In addition to the application form, the applicant shall remit the appropriate license fee, pursuant to R12-1-1303, and such other information as may be required to comply with Article 14.

Historical Note
Adopted effective January 2, 1996 (Supp. 96-1).

Appendix A. Application Information

An application shall contain the following information as required in R12-1-202(B), before a registration will be issued. The Agency shall provide an application form to an applicant with a guide, if

available, or shall assist the applicant to ensure that only correct information is provided on the application.

Name and mailing address of applicant	Use location
Person responsible for radiation safety program	Telephone number
Type of facility	Facility subtype
Legal structure and ownership	Signature of certifying agent
Radiation machine information	Equipment identifiers
Shielding information	Scale drawing, if applicable
Equipment operator instructions and restrictions	Physicist name and training, if applicable
Classification of professional in charge	
Record of calibration for therapy units	Type of request: amendment, new, or renewal
Protection survey results, if applicable	
Type of industrial radiography program, if applicable	
Radiation Safety Officer name, if applicable	Contact person
Other registration requirements listed in Articles 2, 6, 8, and 9	Appropriate fee listed in Article 13 schedule

Historical Note
Appendix repealed; new Appendix made by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

ARRA-4. Repealed

Historical Note
Appendix A, Form ARRA-4 adopted effective November 22, 1988 (Supp. 88-4). Appendix A, Form ARRA-4 repealed, new Form ARRA-4 adopted effective April 17, 1996 (Supp. 96-2). Repealed by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

ARRA-4X. Repealed

Historical Note
Form ARRA-4X adopted effective April 17, 1996 (Supp. 96-2). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Repealed by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

ARRA-4XT. Repealed

Historical Note
Form ARRA-4XT adopted effective April 17, 1996 (Supp. 96-2). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Repealed by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

ARRA-4PAT. Repealed

Historical Note
Form ARRA-4PAT adopted effective April 17, 1996 (Supp. 96-2). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Repealed by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

ARRA-4IG. Repealed

Historical Note
Form ARRA-4IG adopted effective April 17, 1996 (Supp. 96-2). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Repealed by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

ARRA-4IR. Repealed

Historical Note
Form ARRA-4IR adopted effective April 17, 1996 (Supp. 96-2). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Repealed by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

ARRA-4PAR. Repealed

Historical Note
Form ARRA-PAR adopted effective April 17, 1996 (Supp. 96-2). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Repealed by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

ARRA-4PA. Repealed

Historical Note
Form ARRA-4PA adopted effective April 17, 1996 (Supp. 96-2). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

ARRA-13. Repealed

Historical Note
Form ARRA-13 adopted effective April 17, 1996 (Supp. 96-2). Repealed by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

ARRA-1004. Repealed

Historical Note
Form ARRA-1004 adopted effective April 17, 1996 (Supp. 96-2). Repealed by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

ARRA-1005. Repealed

Historical Note
Form ARRA-1005 adopted effective April 17, 1996 (Supp. 96-2). Repealed by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

ARRA-1030. Repealed

Historical Note
Form ARRA-1030 adopted effective April 17, 1996 (Supp. 96-2). Repealed by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

ARRA-1050. Repealed

Historical Note
Form ARRA-1050 adopted effective April 17, 1996 (Supp. 96-2). Repealed by final rulemaking at 7 A.A.R.

2584, effective June 8, 2001 (Supp. 01-2).

ARRA-1070. Repealed

Historical Note
Form ARRA-1070 adopted effective April 17, 1996 (Supp. 96-2). Repealed by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

ARRA-1090. Repealed

Historical Note
Form 1090 adopted effective April 17, 1996 (Supp. 96-2). Repealed by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

ARTICLE 3. RADIOACTIVE MATERIAL LICENSING

R12-1-301. Ownership, Control, or Transfer of Radioactive Material

A. In addition to the requirements of this Article, all licensees are subject to the requirements of 12 A.A.C. 1, Article 1, Article 4 and Article 10. Licensees engaged in industrial radiographic operations are subject to the requirements of 12 A.A.C. 1, Article 5; licensees using radioactive material in the healing arts are subject to the requirements of 12 A.A.C. 1, Article 7; licensees transporting radioactive material are subject to the requirements contained in 12 A.A.C. 1, Article 15.

B. Notwithstanding any other provisions of this Article, any person may own radioactive material, provided that the ownership does not include the actual possession, custody, use or physical transfer of radioactive material or the manufacture or production of any article containing radioactive material without the applicable certification, license or registration.

C. A manufacturer, processor, or producer of any equipment, device, commodity, or other product containing source material or byproduct material whose subsequent possession, use, transfer, or disposal by all other persons is exempt from regulatory requirements may only obtain authority to transfer possession or control of the material from the U.S. Nuclear Regulatory Commission, Washington, D.C. 20555.

Historical Note
Former Rule Section C.1. Former Section R12-1-301 repealed, new Section R12-1-301 adopted effective June 30, 1977 (Supp. 77-3). Amended effective December 20, 1985 (Supp. 85-6). Former Section R12-1-301 renumbered to R12-1-322, new Section R12-1-301 adopted effective February 18, 1994 (Supp. 94-1). Former Section R12-1-301 repealed; new Section R12-1-301 renumbered from R12-1-302 and amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-302. Source Material; Exemptions

A. Any person is exempt from this Article to the extent the person receives, possesses, uses, or transfers source material in any chemical mixture, compound, solution, or alloy in which the source material is by weight less than 1/20th of 1 percent (0.05 percent) of the mixture, compound, solution, or alloy.

B. Any person is exempt from this Article to the extent the person receives, possesses, uses, or transfers unrefined and unprocessed ore containing source material, provided that, the person does not refine or process the ore except as authorized in a specific license.

C. Any person is exempt from this Article if the person receives, possesses, uses, or transfers:

1. Any quantities of thorium contained in:
   a. Incandescent gas mantles;
   b. Vacuum tubes;
   c. Welding rods;
   d. Electric lamps for illuminating purposes provided that each lamp does not contain more than 50 milligrams of thorium;
   e. Germicidal lamps, sunlamps, and lamps for outdoor or industrial lighting, provided that each lamp does not contain more than 2 grams of thorium;
   f. Rare earth metals, compounds, mixtures, or products containing not more than 0.25 percent by weight thorium, uranium, or any combination of thorium and uranium; or
   g. Individual neutron dosimeters, provided that each dosimeter does not contain more than 50 milligrams of thorium;
2. Source material contained in the following products:
   a. Glazed ceramic tableware, provided that the glaze contains not more than 20 percent source material by weight;
   b. Glassware, glass enamel and glass enamel frit containing not more than 10 percent source material by weight, but not including commercially manufactured glass brick, pane glass, ceramic tile or other glass, glass enamel or ceramic used in construction; or
   c. Piezoelectric ceramic containing not more than 2 percent source material by weight;
3. Photographic film, negatives, and prints containing uranium or thorium;
4. Any finished product or part fabricated of, or containing, tungsten-thorium or magnesium-thorium alloys, provided that the thorium content of the alloy does not exceed 4 percent by weight and that the exemption contained in this subsection does not authorize the chemical, physical, or metallurgical treatment or processing of the finished product or part;
5. Uranium contained in counterweights installed in aircraft, rockets, projectiles, and missiles, or stored or handled in connection with installation or removal of counterweights, provided that:
   a. The counterweights are manufactured in accordance with a specific license issued by the U.S. Nuclear Regulatory Commission, authorizing distribution by the licensee according to 10 CFR 40;
   b. Each counterweight has been impressed with the following legend clearly legible through any plating or other covering: "DEPLETED URANIUM";
   c. Each counterweight is durably and legibly labeled or marked with the identification of the manufacturer and the statement: "UNAUTHORIZED ALTERATIONS PROHIBITED";
   d. The exemption contained in this item does not authorize the chemical, physical, or metallurgical treatment or processing of any counterweight other than repair or restoration of any plating or other covering; and
   e. The requirements specified in subsections (C)(5)(b) and (c) do not apply to counterweights manufactured prior to December 31, 1969; provided, that these counterweights are impressed with the legend, "CAUTION -- RADIOACTIVE MATERIAL -- URANIUM."
6. Natural or depleted uranium metal used as shielding and constituting part of any shipping container; provided that:
   a. The shipping container is conspicuously and legibly impressed with the legend "CAUTION -- RADIOACTIVE SHIELDING -- URANIUM," and

b. The uranium metal is encased in mild steel or equally fire resistant metal with minimum wall thickness of 1/8 inch (3.2 mm).

7. Thorium contained in finished optical lenses, provided that each lens does not contain more than 30 percent of thorium by weight, and that the exemption contained in this item does not authorize either
   a. The shaping, grinding, or polishing of a thoriated lens or manufacturing processes other than the assembly of a thoriated lens into optical systems and devices without any alteration of the lens, or
   b. The receipt, possession, use, or transfer of thorium contained in contact lenses, spectacles, or the eyepieces of binoculars or other optical instruments;
8. Uranium contained in detector heads of fire detection units, provided that each detector head contains not more than 5 nanocuries (185 Bq) of uranium; or
9. Thorium contained in any finished aircraft engine part containing nickel-thoria alloy, provided that:
   a. The thorium is dispersed in the nickel-thoria alloy in the form of finely divided thoria (thorium dioxide), and
   b. The thorium content in the nickel-thoria alloy does not exceed 4 percent by weight.

D. The exemptions in subsection (C) do not authorize the manufacture of any of the products described.

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Amended effective December 20, 1985 (Supp. 85-6). Amended subsection (C) effective November 22, 1988 (Supp. 88-4). Former Section R12-1-302 renumbered to R12-1-303, new Section R12-1-302 renumbered from R12-1-301 effective February 18, 1994 (Supp. 94-1). Former Section R12-1-302 renumbered to R12-1-301; new Section R12-1-302 renumbered from R12-1-303 and amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-303. Radioactive Material Other than Source Material; Exemptions

A. Exempt concentrations
1. Except as provided in subsection (A)(2), a person is exempt from this Article if the person receives, possesses, uses, transfers or acquires products or materials containing radioactive material in concentrations not in excess of those listed in Exhibit A.
2. A person shall not introduce radioactive material into a product or material knowing or having reason to believe that it will be transferred to persons exempt under subsection (A)(1) or equivalent Regulations of the U.S. Nuclear Regulatory Commission or any Agreement State or Licensing State, except in accordance with a specific license issued under R12-1-311(A) or a general license prescribed in R12-1-320.

B. Exempt items
1. Except for persons who apply radioactive material to, or persons who incorporate radioactive material into the following products, a person is exempt from this Chapter to the extent that the person receives, possesses, uses, transfers or acquires the following products:
   a. Timepieces, hands, or dials containing not more than the following specified quantities of material and not exceeding the following specified levels of radiation:
      i. 925 MBq (25 millicuries) of tritium per timepiece,
      ii. 185 MBq (5 millicuries) of tritium per hand,
      iii. 555 MBq (15 millicuries) of tritium per dial (bezels are considered part of the dial),
      iv. 3.7 MBq (100 microcuries) of promethium-147 per watch or 7.4 MBq (200 microcuries) of promethium-147 per any other timepiece,
      v. 740 kBq (20 microcuries) of promethium-147 per watch hand or 1.48 MBq (40 microcuries) of promethium-147 per other timepiece hand,
      vi. 2.22.MBq (60 microcuries) of promethium-147 per watch dial or 4.44 MBq (120 microcuries) of promethium-147 per other timepiece dial (bezels are considered part of the dial),
      vii. The levels of radiation from hands and dials containing promethium-147 shall not exceed, when measured through 50 milligrams per square centimeter of absorber:
      (1) For wrist watches, 1.0 μGy (0.1 millirad) per hour at 10 centimeters from any surface of the watch,
      (2) For pocket watches, (0.1 millirad) per hour at 1 centimeter from any surface,
      (3) For any other timepiece, 2.0 μGy (0.2 millirad) per hour at 10 centimeters from any surface,
      viii. 37 kBq (1 microcurie) of radium-226 in time pieces manufactured prior to October 1, 1978;
   b. Lock illuminators containing not more than 555 MBq (15 millicuries) of tritium or not more than 74 MBq (2 millicuries) of promethium-147 installed in automobile locks. The levels of radiation from each lock illuminator containing promethium-147 shall not exceed 10 μGy (1 millirad) per hour at 1 centimeter from any surface when measured through 50 milligrams per square centimeter of absorber;
   c. Balances of precision containing not more than 37 Mbq (1 millicurie) of tritium per balance or not more than 18.5 MBq (0.5 millicurie) of tritium per balance part;
   d. Automobile shift quadrants containing not more than 925 MBq (25 millicuries) of tritium;
   e. Marine compasses containing not more than 27.75 GBq (750 millicuries) of tritium gas and other marine navigational instruments containing not more than 9.25 GBq (250 millicuries) of tritium gas;
   f. Thermostat dials and pointers containing not more than 925 MBq (25 millicuries) of tritium per thermostat;
   g. Electron tubes: Provided that each tube does not contain more than one of the following specified quantities of radioactive material:
      i. 5.55 GBq (150 millicuries) of tritium per microwave receiver protector tube or 370 MBq (10 millicuries) of tritium per any other electron tube;
      ii. 37 kBq (1 microcurie) of cobalt 60;
      iii. 185 kBq (5 microcuries) of nickel 63;
      iv. 1.11 MBq (30 microcuries) of krypton 85;
      v. 185 kBq (5 microcuries) of cesium 137;
      vi. 1.11 MBq (30 microcuries) of promethium-147;
      And provided further, that the level of radiation due to radioactive material contained in each electron tube does not exceed 10 μGy (1 millirad) per hour) at 1 centimeter from any surface when measured through 7 milligrams per

square centimeter of absorber. The term "electron tubes" includes spark gap tubes, power tubes, gas tubes, including glow lamps, receiving tubes, microwave tubes, indicator tubes, pick-up tubes, radiation detection tubes, and any other completely sealed tube that is designed to conduct or control electrical current.

h. Ionizing radiation measuring instruments containing, for purposes of internal calibration or standardization, one or more sources of radioactive material provided that:
   i. Each source contains no more than one exempt quantity set forth in Exhibit B of this Article, and
   ii. Each instrument contains no more than 10 exempt quantities. For the purposes of this subsection, an instrument's source or sources may contain either one type or different types of radionuclide and an individual exempt quantity may be composed of fractional parts of one or more of the exempt quantities in Exhibit B of this Article, provided the sum of the fractions do not exceed unity.
   iii. For the purposes of subsection (B)(1)(h) only, 185 kBq (50 nanocurie) of americium-241 is considered an exempt quantity under Exhibit B of this Article.
   iv. Spark gap irradiators containing not more than 37 kBq (1 microcurie) of cobalt-60 per spark gap irradiator for use in electrically ignited fuel oil burners having a firing rate of at least 3 gallons per hour (11.4 liters/hr or 0.0114 m^3/hr).

2. Resins containing scandium-46 and designed for sand consolidation in oil wells. A person is exempt from this Chapter if the person receives, possesses, uses, transfers, or acquires synthetic plastic resins containing scandium 46 which are designed for sand consolidation in oil wells. The described resins shall be manufactured or imported according to a specific license issued by the U.S. Nuclear Regulatory Commission, or shall be manufactured according to the specifications contained in a specific license issued by the Agency or any Agreement State to the manufacturer of the described resins according to licensing requirements equivalent to those in 10 CFR 32.16 and 10 CFR 32.17 of the U.S. Nuclear Regulatory Commission. This exemption does not authorize the manufacture of any resins containing scandium-46.
3. Self-luminous products
   a. Except for persons who manufacture, process, or produce self-luminous products containing tritium, krypton-85, or promethium-147, a person is exempt from this Chapter if the person receives, possesses, uses, transfers or acquires tritium, krypton-85 or promethium-147 in self-luminous products manufactured, processed, produced, imported, or transferred under a specific license issued by the U.S. Nuclear Regulatory Commission and described in 10 CFR 32.22, and the license authorizes the transfer of the products to persons who are exempt from regulatory requirements. This exemption does not apply to tritium, krypton-85, or promethium-147 used in products for frivolous purposes or in toys or adornments.
   b. A person is exempt from this Chapter if the person receives, possesses, uses, or transfers articles containing less than 3.7 kBq (100 nanocuries) of radium-226, manufactured prior to October 1, 1978.
4. Gas and aerosol detectors containing radioactive material
   a. Except for persons who manufacture, process, or produce gas and aerosol detectors containing radioactive material, a person is exempt from this Chapter if the person receives, possesses, uses, transfers, or acquires radioactive material in gas and aerosol detectors designed to protect life or property from fires and airborne hazards, provided that detectors containing radioactive material shall be manufactured, imported, or transferred according to a specific license issued by the U.S. Nuclear Regulatory Commission and described in 10 CFR 32.26, or equivalent regulations of an Agreement or Licensing State, and the license authorizes the transfer of the detectors to persons who are exempt from regulatory requirements.
   b. Gas and aerosol detectors previously manufactured and distributed to general licensees in accordance with a specific license issued by an Agreement State are exempt under subsection (B)(4)(a), provided that the device is labeled in accordance with the specific license authorizing distribution of the general licensed device, and that the detectors meet the requirements of R12-1-311(C).

C. Exempt quantities
1. Except as provided in subsections (C)(2) and (3), a person is exempt from these rules if the person receives, possesses, uses, transfers or acquires radioactive material in individual quantities each of which does not exceed the applicable quantity set forth in Exhibit B of this Article.
2. This subsection does not authorize the production, packaging, or repackaging of radioactive material for purposes of commercial distribution, or the incorporation of radioactive material into products intended for commercial distribution.
3. Except as specified in this subsection, a person shall not, for purposes of commercial distribution, transfer radioactive material in the individual quantities set forth in Exhibit B of this Article, knowing or having reason to believe the described quantities of radioactive material will be transferred to persons exempt under subsection (C) or equivalent Regulations of the U.S. Nuclear Regulatory Commission or any Agreement State or Licensing State. A person may transfer radioactive material for commercial distribution under a specific license issued by the U.S. Nuclear Regulatory Commission under 10 CFR 32.18, or by the Agency according to R12-1-311(B) which license states that the radioactive material may be transferred by the licensee to persons exempt under this subsection or the equivalent Regulations of the U.S. Nuclear Regulatory Commission or any Agreement State or Licensing State.
4. Sources containing exempt quantities of radioactive material shall not be bundled or placed in close proximity for the purpose of using the radiation from the combined sources in place of a single source, containing a licensable quantity of radioactive material.
5. Possession and use of bundled or combined sources containing exempt quantities of radioactive material in unregistered devices by persons exempt from licensing is prohibited.

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Amended effective December 20, 1985 (Supp. 85-6). Former Sec-

tion R12-1-303 renumbered to R12-1-304, new Section R12-1-303 renumbered from R12-1-302 effective February 18, 1994 (Supp. 94-1). Former Section R12-1-303 renumbered to R12-1-302; new Section R12-1-303 renumbered from R12-1-304 and amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-304. License Types

Licenses for radioactive materials are of two types: general and specific.

1. For a general license, no application is required and no licensing document is issued. The Agency may require that a person file a certificate for a particular general license. The licensee is subject to all other applicable portions of this Chapter and any limitations of the general license.
2. For a specific license, a person submits an application to the Agency. The Agency issues a license if the person satisfies all of the requirements for a license. The licensee is subject to all applicable portions of this Chapter and any limitations contained in the licensing document.

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Amended effective December 20, 1985 (Supp. 85-6). Former Section R12-1-304 renumbered to R12-1-305, new Section R12-1-304 renumbered from R12-1-303 effective February 18, 1994 (Supp. 94-1). Former Section R12-1-304 renumbered to R12-1-303; new Section R12-1-304 renumbered from R12-1-305 and amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-305. General License - Source Material

A. This subsection establishes a general license authorizing use and transfer of not more than 6.8 kg (15 pounds) of source material at any one time, for research, development, educational, commercial, or operational purposes, by persons in the following categories: commercial and industrial firms, research, educational and medical institutions, and State and local government agencies; provided that the person proceeding under this general license, receives no more than 68.2 kg (150 pounds) of source material in any one calendar year.

B. Persons who receive, possess, use, or transfer source material under the general license issued in subsection (A) are exempt from the provisions of 12 A.A.C. 1, Article 4 and Article 10, provided the receipt, possession, use, or transfer is within the terms of the general license; however, this exemption does not apply to any person who is also in possession of source material under a specific license issued under this Article.

C. Depleted uranium in industrial products and devices.

1. This subsection establishes a general license to receive, acquire, possess, use or transfer depleted uranium contained in industrial products or devices for the purpose of providing a concentrated mass in a small volume of the product or device.
2. The general license in subsection (C)(1) applies only to industrial products or devices which have been manufactured under a specific license governed by R12-1-311(M), or a specific license issued by the U.S. Nuclear Regulatory Commission or an Agreement State authorizing manufacture of the products or devices for distribution to persons generally licensed by the U.S. Nuclear Regulatory Commission or an Agreement State.
3. Depleted uranium
   a. Persons who receive, acquire, possess, or use depleted uranium under the general license established by subsection (C)(1) shall file ARRA 23 "Registration Certificate -- Use of Depleted Uranium Under General License," with the Agency. The form, requesting the information in Exhibit E, shall be submitted within 30 days after the first receipt or acquisition of the depleted uranium. The general licensee shall furnish on ARRA 23 the following information.
      i. Name, telephone number, and address of the general licensee;
      ii. Location of use;
      iii. A statement that the general licensee has developed and will maintain procedures designed to establish physical control over the depleted uranium described in subsection (C)(1) and to prevent transfer of the depleted uranium in any form, including metal scrap, to persons not authorized to receive the depleted uranium; and
      iv. Name or title (or both), address, and telephone number of the individual duly authorized to act for and on behalf of the registrant in supervising the procedures identified in subsection (C)(3)(a)(ii).
   b. The general licensee possessing or using depleted uranium under the general license established by subsection (C)(1) shall report in writing to the Agency any changes in information originally furnished on ARRA 23. The report shall be submitted within 30 days after the effective date of the described change.
4. A person who receives, acquires, possesses, or uses depleted uranium under the general license established by subsection (C)(1):
   a. Shall not introduce depleted uranium, in any form, into a chemical, physical, or metallurgical treatment or process, except a treatment or process for repair or restoration of any plating or other covering of the depleted uranium;
   b. Shall not abandon the depleted uranium;
   c. Shall transfer the depleted uranium as prescribed in R12-1-318. If the transferee receives the depleted uranium under the general license established by subsection (C)(1), the transferor shall furnish the transferee with a copy of this rule and a copy of the registration certificate. If the transferee receives the depleted uranium under a general license governed by a regulation of the U.S. Nuclear Regulatory Commission or Agreement State that is equivalent to subsection (C)(1), the transferor shall furnish the transferee a copy of this rule and a copy of the registration certificate, accompanied by a letter explaining that use of the product or device is regulated by the U.S. Nuclear Regulatory Commission or Agreement State under requirements substantially similar to those in this rule;
   d. Within 30 days of any transfer, shall report in writing to the Agency the name and address of the person receiving the depleted uranium; and
   e. Shall not export the depleted uranium except under a license issued by the U.S. Nuclear Regulatory Commission in 10 CFR 110.
5. Any person receiving, acquiring, possessing, using, or transferring depleted uranium according to the general license established by subsection (C)(1) is exempt from

the requirements of 12 A.A.C. 1, Articles 4 and 10 with respect to the depleted uranium covered by that general license.

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Amended effective December 20, 1985 (Supp. 85-6). Former Section R12-1-305 renumbered to R12-1-306, new Section R12-1-305 renumbered from R12-1-304 effective February 18, 1994 (Supp. 94-1). Former Section R12-1-305 renumbered to R12-1-304; new Section R12-1-305 renumbered from R12-1-306 and amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-306. General License - Radioactive Material Other Than Source Material

A. This subsection establishes a general license to transfer, receive, acquire, possess, and use radioactive material incorporated in the following devices or equipment which have been manufactured, tested and labeled by the manufacturer according to a specific license issued to the manufacturer by the U.S. Nuclear Regulatory Commission under 10 CFR 31.3. This general license is subject to the provisions of 12 A.A.C. 1, Articles 1, 4, 10 and 12; Sections R12-1-303(A)(2), R12-1-313, R12-1-318, R12-1-319, and R12-1-321; and A.R.S. §§ 30-654(B)(13), 30-657(A) and (B), 30-681, and 30-685 through 30-689.

1. Static elimination device. Devices designed for use as static eliminators which contain, as a sealed source or sources, radioactive material consisting of a total of not more than 18.5 MBq (500 microcuries) of polonium-210 per device.
2. Ion generating tube. Devices designed for ionization of air which contain, as a sealed source or sources, radioactive material consisting of a total of not more than 18.5 MBq (500 microcuries) of polonium-210 per device or a total of not more than 1.85 GBq (50 millicuries) of hydrogen-3 (tritium) per device.

B. Certain measuring, gauging or controlling devices

1. This subsection establishes a general license for commercial and industrial firms; research, educational and medical institutions; individuals for conducting business; and State or local government agencies to receive, acquire, possess, use or transfer radioactive material according to the provisions of subsections (B)(2), (3), and (4), excluding special nuclear material, contained in devices designed and manufactured for the purpose of detecting, measuring, gauging or controlling thickness, density, level, interface location, radiation, leakage, or qualitative or quantitative chemical composition, or for producing light or an ionized atmosphere.
2. The general license in subsection (B)(1) applies only to radioactive material contained in devices which have been manufactured and labeled according to specifications contained in a specific license issued by the Agency under R12-1-311(D) or in accordance with the specifications contained in a specific license issued by the U.S. Nuclear Regulatory Commission or an Agreement State which authorizes distribution of devices to persons generally licensed by the NRC or an Agreement State. Regulations promulgated under the Federal Food, Drug, and Cosmetic Act, authorizing the use of radioactive control devices in food production, require certain additional labeling prescribed in 21 CFR 179.21.
3. Any person who owns, receives, acquires, possesses, uses, or transfers radioactive material in a device according to the general license in subsection (B)(1):
   a. Shall assure that all labels are affixed to the device at the time of receipt, each bearing a statement that removal of the label is prohibited, maintain the labels on the device and comply with all instructions and precautions provided on the labels;
   b. Shall assure that the device is tested for leakage of radioactive material and proper operation of the actuation mechanism and indicator, if any, at no longer than six-month intervals or the intervals specified on the label; however;
      i. Devices containing only krypton need not be tested for leakage of radioactive material;
      ii. Devices containing only tritium or not more than 3.7 MBq (100 microcuries) of other beta or gamma emitting material or 370 kBq (10 microcuries) of alpha emitting material; and
      iii. Devices held in storage in the original shipping container prior to initial installation need not be tested for any purpose,
   c. Shall assure that the tests required by subsection (B)(3)(b) and other testing, installation, servicing, and removal from installation involving shielding, containment, or radioactive material, are performed:
      i. According to the instructions on any label, or
      ii. By a person holding a specific license from the Agency, the NRC, or an Agreement State or Licensing State to perform the specified activities;
   d. Shall maintain records showing compliance with the requirements of subsections (B)(3)(b) and (c). The records shall show the results of tests. The records also shall show the dates of performance of, and the names of persons performing, testing, installation, servicing, and removal or other work concerning shielding, containment, or radioactive material. Records of tests for leakage of radioactive material required by subsection(B)(3)(b) shall be maintained for one year after the next required leak test is performed or until the sealed source is disposed of or transferred. Records of tests of the actuator mechanism and indicator required by subsection (B)(3)(b) shall be maintained for one year after the next required test of the actuator mechanism and indicator is performed or until the sealed source is disposed of or transferred. Records which are required by subsection (B)(3)(c) shall be maintained for two years from the date of the recorded event or until the device is disposed of or transferred;
   e. Upon failure or damage, or any indication of possible failure or damage of shielding or the actuation mechanism or indicator, or upon the detection of 185 Bq (5 nanocurie) or more removable radioactive material, shall immediately suspend operation of the device until it has been repaired by the manufacturer or other person holding a specific license from the Agency, the NRC or an Agreement State or Licensing State to repair the device, or disposed of by transfer to a person authorized by a specific license to receive the radioactive material contained in the device and, within 30 days, furnish to the Agency a report containing a brief description of the event and the remedial action taken;

f. Shall not abandon the device containing radioactive material;
g. Except as provided in subsection (B)(3)(h), shall transfer or dispose of the device containing radioactive material only by transfer to a specific licensee of the Agency, the NRC, or an Agreement State or Licensing State whose specific license authorizes the receipt of the device and, within 30 days after transfer, furnish a report to the Agency identifying the device by manufacturer's name and model number and the name and address of the person receiving the device. No report is required if the device is transferred to the specific licensee in order to obtain a replacement device;
h. Shall transfer the device to another general licensee only:
i. If the device remains in use at a particular location. The transferor shall give the transferee a copy of this rule and any safety documents identified on the label of the device and within 30 days after the transfer, report to the Agency the manufacturer's name, the model number of the device transferred, the name and address of the transferee, and the name or position or both of a contact person for the Agency; or
ii. Where the device is held in storage in the original shipping container at its intended location of use prior to initial use by a general licensee;
i. Shall comply with the provisions of R12-1-443 and R12-1-444 for reporting radiation incidents, theft, or loss of licensed material, but is exempt from the other requirements of 12 A.A.C. 1, Articles 4 and 10.

4. The general license in subsection (B)(1) does not authorize the manufacture of devices containing radioactive material.
5. The general license provided in subsection (B)(1) is subject to the provisions of 12 A.A.C. 1, Articles 1, 3, 12, and 15, and A.R.S. §§ 30-654(B)(13), 30-657 (A) and (B), 30-681, and 30-685 through 30-689.

C. Luminous safety devices for aircraft
1. This subsection establishes a general license for the receipt, acquisition, possession, and use of tritium or promethium-147 contained in luminous safety devices for use in aircraft, provided:
a. Each device contains not more than 370 GBq (10 curies) of tritium or 11.1 GBq (300 millicuries) of promethium-147; and
b. Each device has been manufactured, assembled or imported according to a specific license issued by the U.S. Nuclear Regulatory Commission, or each device has been manufactured or assembled according to the specifications contained in a specific license issued by the Agency or any Agreement State or Licensing State to the manufacturer or assembler of the device according to licensing requirements equivalent to those in 10 CFR 32.53.
2. Persons who receive, acquire, possess, or use luminous safety devices according to the general license in subsection (C)(1) are exempt from the requirements of 12 A.A.C. 1, Article 4 and Article 10 except that they shall comply with the provisions of R12-1-443 and R12-1-444.
3. This general license does not authorize the manufacture, assembly, or repair of luminous safety devices containing tritium or promethium-147.
4. This general license does not authorize the ownership, receipt, acquisition, possession, or use of radioactive materials contained in instrument dials.
5. This general license is subject to the provisions of 12 A.A.C. 1, Articles 1, 3, 12, and 15 and A.R.S. §§ 30-654(B)(13), 30-657(A), 30-657(B), 30-681, and 30-685 through 30-689.

D. Calibration and reference sources
1. This subsection establishes a general license for those persons listed below to receive, acquire, possess, use, and transfer, according to the provisions of subsections (D)(4) and (5), americium-241 in the form of calibration or reference sources:
a. Any person who holds a specific license issued by the Agency which authorizes the receipt, possession, use, and transfer of radioactive material; and
b. Any person who holds a specific license issued by the U.S. Nuclear Regulatory Commission which authorizes the receipt, possession, use, and transfer of special nuclear material.
2. This subsection establishes a general license for ownership, receipt, possession, use, and transfer of plutonium in the form of calibration or reference sources to any person who holds a specific license issued by the Agency authorizing receipt, possession, use, and transfer of radioactive material.
3. This subsection establishes a general license to receive, possess, use and transfer radium-226 in the form of calibration or reference sources to any person who holds a specific license issued by the Agency authorizing receipt, possession, use, and transfer of radioactive material.
4. The general licenses in subsections (D)(1), (2), and (3) apply to calibration or reference sources which have been manufactured according to the specifications contained in a specific license issued to the manufacturer or importer of the sources by the U.S. Nuclear Regulatory Commission in 10 CFR 32.57 or 10 CFR 70.39. The general licenses also apply to calibration or reference sources which have been manufactured according to the specifications contained in a specific license issued to the manufacturer by the Agency or any Agreement State or Licensing State according to licensing requirements equivalent to those contained in 10 CFR 32.57 or 10 CFR 70.39.
5. The general licenses provided in subsections (D)(1), (2), and (3) are subject to the provisions of 12 A.A.C. 1, Articles 1, 3, 4, 10, 12, and 15 and A.R.S. §§ 30-654(B)(13), 30-657(A), 30-657(B), 30-681, and 30-685 through 30-689. In addition, persons who own, receive, acquire, possess, use, or transfer one or more calibration or reference sources according to these general licenses:
a. Shall not possess at any one time, at any location of storage or use, more than 185 kBq (5 microcuries) of americium-241, plutonium, or radium-226 in calibration or reference sources;
b. Shall not receive, possess, use, or transfer a calibration or reference source unless the source, or the storage container, bears a label which includes one of the following statements or a substantially similar statement which contains the information called for in one of the following statements:
i. The receipt, possession, use and transfer of this source, Model _____, Serial No. _____, are subject to a general license and the regulations of the U.S. Nuclear Regulatory Commission or of a State with which the Commission has

entered into an agreement for the exercise of regulatory authority. Do not remove this label.
CAUTION -- RADIOACTIVE MATERIAL -- THIS SOURCE CONTAINS (name of the appropriate material) -- DO NOT TOUCH RADIOACTIVE PORTION OF THIS SOURCE.

_____
Name of manufacturer or importer

ii. The receipt, possession, use and transfer of this source, Model _____, Serial No. _____, are subject to a general license and the regulations of any Licensing State. Do not remove this label.
CAUTION -- RADIOACTIVE MATERIAL -- THIS SOURCE CONTAINS RADIUM-226. DO NOT TOUCH RADIOACTIVE PORTION OF THIS SOURCE.

_____
Name of manufacturer or importer

c. Shall not transfer, abandon, or dispose of a calibration or reference source except by transfer to a person authorized by a license from the Agency, the U.S. Nuclear Regulatory Commission, an Agreement State or a Licensing State to receive the source;
d. Shall store a calibration or reference source, except when the source is being used, in a closed container adequately designed and constructed to contain americium-241, plutonium, or radium-226 which might otherwise escape during storage; and
e. Shall not use a calibration or reference source for any purpose other than the calibration of radiation detectors or the standardization of other sources.

6. These general licenses do not authorize the manufacture of calibration or reference sources containing americium-241, plutonium, or radium-226.

E. Medical diagnostic uses

Receipt, possession, use, transfer, ownership or acquisition of carbon-14 urea capsules containing 1 microcurie of carbon-14 urea for "in vivo" human diagnostic use:

1. Except as provided in subsections (E)(2) and (3), a physician is exempt from the requirements for a specific license provided that each carbon-14 urea capsule for "in vivo" diagnostic use contains no more than 1 microcurie.
2. Any physician who desires to use the capsules for research involving human subjects shall obtain a specific license issued according to the specific licensing requirements in this Article.
3. Any physician who desires to manufacture, prepare, process, produce, package, repackage, or transfer for commercial distribution carbon-14 urea capsules shall obtain a specific license from the Agency, issued according to the requirements in 10 CFR 32, 1998 Edition, published January 1, 1998, incorporated by reference and on file with the Agency and the Office of Secretary of State. This incorporation by reference contains no future editions or amendments.
4. Nothing in this subsection relieves physicians from complying with applicable FDA and other federal and state requirements governing receipt, administration, and use of drugs.

F. General license for use of radioactive material for certain in vitro clinical or laboratory testing

1. This subsection establishes a general license for any physician, clinical laboratory, or hospital to receive, acquire, possess, transfer, or use, for any of the following stated tests, the following radioactive materials in prepackaged units:
   a. Iodine-125, in units not exceeding 370 kBq (10 microcuries) each for use in in vitro clinical or laboratory tests not involving internal or external administration of radioactive material, or radiation from such material, to human beings or animals.
   b. Iodine-131, in units not exceeding 370 kBq (10 microcuries) each for use in in vitro clinical or laboratory tests not involving internal or external administration of radioactive material, or the radiation from such material, to human beings or animals.
   c. Carbon-14, in units not exceeding 370 kBq (10 microcuries) each for use in in vitro clinical or laboratory tests not involving internal or external administration of radioactive material, or the radiation from such material, to human beings or animals.
   d. Hydrogen-3 (tritium), in units not exceeding 1.85 MBq (50 microcuries) each for use in in vitro clinical or laboratory tests not involving internal or external administration of radioactive material, or the radiation from such material, to human beings or animals.
   e. Iron-59, in units not exceeding 740 kBq (20 microcuries) each for use in in vitro clinical or laboratory tests not involving internal or external administration of radioactive material, or the radiation from such material, to human beings or animals.
   f. Cobalt-57, in units not exceeding 370 kBq (10 microcuries) each for use in in vitro clinical or laboratory tests not involving internal or external administration of radioactive material, or the radiation from such material, to human beings or animals.
   g. Mock iodine-125 reference or calibration sources, in units not exceeding 1.85 kBq (50 nanocurie) of iodine-129 and 185 Bq (5 nanocurie) of americium-241 each, for use in in vitro clinical or laboratory tests not involving internal or external administration of radioactive material, or the radiation from such material, to human beings or animals.
2. A person shall not acquire, receive, possess, use or transfer radioactive material according to the general license established by subsection (F)(1) until the person has filed ARRA-9, "Certificate -- In Vitro Testing with Radioactive Material Under General License," requesting the information listed in Exhibit E, with the Agency and received a validated copy of ARRA-9 which shows the assigned certification number. The physician, clinical laboratory, or hospital shall furnish on ARRA-9 the following information:
   a. Name, telephone number, and address of the physician, clinical laboratory, or hospital; and
   b. A statement that the physician, clinical laboratory, or hospital has appropriate radiation measuring instruments to carry out in vitro clinical or laboratory tests with radioactive material and that tests will be performed only by personnel competent to use the appropriate instruments and handle the radioactive material.
3. A person who receives, acquires, possesses or uses radioactive material according to the general license established by subsection (F)(1) shall comply with the following:
   a. The general licensee shall not possess at any one time, in storage or use, a total amount of iodine-125, iodine-131, iron-59, or cobalt-57 in excess of 7.4

MBq (200 microcuries), or acquire or use in any one calendar month any more than 18.5 MBq (500 microcuries) of these materials.

b. The general licensee shall store the radioactive material, until used, in the original shipping container or in a container providing equivalent radiation protection.

c. The general licensee shall use the radioactive material only for the uses authorized by subsection (F)(1).

d. The general licensee shall not transfer the radioactive material to a person who is not authorized to receive it according to a license issued by the Agency, the U.S. Nuclear Regulatory Commission, or any Agreement State or Licensing State, or transfer the radioactive material in any manner other than in the unopened, labeled shipping container received from the supplier.

e. The general licensee shall not dispose of the mock iodine-125 reference or calibration sources described above except as authorized by R12-1-434.

4. The general licensee shall not receive, acquire, possess, or use radioactive material according to subsection (F)(1):

a. Except as prepackaged units which are labeled according to the provisions of a specific license issued by the U.S. Nuclear Regulatory Commission, or any Agreement State which authorizes the manufacture and distribution of iodine-125, iodine-131, carbon-14, hydrogen-3 (tritium), iron-59, cobalt-57, or mock iodine-125 for distribution to persons generally licensed under subsection (F) or its equivalent federal law, and

b. Unless one of the following statements, or a substantially similar statement which contains the same information, appears on a label affixed to each prepackaged unit or appears in a leaflet or brochure which accompanies the package:

i. This radioactive material may be acquired, received, possessed, and used only by physicians, clinical laboratories or hospitals and only for in vitro clinical or laboratory tests not involving internal or external administration of the material, or the radiation from such material, to human beings or animals. The acquisition, receipt, possession, use, and transfer are subject to the regulations and a general license of the U.S. Nuclear Regulatory Commission or of a state with which the Commission has entered into an agreement for the exercise of regulatory authority.

_____
Name of manufacturer

ii. This radioactive material shall be acquired, received, possessed, and used only by physicians, clinical laboratories or hospitals and only for in vitro clinical or laboratory tests not involving internal or external administration of the material, or the radiation from such material, to human beings or animals. The receipt, acquisition, possession, use, and transfer are subject to the regulations and a general license of a Licensing State.

_____
Name of manufacturer

5. A physician, clinical laboratory or hospital possessing or using radioactive material under the general license in subsection (F)(1) shall report in writing to the Agency, any changes in the information furnished on the ARRA-9. The report shall be furnished within 30 days after the effective date of the change.

6. Any person using radioactive material according to the general license of subsection (F)(1) is exempt from the requirements of 12 A.A.C. 1, Article 4 and Article 10 with respect to radioactive material covered by that general license, except that persons using mock iodine-125 sources described in subsection (F)(1)(g) shall comply with the provisions of R12-1-434, R12-1-443, and R12-1-444 of these rules.

7. For the purposes of subsection (F), a licensed veterinary care facility is considered a "clinical laboratory."

G. Ice detection devices

1. This subsection establishes a general license to receive, acquire, possess, use, and transfer strontium-90 contained in ice detection devices, provided each device contains not more than 1.85 Mbq (50 μCi) of strontium-90 and each device has been manufactured or imported in accordance with a specific license issued by the U.S. Nuclear Regulatory Commission or each device has been manufactured according to the specifications contained in a specific license issued by the Agency or any Agreement State to the manufacturer of the device under licensing requirements equivalent to those in 10 CFR 32.61.

2. Persons who receive, acquire, possess, use, or transfer strontium-90 contained in ice detection devices according to the general license in subsection (G)(1):

a. Shall, upon occurrence of visually observable damage, such as a bend or crack or discoloration from overheating, discontinue use of the device until it has been inspected, tested for leakage, and repaired by a person holding a specific license from the U.S. Nuclear Regulatory Commission or an Agreement State to manufacture or service ice detection devices; or shall dispose of the device according to the provisions of R12-1-434;

b. Shall assure that all labels affixed to the device at the time of receipt, and which bear a statement prohibiting removal of the labels, are maintained on the devices; and

c. Are exempt from the requirements of 12 A.A.C. 1, Article 4 and Article 10, except the users of ice detection devices shall comply with the provisions of R12-1-434, R12-1-443 and R12-1-444.

3. This general license does not authorize the manufacture, assembly, disassembly or repair of strontium-90 in ice detection devices.

4. This general license is subject to the provisions of 12 A.A.C. 1, Articles 1, 3, 12, and 15, and A.R.S. §§ 30-654(B), 30-657(A), 30-657(B), 30-681, and 30-685 through 30-689.

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Amended effective December 20, 1985 (Supp. 85-6). Former Section R12-1-306 renumbered to R12-1-307, new Section R12-1-306 renumbered from R12-1-305 effective February 18, 1994 (Supp. 94-1). Former Section R12-1-306 renumbered to R12-1-305; new Section R12-1-306 renumbered from R12-1-307 and amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-307. Repealed

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Repealed effective December 20, 1985 (Supp. 85-6). Former Section R12-1-307 renumbered to R12-1-308, new Section R12-1-307 renumbered from R12-1-306 effective February 18, 1994 (Supp. 94-1). Former Section R12-1-307 renumbered to R12-1-306; new Section R12-1-307 renumbered from R12-1-308 and repealed by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-308. Filing Application for Specific Licenses

A. An applicant for a specific license shall file an Agency application. The applicant shall prepare the application in duplicate, one copy for the Agency and the other for the applicant.

B. The Agency may at any time after the filing of the original application, and before the expiration of the license, require further statements in order to enable the Agency to determine whether the application should be granted or denied or whether a license should be modified or revoked.

C. Each application shall contain the information specified in Exhibit (E) of this Article and be signed by the applicant, licensee, or person duly authorized to act for the applicant or licensee.

D. An application for a license may include a request for a license authorizing more than one activity authorized by R12-1-1302.

E. In the application, the applicant may incorporate by reference information contained in previous applications, statements, or reports filed with the Agency provided the references are clear and specific.

F. The Agency shall make applications and documents submitted to the Agency available for public inspection, but may withhold any document or part of a document from public inspection if disclosure of its content is not required in the public interest and would adversely affect the interest of a person concerned.

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Amended effective December 20, 1985 (Supp. 85-6). Former Section R12-1-308 renumbered to R12-1-309, new Section R12-1-308 renumbered from R12-1-307 effective February 18, 1994 (Supp. 94-1). Former Section R12-1-308 renumbered to R12-1-307; new Section R12-1-308 renumbered from R12-1-309 and amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-309. General Requirements for the Issuance of Specific Licenses

A license application shall be approved if the Agency determines that:

1. The applicant is qualified by reason of training and experience to use the material in question for the purpose requested according to these rules, in a manner that will minimize danger to public health and safety or property;
2. The applicant's proposed equipment, facilities, and procedures are adequate to minimize danger to public health and safety or property;
3. The issuance of the license will not be inimical to the health and safety of the public;
4. The applicant satisfies all applicable special requirements in R12-1-310, R12-1-311, R12-1-322, R12-1-323, 12 A.A.C. 1, Article 5, 7, and 17; and
5. The applicant demonstrates that a letter has been sent, return receipt requested, to the Mayor's office of the city, town, or, if not within an incorporated community, to the County Board of Supervisors of the county in which the applicant proposes to operate which describes:
   a. The nature of the proposed activity involving radioactive material;
   b. The facility, including use and storage areas.

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Amended effective December 20, 1985 (Supp. 85-6). Former Section R12-1-309 renumbered to R12-1-310, new Section R12-1-309 renumbered from R12-1-308 effective February 18, 1994 (Supp. 94-1). Former Section R12-1-309 renumbered to R12-1-308; new Section R12-1-309 renumbered from R12-1-310 and amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-310. Special Requirements for Issuance of Specific Broad Scope Licenses

A. The Agency shall issue three classes of academic and industrial broad scope licenses, and only a single class A medical broad scope license.

1. A license is a broad scope class A license if it:
   a. Contains the exact wording "Any radioactive material with Atomic Number 3 through 83" or "Any radioactive material with Atomic Number 84 through 92" in License Item 6, and
   b. Contains the word "any" to authorize the chemical or physical form of the materials in License Item 7.

   The license may authorize the radioactive materials in multi-curie quantities, and may authorize other radioactive materials and forms in addition to those listed in subsection (A)(1)(a).
2. A broad scope class B license is any specific license which authorizes the possession and use of the radioactive materials specified in Exhibit C of 12 A.A.C. 1, Article 3 in any chemical or physical form and in quantities determined as follows:
   a. The possession limit, if only one radionuclide is possessed, is the quantity specified for that radionuclide in Exhibit C, Column I, or
   b. The possession limit for multiple radionuclides is determined as follows: The sum of the ratios for all radionuclides possessed under the license shall not exceed unity (1). The ratio for each radionuclide is determined by dividing the quantity possessed by the applicable quantity in Exhibit C, Column I.
3. A broad scope class C license is any specific license authorizing the possession and use of the radioactive materials specified in Exhibit C of 12 A.A.C. 1, Article 3 in any chemical or physical form and in quantities determined as follows:
   a. The possession limit, if only one radionuclide is possessed, is the quantity specified for that radionuclide in Exhibit C, Column II, or
   b. The possession limit for multiple radionuclides is determined as follows: The sum of the ratios for all radionuclides possessed under the license shall not exceed unity (1). The ratio for each radionuclide is determined by dividing the quantity possessed by the applicable quantity in Exhibit C, Column II.

B. The Agency shall approve:

1. An application for a class A broad scope license if:
   a. The applicant satisfies the general requirements specified in R12-1-309;

b. The applicant has engaged in a reasonable number of activities involving the use of radioactive material. For purposes of this subsection, the requirement of "reasonable number of activities" can be satisfied by showing that the applicant has five years of experience in the use of radioactive material. The Agency may accept less than five years of experience if the applicant's qualifications are adequate for the scope of the proposed license; and

c. The applicant has established administrative controls and provisions relating to organization, management, procedures, recordkeeping, material control, accounting, and management review that are necessary to assure safe operations, including:

i. Establishment of a radiation safety committee composed of a radiation safety officer, a representative of management, and persons trained and experienced in the safe use of radioactive material;

ii. Appointment of a radiation safety officer who is qualified by training and experience in radiation protection, and who is available for advice and assistance on radiation safety matters; and

iii. Establishment of appropriate administrative procedures to assure:

Control of procurement and use of radioactive material;

Completion of safety evaluations of proposed uses of radioactive material which take into consideration matters such as the adequacy of facilities and equipment, training and experience of the user, and operating or handling procedures; and

Review, approval, and recording by the radiation safety committee of safety evaluations of proposed uses prepared in accordance with this subsection prior to use of the radioactive material.

2. An application for a class B broad scope license if:

a. The applicant satisfies the general requirements specified in R12-1-309; and

b. The applicant has established administrative controls and provisions relating to organization, management, procedures, recordkeeping, material control, accounting, and management review that are necessary to assure safe operations, including:

i. Appointment of a radiation safety officer who is qualified by training and experience in radiation protection, and available for advice and assistance on radiation safety matters; and

ii. Establishment of appropriate administrative procedures to assure:

Control of procurement and use of radioactive material;

Completion of safety evaluations of proposed uses of radioactive material which take into consideration matters such as the adequacy of facilities and equipment, training and experience of the user, and the operating or handling procedures; and

Review, approval, and recording by the radiation safety officer of safety evaluations of proposed uses prepared according to subsection (B)(2)(b)(ii) prior to use of the radioactive material.

3. An application for a class C broad scope license if:

a. The applicant satisfies the general requirements specified in R12-1-309;

b. The applicant submits a statement that radioactive material will be used only by, or under the direct supervision of, individuals who have received:

i. A college degree at the bachelor level, or equivalent training and experience, in the physical or biological sciences or in engineering; and

ii. At least 40 hours of training and experience in the safe handling of radioactive material, the characteristics of ionizing radiation, units of dose and quantities, radiation detection instrumentation, and biological hazards of exposure to radiation appropriate to the type and forms of radioactive material to be used; and

c. The applicant has established administrative controls and provisions relating to procurement of radioactive material, procedures, recordkeeping, material control and accounting, and management review necessary to assure safe operations.

C. Unless specifically authorized, broad-scope licensees shall not:

1. Conduct tracer studies in the environment involving direct release of radioactive material;
2. Acquire, receive, possess, use, or transfer devices containing 3.7 petabecquerel (100,000 curies) or more of radioactive material in sealed sources used for irradiation of materials;
3. Conduct activities for which a specific license is issued under R12-1-311, and 12 A.A.C. 1, Articles 5, 7, or 17; or
4. Add or cause the addition of radioactive material to any food, beverage, cosmetic, drug, or other product designed for ingestion or inhalation by, or application to, a human being.

D. Radioactive material possessed under the class A broad scope license shall only be used by, or under the direct supervision of, individuals approved by the licensee's radiation safety committee.

E. Radioactive material possessed under the class B broad scope license shall only be used by, or under the direct supervision of, individuals approved by the licensee's radiation safety officer.

F. Radioactive material possessed under the class C broad scope license shall only be used by, or under the direct supervision of, individuals who satisfy the requirements of R12-1-310(B)(3)(b).

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Amended effective December 20, 1985 (Supp. 85-6). Amended effective November 5, 1993 (Supp. 93-4). Former Section R12-1-310 renumbered to R12-1-311, new Section R12-1-310 renumbered from R12-1-309 effective February 18, 1994 (Supp. 94-1). Former Section R12-1-310 renumbered to R12-1-309; new Section R12-1-310 renumbered from R12-1-311 and amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-311. Special Requirements for a Specific License to Manufacture, Assemble, Repair, or Distribute Commodities, Products, or Devices that Contain Radioactive Material

A. Licensing the introduction of radioactive material into products in exempt concentrations.

1. In addition to the requirements set forth in R12-1-309, a specific license authorizing the introduction of radioac-

tive material into a product or material owned by or in the possession of the licensee or another to be transferred to persons exempt under R12-1-303(A)(1) shall be issued if:

a. The applicant submits a description of the product or material into which the radioactive material will be introduced, intended use of the radioactive material and the product or material into which it is introduced, method of introduction, initial concentration of the radioactive material in the product or material, control methods to assure that no more than the specified concentration is introduced into the product or material, estimated time interval between introduction and transfer of the product or material, and estimated concentration of the radioactive material in the product or material at the time of transfer; and

b. The applicant provides reasonable assurance that the concentrations of radioactive material at the time of transfer will not exceed the concentrations in Exhibit A; reconcentration of the radioactive material in concentrations exceeding those in Exhibit A is not likely; use of lower concentrations is not feasible; and product or material is not likely to be incorporated in any food, beverage, cosmetic, drug, or other commodity or product designed for ingestion or inhalation by, or application to, a human being.

2. Each person licensed under this subsection shall file an annual report with the Agency which identifies the type and quantity of each product or material into which radioactive material has been introduced during the reporting period; the name and address of the person who owned or possessed the product or material, into which radioactive material has been introduced, at the time of introduction; the type and quantity of radionuclide introduced into each product or material; and the initial concentrations of the radionuclide in the product or material at time of transfer of the radioactive material by the licensee. If no transfers of radioactive material have been made according to this subsection during the reporting period, the report shall so indicate. The report shall cover the year ending June 30, and be filed within 30 days after June 30.

B. Licensing the distribution of naturally occurring and accelerator-produced radioactive material (NARM) in exempt quantities.

1. An application for a specific license to distribute NARM to persons exempted from these rules according to R12-1-303(C) will be approved if the applicant satisfies the requirements of R12-1-309, and:

a. The radioactive material is not contained in any food, beverage, cosmetic, drug, or other commodity designed for ingestion or inhalation by, or application to, a human being;

b. The radioactive material is in the form of processed chemical elements, compounds, or mixtures, tissue samples, bioassay samples, counting standards, plated or encapsulated sources, or similar substances, identified as radioactive and to be used for its radioactive properties, but it is not incorporated into any manufactured or assembled commodity, product, or device intended for commercial distribution; and

c. The applicant submits copies of prototype labels and brochures and the Agency approves the labels and brochures.

2. The licensee issued under subsection (B)(1) is subject to the following conditions:

a. No more than 10 exempt quantities shall be sold or transferred in any single transaction. However, an exempt quantity may be composed of fractional parts of one or more of the exempt quantity provided the sum of the fractions shall not exceed unity.

b. Each exempt quantity shall be separately and individually packaged. No more than 10 packaged exempt quantities shall be contained in any outer package for transfer to persons exempt according to R12-1-303(C). The outer package shall be such that the dose rate at the external surface of the package does not exceed 5 u Sv (0.5 millirem) per hour.

c. The immediate container of each quantity or separately packaged fractional quantity of radioactive material shall bear a durable, legible label which

i. Identifies the radionuclide and the quantity of radioactivity, and

ii. Bears the words “Radioactive Material.”

d. In addition to the labeling information required by subsection (B)(2)(c), the label affixed to the immediate container, or an accompanying brochure, shall

i. State that the contents are exempt from Licensing State requirements;

ii. Bear the words “Radioactive Material -- Not for Human Use -- Introduction into Foods, Beverages, Cosmetics, Drugs, or Medicinals, or into Products Manufactured for Commercial Distribution is Prohibited -- Exempt Quantities Should Not Be Combined”; and

iii. Set forth appropriate additional radiation safety precautions and instructions relating to the handling, use, storage, and disposal of the radioactive material.

3. Each person licensed under subsection (B) shall maintain records identifying, by name and address, each person to whom radioactive material is transferred for use under R12-1-303(C) or the equivalent regulations of a Licensing State, and stating the kinds and quantities of radioactive material transferred. An annual summary report stating the total quantity of each radionuclide transferred under the specific license shall be filed with the Agency. Each report shall cover the year ending June 30, and shall be filed within 30 days after June 30. If no transfers of radioactive material have been made according to this subsection during the reporting period, the report shall so indicate.

C. The Agency shall approve an application for a specific license authorizing the incorporation of radioactive material, other than source or byproduct material, into gas and aerosol detectors to be distributed to persons exempt under R12-1-303(B) if the application satisfies requirements equivalent to those contained in 10 CFR 32.26, 1998 Edition, published January 1, 1998, incorporated by reference and on file with the Agency and the Office of the Secretary of State which shall not contain any future editions or references, and provided:

1. The applicant satisfies the requirements of R12-1-309.

2. The licensee files annual reports required by 10 CFR 32.29, 1998 Edition, published January 1, 1998, incorporated by reference and on file with the Agency and the Office of the Secretary of State, with the Agency. This incorporation by reference contains no future editions or references.

D. Licensing the manufacture and distribution of devices to persons generally licensed under R12-1-306(B).

1. The Agency shall approve an application for a specific license to manufacture or distribute devices containing

radioactive material, excluding special nuclear material, to persons generally licensed under R12-1-306(B) or equivalent regulations of the U.S. NRC, an Agreement State, or the Licensing State if:

a. The applicant satisfies the general requirements of R12-1-309;
b. The applicant submits sufficient information relating to the design, manufacture, prototype testing, quality control, labels, proposed uses, installation, servicing, leak testing, operating and safety instructions, and potential hazards of the device to provide reasonable assurance that:
   i. The device can be safely operated by persons not having training in radiological protection;
   ii. Under ordinary conditions of handling, storage, and use of the device, the radioactive material contained in the device will not be released or inadvertently removed from the device, and it is unlikely that any person will receive a dose in excess of 10% of the limits specified in R12-1-408; and
   iii. Under accident conditions (such as fire and explosion) associated with handling, storage, and use of the device, it is unlikely that any person would receive an external radiation dose or dose commitment in excess of the following organ doses:

Whole body; head and trunk; active blood-forming organs; gonads; or lens of eye	150 mSv (15 rem)
Hands and forearms; feet and ankles; localized areas of skin averaged over areas no larger than 1 square centimeter	2 Sv (200 rem)
Other organs	500 mSv (50 rem)

c. Each device bears a durable, legible, clearly visible label or labels which contain in a clearly identified and separate statement:
   i. Instructions and precautions necessary to assure safe installation, operating, and servicing of the device (documents such as operating and service manuals may be identified in the label and used to provide this information);
   ii. The requirement, or lack of requirement, for leak testing, or for testing any on-off mechanism and indicator, including the maximum time interval for the testing, and the identification of radioactive material by isotope, quantity of radioactivity, and date of determination of the quantity; and
   iii. The information called for in one of the following statements in the same or substantially similar form:

The receipt, possession, use, and transfer of this device, Model _____, Serial No. _____, are subject to a general license or the equivalent and the regulations of the U.S. Nuclear Regulatory Commission or a state with which the Nuclear Regulatory Commission has entered into an agreement for the exercise of regulatory authority. This label shall be maintained on the device in a legible condition. Removal of this label is prohibited.

CAUTION -- RADIOACTIVE MATERIAL

_____
(name of manufacturer or distributor)

The receipt, possession, use and transfer of this device, Model _____, Serial No. _____, are subject to a general license or the equivalent, and the regulations of a Licensing State. This label shall be maintained on the device in a legible condition. Removal of this label is prohibited.

CAUTION -- RADIOACTIVE MATERIAL

_____
(name of manufacturer or distributor)

   d. The model, serial number, and name of manufacturer or distributor may be omitted from this label provided they are elsewhere specified in labeling affixed to the device.

2. In the event the applicant desires that the device undergo mandatory testing at intervals longer than six months, either for proper operation of the on-off mechanism and indicator, if any, or for leakage of radioactive material or for both, the application shall contain sufficient information to demonstrate that the longer interval is justified by performance characteristics of the device or similar devices and by design features which have a significant bearing on the probability or consequences of leakage of radioactive material from the device or failure of the on-off mechanism and indicator. In determining the acceptable interval for the test for leakage of radioactive material, the Agency shall consider information which includes, but is not limited to:
   a. Primary containment (source capsule);
   b. Protection of primary containment;
   c. Method of sealing containment;
   d. Containment construction materials;
   e. Form of contained radioactive material;
   f. Maximum temperature withstood during prototype tests;
   g. Maximum pressure withstood during prototype tests;
   h. Maximum quantity of contained radioactive material;
   i. Radiotoxicity of contained radioactive material; and
   j. Operating experience with identical devices or similarly designed and constructed devices.
3. In the event the applicant desires that the general licensee under R12-1-306(B), or under equivalent regulations of the NRC or an Agreement State or Licensing State, be authorized to install the device, collect the sample to be analyzed by a specific licensee for leakage of radioactive material, service the device, test the on-off mechanism and indicator, or remove the device from installation, the application shall include written instructions to be followed by the general licensee, estimated calendar quarter doses associated with the activity or activities, and bases for the estimates. The submitted information shall demonstrate that performance of the activity or activities by an individual untrained in radiological protection, in addition to other handling, storage, and use of devices under the general license, is unlikely to cause that individual to receive a dose in excess of 10% of the limits specified in R12-1-408.
4. A person licensed under subsection (D) to distribute devices to a generally licensed person shall furnish to a generally licensed person to whom radioactive material is transferred, either directly or through an intermediate person:

a. A copy of the general license requirements contained in R12-1-306(B) and a note explaining that use of the device is regulated by the NRC, Agreement State, or Licensing State under requirements substantially the same as those in R12-1-306(B); or
b. A copy of the general license contained in the NRC, Agreement State's, or Licensing State's regulation equivalent to R12-1-306(B).

5. A person licensed under subsection (D) to initially transfer devices to a generally licensed person, shall comply with the following requirements:
   a. The person licensed under subsection (D) shall report all transfers of devices to persons for use under a general license obtained under R12-1-306(B), and all receipts of devices from persons licensed under R12-1-306(B) to the Agency, NRC, or other affected Agreement State. The report shall be submitted on a quarterly basis, in a clear and legible form, and contain the following information:
      i. The identity of each general licensee by name and mailing address for the location of use. If there is no mailing address for the location of use, the person licensed under subsection (D) shall submit an alternate address for the general licensee, along with information on the actual location of use;
      ii. The name, title, and telephone number of a person identified by the general licensee as having knowledge of and authority to take required actions to ensure compliance with the applicable laws;
      iii. The date of transfer;
      iv. The type, model number, and serial number of the device transferred; and
      v. The quantity and type of byproduct material contained in the device.
   b. If one or more intermediate persons will temporarily possess the device at the intended place of use before its possession by the intended user, the report shall include the information required of the general licensee in subsection (D)(5)(a) for both the intended user and each intermediate person, clearly identifying the intended user and each intermediate person.
   c. For devices received from a general licensee, licensed under R12-1-306(B), the report shall include:
      i. The identity of the general licensee by name and address;
      ii. The type, model number, and serial number of the device received;
      iii. The date of receipt; and
      iv. In the case of a device not initially transferred by the reporting licensee, the name of the manufacturer or initial transferor.
   d. If the person licensed under subsection (D) makes a change to a device possessed by a general licensee so that the label must be changed to update required information, the report shall identify the general licensee, the device, and the changes to information on the device label.
   e. The report shall cover a calendar quarter, be filed within 30 days of the end of each calendar quarter, and clearly indicate the period covered by the report.
   f. The report shall clearly identify the person licensed under subsection (D) submitting the report and include the license number of the licensee.
   g. If no transfers are made to or from persons generally licensed under R12-1-306(B) during a reporting period, the person licensed under subsection (D) shall submit a report indicating the lack of activity.
6. The person licensed under subsection (D) shall maintain records of all transfers for Agency inspection. Records shall be maintained for three years after termination of the license to manufacture the generally licensed devices regulated under R12-1-306(B).

E. The Agency shall approve an application for a specific license to manufacture, assemble, or repair luminous safety devices containing tritium or promethium-147 for use in aircraft, for distribution to persons generally licensed under R12-1-306(C), if the applicant satisfies:
1. The general requirements specified in R12-1-309; and
2. The requirements of 10 CFR 32.53 through 32.56 and 32.101, 1998 Edition, published January 1, 1998, incorporated by reference and on file with the Agency and the Office of the Secretary of State, or their equivalent. These incorporations by reference contain no future editions or amendments.

F. The Agency shall approve an application for a specific license to manufacture calibration sources containing americium-241 or plutonium for distribution to persons generally licensed under R12-1-306(D) if the applicant satisfies:
1. The general requirements of R12-1-309; and
2. The requirements of 10 CFR 32.57, 32.58, 32.102, and 70.39, 1998 Edition, published January 1, 1998, incorporated by reference and on file with the Agency and the Office of the Secretary of State, or their equivalent. These incorporations by reference contain no future editions or amendments.

G. In addition to requirements set forth in R12-1-309, the Agency shall issue a specific license authorizing the distribution of radioactive material for use by physicians under the general license in R12-1-306(E) if:
1. The applicant submits evidence that the radioactive material is to be manufactured, labeled, and packaged under a new drug application which the Commissioner of Food and Drugs, U.S. Food and Drug Administration has approved, or according to a license for a biologic product issued by the FDA; and
2. One of the following statements, or a substantially similar statement which contains the information called for in the following statements, appears on the label affixed to the container or appears in the leaflet or brochure which accompanies the package:
   a. This radioactive drug may be received, possessed, and used only by physicians licensed to dispense drugs in the practice of medicine. Its receipt, possession, use and transfer are subject to the regulations and general license or its equivalent of the U.S. Nuclear Regulatory Commission or of a state with which the Commission has entered into agreement for the exercise of regulatory authority.

      _____
      Name of Manufacturer
   b. This radioactive drug may be received, possessed, and used only by physicians licensed (to dispense drugs) in the practice of medicine. Its receipt, possession, use and transfer are subject to the regulations and a general license or its equivalent of a Licensing State.

_____
Name of Manufacturer

H. The Agency shall approve an application for a specific license to manufacture or distribute radioactive material for use under the general license of R12-1-306(F) if:
1. The applicant satisfies the general requirements specified in R12-1-309.
2. The radioactive material is to be prepared for distribution in prepackaged units of:
   a. Iodine-125 in units not exceeding 370 kBq (10 microcuries) each;
   b. Iodine-131 in units not exceeding 370 kBq (10 microcuries) each;
   c. Carbon-14 in units not exceeding 370 kBq (10 microcuries) each;
   d. Hydrogen-3 (tritium) in units not exceeding 1.85 MBq (50 microcuries) each;
   e. Iron-59 in units not exceeding 740 kBq (20 microcuries) each;
   f. Cobalt-57 in units not exceeding 370 kBq (10 microcuries) each;
   g. Mock iodine-125 in units not exceeding 1.85 kBq (50 nanocuries) of iodine-129 and 185 Bq (5 nanocuries) of americium-241 each.
3. Each prepackaged unit bears a durable, clearly visible label:
   a. Identifying the radioactive contents as to chemical form and radionuclide and indicating that the amount of radioactivity does not exceed 370 kBq (10 microcuries) of iodine-125, iodine-131, cobalt-57 or carbon-14; 1.85 MBq (50 microcuries) of hydrogen-3 (tritium), 740 kBq (20 microcuries) of iron-59; or mock iodine-125 in units not exceeding 1.85 kBq (50 nanocurie) of iodine-129 and 185 Bq (5 nanocuries) of americium-241 each; and
   b. Displaying the radiation caution symbol described in R12-1-428, the words, "CAUTION, RADIOACTIVE MATERIAL," and the phrase "Not for Internal or External Use in Humans or Animals."
4. One of the following statements, or a substantially similar statement which contains the information called for in the following statements appears on a label affixed to each prepackaged unit or appears in a leaflet or brochure which accompanies the package:
   a. This radioactive material may be received, acquired, possessed, and used only by physicians, clinical laboratories or hospitals and only for in vitro clinical or laboratory tests not involving internal or external administration of the material, or the radiation from the radioactive material, to human beings or animals. Its receipt, acquisition, possession, use, and transfer are subject to the regulations and a general license of the U.S. Nuclear Regulatory Commission or of a state with which the Commission has entered into an agreement for the exercise of regulatory authority.

      _____
      Name of Manufacturer
   b. This radioactive drug may be received, acquired, possessed, and used only by physicians, clinical laboratories or hospitals and only for in vitro clinical or laboratory tests not involving internal or external administration of the material, or the radiation from the radioactive material, to human beings or animals. Its receipt, acquisition, possession, use and transfer are subject to the regulations and a general license of a Licensing State.

      _____
      Name of Manufacturer
5. The label affixed to the unit, or the leaflet or brochure which accompanies the package, contains adequate information about the precautions to be observed in handling and storing the specified radioactive material. In the case of the mock iodine-125 reference or calibration source, the information accompanying the source must also contain directions to the licensee regarding the waste disposal requirements set out in R12-1-434.

I. The Agency shall approve an application for a specific license to manufacture and distribute ice detection devices to persons generally licensed under R12-1-306(G) if the applicant satisfies:
1. The general requirements of R12-1-309; and
2. The criteria of 10 CFR 32.61, 32.62, and 32.101, 1998 Edition, published January 1, 1998, incorporated by reference and on file with the Agency and the Office of the Secretary of State. These incorporations by reference contain no future editions or amendments.

J. Manufacture and distribution of radiopharmaceuticals for medical use under a license issued according to 12 A.A.C. 1, Article 7.
1. The Agency shall approve an application for a specific license to manufacture and distribute radiopharmaceuticals for use by persons licensed under 12 A.A.C. 1, Article 7 if:
   a. The applicant satisfies the general requirements specified in R12-1-309; and
   b. The applicant submits evidence that:
      i. The radiopharmaceutical will be manufactured, labeled, and packed according to the Federal Food, Drug, and Cosmetic Act or the Public Health Service Act, a new drug application (NDA) approved by the Food and Drug Administration (FDA), a biological product license issued by the FDA or a "Notice of Claimed Investigational Exemption for a New Drug" (IND) that has been accepted by the FDA; or
      ii. The manufacture and distribution of the radiopharmaceutical is not subject to the Federal Food, Drug, and Cosmetic Act and the Public Health Service Act.
   c. The applicant submits information on the radionuclide; chemical and physical form, packaging including maximum activity per package, and shielding provided by the packaging of the radioactive material which is appropriate for safe handling and storage of radiopharmaceuticals by group licensees; and
   d. The label affixed to each package of the radiopharmaceutical contains information on the radionuclide; quantity, and date of assay; and the label affixed to each package, or the leaflet or brochure which accompanies each package, contains a statement that the radiopharmaceutical is licensed by the Agency for distribution to persons licensed according to the requirements in 12 A.A.C. 1, Article 7 or an equivalent license of the U.S. Nuclear Regulatory Commission or an Agreement State or Licensing State. The labels, leaflets or brochures required by this subsection supplement the labeling required by the Food and Drug Administration (FDA) and they may be

separate from or, with the approval of FDA, combined with the labeling required by FDA.

2. A radiopharmaceutical dispensed from a nuclear pharmacy according to A.R.S. § 32-1904 is exempt from the requirements contained in subsection (J)(1). Labeling of such radiopharmaceuticals is governed by Board of Pharmacy rules and the conditions of a radioactive material license.

K. The Agency shall approve an application for a specific license to manufacture and distribute generators or reagent kits containing radioactive material for preparation of radiopharmaceuticals by persons licensed according to 12 A.A.C. 1, Article 7 if:

1. The applicant satisfies the general requirements of R12-1-309;
2. The applicant submits evidence that:
   a. The generator or reagent kit is to be manufactured, labeled and packaged according to the Federal Food, Drug, and Cosmetic Act or the Public Health Service Act, a new drug application (NDA) approved by the Food and Drug Administration (FDA), a biologic product license issued by FDA, or a "Notice of Claimed Investigational Exemption for a New Drug" (IND) that has been accepted by the FDA; or
   b. The manufacture and distribution of the generator or reagent kit are not subject to the Federal Food, Drug, and Cosmetic Act and the Public Health Service Act.
3. The applicant submits information on the radionuclide; chemical and physical form, packaging including maximum activity per package, and shielding provided by the packaging of the radioactive material contained in the generator or reagent kit;
4. The label affixed to the generator or reagent kit contains information on the radionuclide, including quantity, and date of assay; and
5. The label affixed to the generator or reagent kit, or the leaflet or brochure which accompanies the generator or reagent kit, contains:
   a. Adequate information, from a radiation safety stand point, on the procedures to be followed and the equipment and shielding to be used in eluting the generator or processing radioactive material with the reagent kit, and
   b. A statement that this generator or reagent kit (as appropriate) is approved for use by persons licensed by the Agency under 12 A.A.C. 1, Article 7 or equivalent licenses of the U.S. Nuclear Regulatory Commission or an Agreement State or Licensing State. The labels, leaflets or brochures required by this subsection supplement the labeling required by FDA and they may be separate from or, with the approval of FDA, combined with the labeling required by FDA.

L. Manufacture and distribution of sources or devices containing radioactive material for medical use

1. The Agency shall approve an application for a specific license to manufacture and distribute sources and devices containing radioactive material to persons licensed under 12 A.A.C. 1, Article 7 for use as a calibration or reference source or for certain medical uses as sealed sources if:
   a. The applicant satisfies the general requirements in R12-1-309;
   b. The applicant submits sufficient information regarding each type of source or device pertinent to an evaluation of radiation safety, including:
      i. The radioactive material contained, its chemical and physical form, and amount;
      ii. Details of design and construction of the source or device;
      iii. Procedures for, and results of, prototype tests to demonstrate that the source or device will maintain its integrity under stresses likely to be encountered in normal use and accidents;
      iv. For devices containing radioactive material, the radiation profile of a prototype device;
      v. Details of quality control procedures to assure that production sources and devices meet the standards of the design and prototype tests;
      vi. Procedures and standards for calibrating sources and devices;
      vii. Legend and methods for labeling sources and devices as to their radioactive content;
      viii. Instruction for handling and storing the source or device from the radiation safety standpoint; these instructions are to be included on a durable label attached to the source or device or attached to a permanent storage container for the source or device; provided that instructions which are too lengthy for the label may be summarized on the label and printed in detail on a brochure which is referenced on the label;
   c. The label affixed to the source or device, or to the permanent storage container for the source or device, contains information on the radionuclide; quantity, the date of assay, and a statement that the (name of source or device) is licensed by the Agency for distribution to persons licensed under 12 A.A.C. 1, Article 7 or equivalent license of the U.S. Nuclear Regulatory Commission or an Agreement State or a Licensing State, provided that labeling for sources which do not require long term storage may be on a leaflet or brochure which accompanies the source.
2. In the event the applicant desires that the source or device undergo mandatory testing for leakage of radioactive material at intervals longer than six months, the application shall include sufficient information to demonstrate that the longer interval is justified by performance characteristics of the source or device or similar sources or devices and by design features that have a significant bearing on the probability or consequences of leakage of radioactive material from the source. In determining the acceptable interval for test of leakage of radioactive material, the Agency shall consider information that includes, but is not limited to:
   a. Primary containment (source capsule);
   b. Protection of primary containment;
   c. Method of sealing containment;
   d. Containment construction materials;
   e. Form of contained radioactive material;
   f. Maximum temperature withstood during prototype tests;
   g. Maximum pressure withstood during prototype tests;
   h. Maximum quantity of contained radioactive material;
   i. Radiotoxicity of contained radioactive material; and
   j. Operating experience with identical sources or devices or similarly designed and constructed sources or devices.

M. Requirements for license to manufacture and distribute industrial products containing depleted uranium for mass volume applications.

1. The Agency shall approve an application for a specific license to manufacture industrial products and devices containing depleted uranium for use under R12-1-305(C) or equivalent regulations of the U.S. Nuclear Regulatory Commission or an Agreement State if:
   a. The applicant satisfies the general requirements in R12-1-309;
   b. The applicant submits sufficient information relating to the design, manufacture, prototype testing, quality control procedures, labeling or marking, proposed uses, and potential hazards of the industrial product or device to provide reasonable assurance that possession, use, or transfer of the depleted uranium in the product or device is not likely to cause any individual to receive a radiation dose in excess of 10 percent of the limits specified in R12-1-408.
   c. The applicant submits sufficient information regarding the industrial product or device and the presence of depleted uranium for a mass volume application in the product or device to provide reasonable assurance that unique benefits will accrue to the public because of the usefulness of the product or device.
2. In the case of an industrial product or device whose unique benefits are questionable, the Agency shall approve an application for a specific license under this subsection only if the product or device is found to combine a high degree of utility and low probability of uncontrolled disposal and dispersal of significant quantities of depleted uranium into the environment.
3. The Agency may deny any application for a specific license under this subsection if the end use or uses of the industrial product or device cannot be reasonably foreseen.
4. Each person licensed under subsection (M)(1) shall:
   a. Maintain the level of quality control required by the license in the manufacture of the industrial product or device and the installation of the depleted uranium into the product or device;
   b. Label or mark each unit to:
      i. Identify the manufacturer of the product or device, the number of the license under which the product or device was manufactured, the fact that the product or device contains depleted uranium, and the quantity of depleted uranium in each product or device; and
      ii. State that the receipt, possession, use, and transfer of the product or device are subject to a general license or the equivalent and the regulations of the U.S. Nuclear Regulatory Commission or an Agreement State;
   c. Assure that the depleted uranium, before being installed in each product or device, has been impressed with the following legend, clearly legible through any plating or other covering: "Depleted Uranium";
   d. Furnish a copy of the general license contained in R12-1-305(C) and a copy of ARRA-23 to each person to whom depleted uranium in a product or device is transferred for use under a general license contained in R12-1-305(C); or
   e. Furnish a copy of the general license contained in the U.S. Nuclear Regulatory Commission's or Agreement State's regulation equivalent to R12-1-305(C) and a copy of the U.S. Nuclear Regulatory Commission's or Agreement State's certificate, or alternatively, furnish a copy of the general license contained in R12-1-305(C) and a copy of ARRA-23 to each person to whom depleted uranium in a product or device is transferred for use under a general license of the U.S. Nuclear Regulatory Commission or an Agreement State, with a document explaining that use of the product or device is regulated by the U.S. Nuclear Regulatory Commission or an Agreement State under requirements substantially the same as those in R12-1-305(C);
   f. Report to the Agency all transfers of industrial products or devices to persons for use under the general license in R12-1-305(C). The report shall identify each general licensee by name and address, an individual by name or position who serves as the point of contact person for the general licensee, the type and model number of device transferred, and the quantity of depleted uranium contained in the product or device. The report shall be submitted within 30 days after the end of each calendar quarter in which a product or device is transferred to the generally licensed person. If no transfers have been made to persons generally licensed under R12-1-305(C) during the reporting period, the report shall so indicate;
      i. Report to the U.S. Nuclear Regulatory Commission all transfers of industrial products or devices to persons for use under the U.S. Nuclear Regulatory Commission general license in 10 CFR 40.25; or
      ii. Report to the responsible state agency all transfers of devices manufactured and distributed under subsection (M)(4)(f) for use under a general license in that state's regulations equivalent to R12-1-305(C);
      iii. The report required in subsection (M)(4)(f)(i) or (ii) shall identify each general licensee by name and address, an individual by name or position who serves as the contact person for the general licensee, the type and model number of the device transferred, and the quantity of depleted uranium contained in the product or device. The report shall be submitted within 30 days after the end of each calendar quarter in which a product or device is transferred to the generally licensed person;
      iv. If no transfers have been made to U.S. Nuclear Regulatory Commission licensees during the reporting period, this information shall be reported to the U.S. Nuclear Regulatory Commission;
      v. If no transfers have been made to general licensees within a particular Agreement State during the reporting period, this information shall be reported to the responsible Agreement state agency; and
      vi. Keep records showing the name, address, and contact person for each general licensee to whom depleted uranium in industrial products or devices is transferred for use under a general license provided in R12-1-305(C) or equivalent regulations of the U.S. Nuclear Regulatory Commission or of an Agreement State. The records shall be maintained for a period of two

years and show the date of each transfer, the quantity of depleted uranium in each product or device transferred, and compliance with the reporting requirements of this Section.

Historical Note

Former Rule Section C.101. Former Section R12-1-311 repealed, new Section R12-1-311 adopted effective June 30, 1977 (Supp. 77-3). Amended effective December 20, 1985 (Supp. 85-6). Former Section R12-1-311 renumbered to R12-1-312, new Section R12-1-311 renumbered from R12-1-310 effective February 18, 1994 (Supp. 94-1). Former Section R12-1-311 renumbered to R12-1-310; new Section R12-1-311 renumbered from R12-1-312 and amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-312. Issuance of Specific Licenses

A. Upon a determination that an application meets the requirements of the Act and the rules of the Agency, the Agency shall issue a specific license authorizing the proposed activity containing conditions and limitations as it deems appropriate or necessary.

B. The Agency may incorporate in any license at the time of issuance, or thereafter by appropriate rule, or order, additional requirements and conditions with respect to the licensee's receipt, possession, use, and transfer of radioactive material in order to:
1. Minimize danger to public health and safety or property;
2. Require reports and the recordkeeping, and to provide for inspections of activities under the license as may be appropriate or necessary; and
3. Prevent loss or theft of material subject to this Article.

C. The Agency may verify information contained in an application and secure additional information necessary to make a determination on issuance of a license and whether any special conditions should be attached to the license. The Agency may inspect the facility or location where radioactive materials would be possessed or used, and discuss details of the proposed possession or use of the radioactive materials with the applicant or representatives designated by the applicant.

Historical Note

Former Rule Section C.102; Former Section R12-1-312 repealed, new Section R12-1-312 adopted effective June 30, 1977 (Supp. 77-3). Amended effective December 20, 1985 (Supp. 85-6). Former Section R12-1-312 renumbered to R12-1-313, new Section R12-1-312 renumbered from R12-1-311 effective February 18, 1994 (Supp. 94-1). Former Section R12-1-312 renumbered to R12-1-311; new Section R12-1-312 renumbered from R12-1-313 and amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-313. Specific Terms and Conditions of Licenses

A. Each license issued under this Article is subject to all provisions of A.R.S. Title 30, Chapter 4 and to all rules and orders of the Agency.

B. A licensee shall not transfer, assign, or in any manner dispose of a license issued or granted under this Article or a right to possess or utilize radioactive material granted by any license issued under this Article unless the Agency finds that the transfer is consistent with the Agency's statutes and rules, and gives its consent in writing.

C. Each person licensed by the Agency under this Article shall confine the use and possession of the material licensed to the locations and purposes authorized in the license.

D. Each person licensed under this Section shall notify the Agency in writing when the licensee decides to permanently discontinue any or all activities involving materials authorized under the license.

E. Each licensee shall notify the Agency, in writing:
1. Immediately following the filing of a petition for bankruptcy under any Chapter of Title 11 of the United States Code if the petition for bankruptcy is by or against:
   a. The licensee;
   b. An entity (as defined in the bankruptcy code) controlling the licensee or listing the license or licensee as property of the estate; or
   c. An affiliate (as defined in the bankruptcy code) of the licensee.
2. Providing the following information:
   a. The bankruptcy court in which the petition for bankruptcy was filed;
   b. The bankruptcy case title and number; and
   c. The date the petition was filed.

Historical Note

Former Rule Section C.103; Former Section R12-1-313 repealed, new Section R12-1-313 adopted effective June 30, 1977 (Supp. 77-3). Amended effective December 20, 1985 (Supp. 85-6). Amended effective June 20, 1990 (Supp. 90-2). Former Section R12-1-313 renumbered to R12-1-314, new Section R12-1-313 renumbered from R12-1-312 effective February 18, 1994 (Supp. 94-1). Former Section R12-1-313 renumbered to R12-1-312; new Section R12-1-313 renumbered from R12-1-314 and amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-314. Expiration of License

Except as provided in R12-1-315(B), each specific license expires at the end of the day, in the month and year stated on the license.

Historical Note

Former Rule Section C.104; Former Section R12-1-314 repealed, new Section R12-1-314 adopted effective June 30, 1977 (Supp. 77-3). Former Section R12-1-314 renumbered to R12-1-315, new Section R12-1-314 renumbered from R12-1-313 effective February 18, 1994 (Supp. 94-1). Former Section R12-1-314 renumbered to R12-1-313; new Section R12-1-314 renumbered from R12-1-315 and amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-315. Renewal of License

A. An applicant shall file an application for renewal of a specific license according to R12-1-308.

B. In any case in which a licensee, not less than 30 days prior to expiration of the existing license, has filed an application in proper form for renewal or for a new license authorizing the same activities, the existing license does not expire until a final determination by the Agency.

Historical Note

Former Rule Section C.105; Former Section R12-1-315 repealed, new Section R12-1-315 adopted effective June 30, 1977 (Supp. 77-3). Amended effective December 20, 1985 (Supp. 85-6). Former Section R12-1-315 renumbered to R12-1-316, new Section R12-1-315 renumbered from R12-1-314 effective February 18, 1994 (Supp. 94-1). Former Section R12-1-315 renumbered to R12-1-314; new Section R12-1-315 renumbered from R12-1-316 and

amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-316. Amendment of Licenses at Request of Licensee
An applicant shall file an application for amendment of a specific license by complying with R12-1-308 and specifying the grounds for the amendment.

Historical Note
Former Rule Section C.106; Former Section R12-1-316 repealed, new Section R12-1-316 adopted effective June 30, 1977 (Supp. 77-3). Amended effective December 20, 1985 (Supp. 85-6). Former Section R12-1-316 renumbered to R12-1-317, new Section R12-1-316 renumbered from R12-1-315 effective February 18, 1994 (Supp. 94-1). Former Section R12-1-316 renumbered to R12-1-315; new Section R12-1-316 renumbered from R12-1-317 and amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-317. ARRA Action on Applications to Renew or Amend
In considering an application by a licensee to renew or amend a specific license, the Agency shall apply the criteria set forth in R12-1-309, R12-1-310, or R12-1-311 as applicable.

Historical Note
Former Rule Section C.107; Former Section R12-1-317 repealed, new Section R12-1-317 adopted effective June 30, 1977 (Supp. 77-3). Amended effective December 20, 1985 (Supp. 85-6). Former Section R12-1-317 renumbered to R12-1-318, new Section R12-1-317 renumbered from R12-1-316 effective February 18, 1994 (Supp. 94-1). Former Section R12-1-317 renumbered to R12-1-316; new Section R12-1-317 renumbered from R12-1-318 and amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-318. Transfer of Radioactive Material

A. A licensee shall not transfer radioactive material except as authorized under this Section.

B. Except as otherwise provided in the license and subject to the provisions of subsections (C) and (D), any licensee may transfer radioactive material:
1. To the Agency; after receiving prior approval from the Agency;
2. To the Department of Energy;
3. To any person exempt from the rules in this Article to the extent permitted under the exemption;
4. To any person authorized to receive radioactive material under terms of a general license or its equivalent, or a specific license or equivalent licensing document, issued by the Agency, the U.S. Nuclear Regulatory Commission, or any Agreement State or Licensing State, or to any person otherwise authorized to receive radioactive material by the Federal Government or any agency of the Federal Government, the Agency, any Agreement State or Licensing State; or
5. As otherwise authorized by the Agency in writing.

C. Before transferring radioactive material to a specific licensee of the Agency, the U.S. Nuclear Regulatory Commission, or an Agreement State or Licensing State, or to a general licensee who is required to register with the Agency, the U.S. Nuclear Regulatory Commission, or an Agreement State or Licensing State prior to receipt of the radioactive material, the licensee transferring the material shall verify that the transferee's license authorizes the receipt of the type, form, and quantity of radioactive material to be transferred.

D. The transferor shall use one or more of the following methods for the verification required by subsection (C):
1. The transferor shall possess, and read, a current copy of the transferee's specific license or registration certificate;
2. The transferor shall possess a written certification by the transferee that the transferee is authorized by license or registration certificate to receive the type, form, and quantity of radioactive material to be transferred, specifying the license or registration certificate number, issuing agency, and expiration date;
3. For emergency shipments the transferor shall accept oral certification by the transferee that the transferee is authorized by license or registration certificate to receive the type, form, and quantity of radioactive material to be transferred, specifying the license or registration certificate number, issuing agency, and expiration date; provided the oral certification is confirmed in writing within 10 days;
4. The transferor shall obtain information equivalent to that in subsection (D)(1) to (3) compiled by a reporting service from official records of the Agency, the U.S. Nuclear Regulatory Commission, or the licensing agency of an Agreement State or Licensing State regarding the identity of any licensee and the scope and expiration date of any license, registration, or certificate; or
5. When none of the methods of verification described in subsections (D)(1) to (4) are readily available or when a transferor desires to verify that information received by one of the above methods is correct or up-to-date, the transferor shall obtain and record confirmation from the Agency, the U.S. Nuclear Regulatory Commission, or the licensing agency of an Agreement State or Licensing State that the transferee is licensed to receive the radioactive material.

E. A transferor shall prepare and transport radioactive material as prescribed in the provisions of 12 A.A.C. 1, Article 15.

Historical Note
Adopted effective June 30, 1977 (Supp. 77-3). Amended effective December 20, 1985 (Supp. 85-6). Former Section R12-1-318 renumbered to R12-1-319, new Section R12-1-318 renumbered from R12-1-317 effective February 18, 1994 (Supp. 94-1). Former Section R12-1-318 renumbered to R12-1-317; new Section R12-1-318 renumbered from R12-1-319 and amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-319. Modification, Revocation, or Termination of a License

A. The terms and conditions of all licenses are subject to amendment, revision, or modification, and a license may be suspended or revoked by reason of amendments to the Agency's statutes or rules and orders issued by the Agency.

B. The Agency may revoke, suspend, or modify any license, in whole or in part, for any material false statement in the application; any omission or misstatement of fact required by statute, rule, or order, or because of conditions revealed by the application or any report, record, or inspection or other means that would cause the Agency to refuse to grant a license; or any violation of license terms and conditions, or the Agency's statutes, rules, or orders.

C. Except in cases of willfulness or those in which the public health, interest, or safety requires otherwise, the Agency shall not modify, suspend, or revoke a license unless, prior to the institution of proceedings, facts or conduct which may warrant such action have been called to the attention of the licensee in

writing and the licensee has been accorded an opportunity to demonstrate or achieve compliance.

D. The Agency may terminate a specific license upon a written request by the licensee, based on whether the licensee has met the termination criteria in R12-1-451, R12-1-452, and the decommissioning requirements in R12-1-323.

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Amended effective December 20, 1985 (Supp. 85-6). Former Section R12-1-319 renumbered to R12-1-320, new Section R12-1-319 renumbered from R12-1-318 effective February 18, 1994 (Supp. 94-1). Former Section R12-1-319 renumbered to R12-1-318; new Section R12-1-319 renumbered from R12-1-320 and amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-320. Reciprocal Recognition of Licenses

A. A general license is established by the Agency to perform specific licensed activities in Arizona for a period not to exceed 180 days in any calender year to any person who holds a specific license for activity involving the use of radioactive material from the U.S. Nuclear Regulatory Commission, Licensing State, or any Agreement State, issued by the agency with jurisdiction where the licensee maintains an office for directing the licensed activity and at which radiation safety records are normally maintained, provided that:

1. The license does not limit the activity to specified installations or locations;
2. The out-of-state licensee notifies the Agency in writing at least three days prior to engaging in the licensed activity. The notification shall indicate the location, period, and type of proposed possession and use within the State, and be accompanied by a copy of the pertinent licensing document. If, for a specific case, the three-day period would impose an undue hardship on the out-of-state licensee, the licensee may, upon application to the Agency, obtain permission to proceed sooner. The Agency may waive the requirement for filing additional written notifications during the remainder of the calendar year, following receipt of the initial notification from a person engaging in activities under the general license provided in this Section;
3. The out-of-state licensee complies with all applicable statutes and rules of the Agency and with all the terms and conditions of the license, except those terms and conditions inconsistent with applicable statutes and rules of the Agency;
4. The out-of-state licensee supplies any other information the Agency requests; and
5. The out-of-state licensee does not transfer or dispose of radioactive material possessed or used under the general license provided in this Section except by transfer to a person:
   a. Specifically licensed by the Agency, or by the U.S. Nuclear Regulatory Commission to receive the radioactive material; or
   b. Exempt under R12-1-303(A).

B. Notwithstanding the provisions of subsection (A)(1), a general license is established by the Agency to manufacture, install, transfer, demonstrate, or service a device described in R12-1-306(B)(1) to any person who holds a specific license issued by the U.S. Nuclear Regulatory Commission, Licensing State, or an Agreement State authorizing the same activities within areas subject to the jurisdiction of the licensing body, provided that:

1. The person files a report with the Agency within 30 days after the end of each calendar quarter in which any device is transferred to or installed in this State. Each report shall identify the general licensee to whom the device is transferred by name and address, the type of device transferred, and the quantity and type of radioactive material contained in the device;
2. The device has been manufactured, labeled, installed, and serviced according to the applicable provisions of the specific license issued to the person by the U.S. Nuclear Regulatory Commission or an Agreement State;
3. The person entering the state ensures that any labels required to be affixed to the device under rules of the authority which licensed manufacture of the device bear the following statement: "Removal of this label is prohibited"; and
4. The holder of the specific license furnishes a copy of the general license contained in R12-1-306(B), or equivalent rules of the agency having jurisdiction over the manufacture or distribution of the device, to each general licensee to whom the licensee transfers the device or on whose premises the device is installed.

C. The Agency may withdraw, limit, or qualify the acceptance of any specific license or equivalent licensing document issued by another agency, or any product distributed under a license, upon determining that an action is necessary to prevent undue hazard to public health and safety, or property.

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Amended effective December 20, 1985 (Supp. 85-6). Former Section R12-1-320 renumbered to R12-1-321, new Section R12-1-320 renumbered from R12-1-319 effective February 18, 1994 (Supp. 94-1). Former Section R12-1-320 renumbered to R12-1-319; new Section R12-1-320 renumbered from R12-1-321 and amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-321. Preparation of Radioactive Material for Transport

A licensee shall not deliver any radioactive material to a carrier for transport, unless the licensee complies with the provisions of 12 A.A.C. 1, Article 15.

Historical Note

Former Rule Section C.201; Former Section R12-1-321 repealed, new Section R12-1-321 adopted effective June 30, 1977 (Supp. 77-3). Amended effective December 20, 1985 (Supp. 85-6). Former Section R12-1-321 renumbered to R12-1-322, new Section R12-1-321 renumbered from R12-1-320 effective February 18, 1994 (Supp. 94-1). Former Section R12-1-321 renumbered to R12-1-320; new Section R12-1-321 renumbered from R12-1-322 and amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-322. The Need for an Emergency Plan for Response to a Release of Radioactive Material

A. For purposes of this rule, "Emergency Plan" means a procedure that will be followed when an accident occurs involving licensed radioactive materials for which an offsite response may be needed from organizations, such as police, fire, or medical organizations.

B. Each application to possess radioactive materials in unsealed form, on foils or plated sources, or sealed in glass in excess of the quantities in Exhibit D, "Radioactive Material Quantities

Requiring Consideration for an Emergency Plan" shall contain either:

1. An evaluation showing that the maximum dose to a person off-site due to a release of radioactive materials would not exceed 1 rem effective dose equivalent or 5 rems to the thyroid; or
2. An emergency plan for responding to a release of radioactive material.

C. One or more of the following factors may be used to support an evaluation submitted under subsection (B)(1):

1. The radioactive material is physically separated so that only a portion could be involved in an accident.
2. All or part of the radioactive material is not subject to release during an accident because of the way it is stored or packaged;
3. The release fraction in the respirable size range would be lower than the release fraction shown in Exhibit D due to the chemical or physical form of the material;
4. The solubility of the radioactive material would reduce the dose received;
5. Facility design or engineered safety features in the facility would cause the release fraction to be lower than shown in Exhibit D;
6. Operating restrictions or procedures would prevent a release fraction as large as that shown in Exhibit D; or
7. Other factors appropriate for the specific facility.

D. An emergency plan for responding to a release of radioactive material submitted under subsection (B)(2) shall include the following information:

1. A brief description of the licensee's facility and areas near the site that could expose a member of the public to a dose equal to or greater than the levels expressed in subsection (B)(1).
2. An identification of each type of radioactive materials accident for which protective actions may be needed.
3. A classification system for classifying accidents as alerts or site area emergencies.
4. Identification of the means of detecting each type of accident in a timely manner.
5. A brief description of the means and equipment for mitigating the consequences of each type of accident, including those provided to protect workers onsite, and a description of the program for maintaining the equipment.
6. A brief description of the methods and equipment to assess releases of radioactive materials.
7. A brief description of the responsibilities of licensee personnel responsible for promptly notifying offsite response organizations and the Agency; also responsibilities for developing, maintaining, and updating the plan.
8. A commitment to and a brief description of the means to promptly notify offsite response organizations and request off-site assistance, including medical assistance for the treatment of contaminated and injured onsite workers when appropriate. A control point shall be established. The notification and coordination shall be planned so that unavailability of some personnel, parts of the facility, and some equipment will not prevent the notification and coordination. The licensee shall also commit to notify the Agency immediately after notification of the appropriate off-site response organizations and not later than one hour after the licensee declares an emergency.
9. A brief description of the types of information on facility status, radioactive releases, and recommended protective actions, if necessary, to be given to off-site response organizations and to the Agency.
10. A brief description of the frequency, performance objectives, and plans for the training that the licensee will provide workers on how to respond to an emergency including any special instructions and orientation tours the licensee would offer to fire, police, medical, and other emergency personnel. The training shall familiarize personnel with site-specific emergency procedures. Also, the training shall thoroughly prepare site personnel for their responsibilities in the event of accident scenarios postulated as most probable for the specific site, including the use of team training for such scenarios.
11. A brief description of the means of restoring the facility to a safe condition after an accident.
12. Provisions for conducting quarterly communications checks with off-site response organizations and biennial onsite exercises to test response to simulated emergencies. Quarterly communications checks with off-site response organizations shall include the verifying and updating of all necessary telephone numbers. The licensee shall invite off-site response organizations to participate in the biennial exercises. Their participation is not required. Exercises shall use accident scenarios postulated as most probable for the specific site and the scenarios shall not be known to most exercise participants. The licensee shall critique each exercise, using individuals without direct implementation responsibility for the plan. Critiques of exercises shall evaluate the appropriateness of the plan, emergency procedures, facilities, equipment, training of personnel, and overall effectiveness of the response. Deficiencies found by the critiques shall be corrected.
13. A certification that the applicant has met its responsibilities in A.R.S. §§ 26-341 through 26-353 (emergency Planning and Community Right-to-Know Act of 1986), if applicable to the applicant's activities at the proposed place of use of the radioactive material.

E. The licensee shall allow 60 days for the off-site response organizations, expected to respond in case of an accident, to comment on the licensee's emergency plan before submitting it to the Agency. The licensee shall provide any comments received within the 60 days to the Agency with the emergency plan.

Historical Note

Former Section R12-1-322 repealed effective June 30, 1977 (Supp. 77-3). New Section R12-1-322 renumbered from R12-1-321 effective February 18, 1994 (Supp. 94-1). Former Section R12-1-322 renumbered to R12-1-321; new Section R12-1-322 renumbered from R12-1-323 and amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-323. Financial Assurance and Recordkeeping for Decommissioning

A. For purposes of this rule:

1. "Decommissioning" means to remove a radioactive material use facility safely from service and to reduce residual radioactivity to a level that permits release of the property for unrestricted use and termination of the radioactive material use license.
2. "Byproduct material" as used in 10 CFR 30, means "radioactive material" which is defined in A.R.S. § 30-651.
3. "Facility" means the entire site of radioactive material use, or any separate building or outdoor area where it is used.
4. "Appendix B to Part 30" as used in 10 CFR 30, means Appendix E in 12 A.A.C. 1, Article 4.

5. "Financial security" means having a net worth of not less than $10,000.

B. When applying, each nongovernment applicant for a specific license authorizing the possession and use of radioactive material, and each nongovernment holder of a license to possess and use radioactive material issued before the effective date of this rule, shall submit to the Agency certification of financial security, as required in A.R.S. § 30-672(H).

1. Each affected licensee shall submit certification of financial security no later than three months following the effective date of this rule.
2. Licensees required to meet the requirements in subsection (C) are exempt from the requirements in this subsection.

C. When applying, each applicant for a specific license authorizing the possession and use of radioactive material, and each holder of a license to possess and use radioactive material issued before the effective date of this rule, shall submit to the Agency a decommissioning funding plan or certification of financial assurance meeting the requirements in 10 CFR 30.35 or 40.36, 1998 Edition, published January 1, 1998, incorporated by reference and on file with the Agency and the Office of Secretary of State. This incorporation by reference contains no future editions or amendments. Each affected licensee shall submit the plan or certification no later than six months following the effective date of this rule.

D. Each licensee required to provide financial assurance for decommissioning a radioactive material facility under this rule shall maintain records of information important to the safe and effective decommissioning of the facility in an identified location until the license is terminated by the Agency. The licensee shall maintain the following records during the decommissioning process:

1. Records of spills or other unusual occurrences involving the spread of contamination in and around the facility, equipment, and site. The licensee shall keep records identifying the involved radionuclides and associated quantities, forms, and concentrations.
2. As-built drawings showing modifications of structures and equipment in restricted areas where radioactive materials are used and stored, and locations of possible inaccessible contamination. If drawings are not available, the licensee shall provide appropriate records describing each location of possible contamination.
3. Records of the cost estimate performed for the decommissioning funding plan or of the amount certified for decommissioning, and records of the funding method used for assuring funds if either a funding plan or certification is used.

E. Decommissioning procedures:

1. Upon expiration or termination of licensed activities, a licensee shall begin decommissioning its facility within 60 days of notifying the Agency of the decision to discontinue licensed activities, or within 12 months of the decision, submit to the Agency a decommissioning plan, as prescribed in 10 CFR 30.36(g)(1), 1998 Edition, published January 1, 1998, incorporated by reference and on file with the Agency and the Office of Secretary of State, containing no future editions or amendments, and begin decommissioning upon approval of the plan if the license has expired or no licensed activities have been conducted at the licensee's facility for a period of 24 months.
2. In addition to the notification requirements in subsection (E)(1), the licensee shall maintain in effect all decommissioning financial assurances required by this Section. The financial assurances shall be increased or may be decreased as appropriate to cover the cost estimate established for decommissioning in subsection (E)(1).
   a. Any licensee who has not provided financial assurance to cover decommissioning shall do so one year from the effective date of this rule.
   b. The licensee may reduce the amount of the financial assurance following approval of the decommissioning plan, provided the radiological hazard is decreasing and the licensee has the approval of the Agency.
3. The Agency shall extend the time periods established in subsection (E)(1) if a new time period is in the best interest of public health and safety.
   a. The licensee shall submit the request for the change no later than 30 days before the notification timeframe specified in subsection (E)(1).
   b. If appropriate, the schedule for decommissioning activities, specified in subsection (E)(1), shall not commence until the Agency has made a determination on the request described in subsection (E)(3)(a).
4. Except as provided in subsection (E)(5), the licensee shall complete decommissioning of a facility as soon as practicable but no later than 24 months following the initiation of decommissioning; and except as provided in subsection (E)(5), when decommissioning involves the entire facility, the licensee shall request license termination as soon as practicable but no later than 24 months following initiation of decommissioning.
5. The Agency shall approve a request for an alternate schedule for completion of decommissioning and license termination if the Agency determines that the alternative is warranted by consideration of the conditions specified in 10 CFR, 30.36(i), 1998 Edition, published January 1, 1998, incorporated by reference and on file with the Agency and the Office of Secretary of State, containing no future editions or amendments.
6. As a final step in decommissioning, the licensee shall meet the requirements specified in 10 CFR Part 30.36(j), 1998 Edition, published January 1, 1998, incorporated by reference and on file with the Agency and the Office of Secretary of State, containing no future editions or amendments.

Historical Note

Former Section R12-1-323 repealed effective June 30, 1977 (Supp. 77-3). New Section R12-1-323 adopted effective February 18, 1994 (Supp. 94-1). Former Section R12-1-323 renumbered to R12-1-322; new Section adopted by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-324. Repealed

Historical Note

Repealed effective June 30, 1977 (Supp. 77-3).

R12-1-325. Repealed

Historical Note

Repealed effective June 30, 1977 (Supp. 77-3).

R12-1-326. Repealed

Historical Note

Repealed effective June 30, 1977 (Supp. 77-3).

R12-1-327. Repealed

Historical Note

Repealed effective June 30, 1977 (Supp. 77-3).

R12-1-328. Repealed

Historical Note
Repealed effective June 30, 1977 (Supp. 77-3).

R12-1-329. Repealed

Historical Note
Repealed effective June 30, 1977 (Supp. 77-3).

R12-1-330. Repealed

Historical Note
Repealed effective June 30, 1977 (Supp. 77-3).

R12-1-331. Repealed

Historical Note
Repealed effective June 30, 1977 (Supp. 77-3).

R12-1-332. Repealed

Historical Note
Repealed effective June 30, 1977 (Supp. 77-3).

R12-1-333. Repealed

Historical Note
Repealed effective June 30, 1977 (Supp. 77-3).

R12-1-334. Repealed

Historical Note
Repealed effective June 30, 1977 (Supp. 77-3).

R12-1-335. Repealed

Historical Note
Repealed effective June 30, 1977 (Supp. 77-3).

R12-1-336. Repealed

Historical Note
Repealed effective June 30, 1977 (Supp. 77-3).

R12-1-337. Repealed

Historical Note
Repealed effective June 30, 1977 (Supp. 77-3).

R12-1-338. Repealed

Historical Note
Repealed effective June 30, 1977 (Supp. 77-3).

R12-1-339. Repealed

Historical Note
Repealed effective June 30, 1977 (Supp. 77-3).

R12-1-340. Repealed

Historical Note
Repealed effective June 30, 1977 (Supp. 77-3).

R12-1-341. Repealed

Historical Note
Repealed effective June 30, 1977 (Supp. 77-3).

R12-1-342. Repealed

Historical Note
Repealed effective June 30, 1977 (Supp. 77-3).

R12-1-343. Repealed

Historical Note
Repealed effective June 30, 1977 (Supp. 77-3).

R12-1-344. Repealed

Historical Note
Repealed effective June 30, 1977 (Supp. 77-3).

R12-1-345. Repealed

Historical Note
Repealed effective June 30, 1977 (Supp. 77-3).

R12-1-346. Repealed

Historical Note
Repealed effective June 30, 1977 (Supp. 77-3).

R12-1-347. Repealed

Historical Note
Repealed effective June 30, 1977 (Supp. 77-3).

R12-1-348. Repealed

Historical Note
Repealed effective June 30, 1977 (Supp. 77-3).

Exhibit A. Exempt Concentrations

Element (atomic number)	Isotope	Column I Gas Concentration (μCi/ml)[1]/	Column II Liquid and Solid Concentration (μCi/ml)[2]/
Antimony (51)	Sb-122		$3X10^{-4}$
	Sb-124		$2X10^{-4}$
	Sb-125		$1X10^{-3}$
Argon (18)	Ar-37	$1X10^{-3}$	
	Ar-41	$4X10^{-7}$	
Arsenic (33)	As-73		$5X10^{-3}$
	As-74		$5X10^{-4}$
	As-76		$2X10^{-4}$
	As-77		$8X10^{-4}$
Barium (56)	Ba-131		$2X10^{-3}$
	Ba-140		$3X10^{-4}$
Beryllium (4)	Be-7		$2X10^{-2}$
Bismuth (83)	Bi-206		$4X10^{-4}$
Bromine (35)	Br-82	$4X10^{-7}$	$3X10^{-3}$
Cadmium (48)	Cd-109		$2X10^{-3}$
	Cd-115m		$3X10^{-4}$
	Cd-115		$3X10^{-4}$
Calcium (20)	Ca-45		$9X10^{-5}$
	Ca-47		$5X10^{-4}$
Carbon (6)	C-14	$1X10^{-6}$	$8X10^{-3}$
Cerium (58)	Ce-141		$9X10^{-4}$
	Ce-143		$4X10^{-4}$
	Ce-144		$1X10^{-4}$
Cesium (55)	Cs-131		$2X10^{-2}$
	Cs-134m		$6X10^{-2}$
	Cs-134		$9X10^{-5}$
Chlorine (17)	Cl-38	$9X10^{-7}$	$4X10^{-3}$
Chromium (24)	Cr-51		$2X10^{-2}$
Cobalt (27)	Co-57		$5X10^{-3}$
	Co-58		$1X10^{-3}$
	Co-60		$5X10^{-4}$
Copper (29)	Cu-64		$3X10^{-3}$
Dysprosium (66)	Dy-165		$4X10^{-3}$
	Dy-166		$4X10^{-4}$
Erbium (68)	Er-169		$9X10^{-4}$
	Er-171		$1X10^{v}$
Europium (63)	Eu-152 (T_r=9.2 h)		$6X10^{-4}$
	Eu-155		$2X10^{-3}$
Fluorine (9)	F-18	$2X10^{-6}$	$8X10^{-3}$
Gadolinium (64)	Gd-153		$2X10^{-3}$
	Gd-159		$8X10^{-4}$
Gallium (31)	Ga-72		$4X10^{-4}$
Germanium (32)	Ge-71		$2X10^{-2}$
Gold (79)	Au-196		$2X10^{-3}$
	Au-198		$5X10^{-4}$
	Au-199		$2X10^{-3}$
Hafnium (72)	Hf-181		$7X10^{-4}$

Hydrogen (1)	H-3	$5X10^{-6}$	$3X10^{-2}$
Indium (49)	In-113m		$1X10^{-2}$
	In-114m		$2X10^{-4}$
Iodine	I-126	$3X10^{-9}$	$2X10^{-5}$
	I-131	$3X10^{-9}$	$2X10^{-5}$
	I-132	$8X10^{-8}$	$6X10^{-4}$
	I-133	$1X10^{-8}$	$7X10^{-5}$
	I-134	$2X10^{-7}$	$1X10^{-3}$
Iridium (77)	Ir-190		$2X10^{-3}$
	Ir-192		$4X10^{-4}$
	Ir-194		$3X10^{-4}$
Iron (26)	Fe-55		$8X10^{-3}$
	Fe-59		$6X10^{-4}$
Krypton (36)	Kr-85m	$1X10^{-6}$	
	Kr-85	$3X10^{-6}$	
Lanthanum (57)	La-140		$2X10^{-4}$
Lead (82)	Pb-203		$4X10^{-3}$
Lutetium (71)	Lu-177		$1X10^{-3}$
Manganese (25)	Mn-52		$3X10^{-4}$
	Mn-54		$1X10^{-3}$
	Mn-56		$1X10^{-3}$
Mercury (80)	Hg-197m		$2X10^{-3}$
	Hg-197		$3X10^{-3}$
	Hg-203		$2X10^{-4}$
Molybdenum (42)	Mo-99		$2X10^{-3}$
Neodymium (60)	Nd-147		$6X10^{-4}$
	Nd-149		$3X10^{-3}$
Nickel (28)	Ni-65		$1X10^{-3}$
Niobium (Columbium) (41)	Nb-95		$1X10^{-3}$
	Nb-97		$9X10^{-3}$
Osmium (76)	Os-185		$7X10^{-4}$
	Os-191m		$3X10^{-2}$
	Os-191		$2X10^{-3}$
	Os-193		$6X10^{-4}$
Palladium (46)	Pd-103		$3X10^{-3}$
	Pd-109		$9X10^{-4}$
Phosphorus (15)	P-32		$2X10^{-4}$
Platinum (78)	Pt-191		$1X10^{-3}$
	Pt-193m		$1X10^{-2}$
	Pt-197m		$1X10^{-2}$
	Pt-197		$1X10^{-3}$
Potassium (19)	K-42		$3X10^{-3}$
Praseodymium (59)	Pr-142		$3X10^{-4}$
	Pr-143		$5X10^{-4}$
Promethium (61)	Pm-147		$2X10^{-3}$
	Pm-149		$4X10^{-4}$
Rhenium (75)	Re-183		$6X10^{-3}$
	Re-186		$9X10^{-4}$
	Re-188		$6X10^{-4}$
Rhodium (45)	Rh-103m		$1X10^{-1}$
	Rh-105		$1X10^{-3}$
Rubidium (37)	Rb-86		$7X10^{-4}$
Ruthenium (44)	Ru-97		$4X10^{-3}$

	Ru-103		$8X10^{-4}$
	Ru-105		$1X10^{-3}$
	Ru-106		$1X10^{-4}$
Samarium (62)	Sm-153		$8X10^{-4}$
Scandium (21)	Sc-46		$4X10^{-4}$
	Sc-47		$9X10^{-4}$
	Sc-48		$3X10^{-4}$
Selenium (34)	Se-75		$3X10^{-3}$
Silicon (14)	Si-31		$9X10^{-3}$
Silver (47)	Ag-105		$1X10^{-3}$
	Ag-110m		$3X10^{-4}$
	Ag-111		$4X10^{-4}$
Sodium (11)	Na-24		$2X10^{-3}$
Strontium (38)	Sr-85		$1X10^{-3}$
	Sr-89		$1X10^{-4}$
	Sr-91		$7X10^{-4}$
	Sr-92		$7X10^{-4}$
Sulfur (16)	S-35	$9X10^{-8}$	$6X10^{-4}$
Tantalum (73)	Ta-182		$4X10^{-4}$
Technetium (43)	Tc-96m		$1X10^{-1}$
	Tc-96		$1X10^{-3}$
Tellurium (52)	Te-125m		$2X10^{-3}$
	Te-127m		$6X10^{-4}$
	Te-127		$3X10^{-3}$
	Te-129m		$3X10^{-4}$
	Te-131m		$6X10^{-4}$
	Te-132		$3X10^{-4}$
Terbium (65)	Tb-160		$4X10^{-4}$
Thallium (81)	Tl-200		$4X10^{-3}$
	Tl-201		$3X10^{-3}$
	Tl-202		$1X10^{-3}$
	Tl-204		$1X10^{-3}$
Thulium (69)	Tm-170		$5X10^{-4}$
	Tm-171		$5X10^{-3}$
Tin (50)	Sn-113		$9X10^{-4}$
	Sn-125		$2X10^{-4}$
Tungsten (Wolfram) (74)	W-181		$4X10^{-3}$
	W-187		$7X10^{-4}$
Vanadium (23)	V-48		$3X10^{-4}$
Xenon (54)	Xe-131m	$4X10^{-6}$	
	Xe-133	$3X10^{-6}$	
	Xe-135	$1X10^{-6}$	
Ytterbium (70)	Yb-175		$1X10^{-3}$
Yttrium (39)	Y-90		$2X10^{-4}$
	Y-91m		$3X10^{-2}$
	Y-91		$3X10^{-4}$
	Y-92		$6X10^{-4}$
	Y-93		$3X10^{-4}$
Zinc (30)	Zn-65		$1X10^{-3}$
	Zn-69m		$7X10^{-4}$
	Zn-69		$2X10^{-2}$
Zirconium (40)	Zr-95		$6X10^{-4}$
	Zr-97		$2X10^{-4}$

(See notes at end of appendix)

Beta and/or gamma emitting radioactive material not listed above with half-life less than three years	$1X10^{-10}$	$1X10^{-6}$

NOTE 1: Many radioisotopes disintegrate into isotopes which are also radioactive. In expressing the concentrations in Schedule A the activity stated is that of the parent isotope and takes into account the daughters.

1/ Values are given in Column I only for those materials normally used as gases

2/ μCi/gm are for solids

NOTE 2: For purposes of Section 303 where there is involved a combination of isotopes, the limit for the combination should be derived as follows: Determine for each isotope in the product the ratio between the concentration present in the product and the exempt concentration established in Schedule A for the specific isotope when not in combination. The sum of such ratios may not exceed "1" (i.e., unity).

EXAMPLE:

$$\frac{\text{Concentration of Isotope A in Product}}{\text{Exempt concentration of Isotope A}} + \frac{\text{Concentration of Isotope B in Product}}{\text{Exempt concentration of Isotope B}} \leq 1$$

Historical Note

Appendix A repealed, Schedule A adopted effective June 30, 1977 (Supp. 77-3). Amended effective December 20, 1985 (Supp. 85-6). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

Exhibit B. Exempt Quantities

Material	Microcuries	Material	Microcuries
Antimony-122 (Sb-122)	100	Dysprosium-166 (Dy-166)	100
Antimony-124 (Sb-124)	10	Erbium-169 (Er-169)	100
Antimony-125 (Sb-125)	10	Erbium-171 (Er-171)	100
Arsenic-73 (As-73)	100	Europium-152 (Eu-152) (9.2 h)	100
Arsenic-74 (As-74)	10	Europium-152 (Eu-152) (13 yr)	1
Arsenic-76 (As-76)	10	Europium-154 (Eu-154)	1
Arsenic-77 (As-77)	100	Europium-155 (Eu-155)	10
Barium-131 (Ba-131)	10	Fluorine-18 (F-18)	1,000
Barium-133 (Ba-133)	10	Gadolinium-153 (Gd-153)	10
Barium-140 (Ba-140)	10	Gadolinium-159 (Gd-159)	100
Bismuth-210 (Bi-210)	1	Gallium-67 (Ga-67)	100
Bromine-82 (Br-82)	10	Gallium-72 (Ga-72)	10
Cadmium-109 (Cd-109)	10	Germanium-71 (Ge-71)	100
Cadmium-115m (Cd-115m)	10	Gold-195 (Au-195)	10
Cadmium-115 (Cd-115)	100	Gold-198 (Au-198)	100
Calcium-45 (Ca-45)	10	Gold-199 (Au-199)	100
Calcium-47 (Ca-47)	10	Hafnium-181 (Hf-181)	10
Carbon-14 (C-14)	100	Holmium-166 (Ho-166)	100
Cerium-141 (Ce-141)	100	Hydrogen-3 (H-3)	1,000
Cerium-143 (Ce-143)	100	Indium-113m (In-113m)	100
Cerium-144 (Ce-144)	1	Indium-114m (In-114m)	10
Cesium-129 (Cs-129)	100	Indium-115m (In-115m)	100
Cesium-131 (Cs-131)	1,000	Indium-115 (In-115)	10
Cesium-134m (Cs-134m)	100	Iodine-123 (I-123)	100
Cesium-134 (Cs-134)	1	Iodine-125 (I-125)	1
Cesium-135 (Cs-135)	10	Iodine-126 (I-126)	1
Cesium-136 (Cs-136)	10	Iodine-129 (I-129)	0.1
Cesium-137 (Cs-137)	10	Iodine-131 (I-131)	1
Chlorine-36 (Cl-36)	10	Iodine-132 (I-132)	10
Chlorine-38 (Cl-38)	10	Iodine-133 (I-133)	1
Chromium-51 (Cr-51)	1,000	Iodine-134 (I-134)	10
Cobalt-57 (Co-57)	100	Iodine-135 (I-135)	10
Cobalt-58m (Co-58m)	10	Iridium-192 (Ir-192)	10
Cobalt-58 (Co-58)	10	Iridium-194 (Ir-194)	100
Cobalt-60 (Co-60)	1	Iron-52 (Fe-52)	10
Copper-64 (Cu-64)	100	Iron-55 (Fe-55)	100
Dysprosium-165 (Dy-165)	10	Iron-59 (Fe-59)	10

Material	Microcuries
Krypton-85 (Kr-85)	100
Krypton-87 (Kr-87)	10
Lanthanum-140 (La-140)	10
Lutetium-177 (Lu-177)	100
Manganese-52 (Mn-52)	10
Manganese-54 (Mn-54)	10
Manganese-56 (Mn-56)	10
Mercury-197m (Hg-197m)	100
Mercury-197 (Hg-197)	100
Mercury-203 (Hg-203)	10
Molybdenum-99 (Mo-99)	100
Neodymium-147 (Nd-147)	100
Neodymium-149 (Nd-149)	100
Nickel-59 (Ni-59)	100
Nickel-63 (Ni-63)	10
Nickel-65 (Ni-65)	100
Niobium-93m (Nb-93m)	10
Niobium-95 (Nb-95)	10
Niobium-97 (Nb-97)	10
Osmium-185 (Os-185)	10
Osmium-191m (Os-191m)	100
Osmium-191(Os-191)	100
Osmium-193 (Os-193)	100
Palladium-103 (Pd-103)	100
Palladium-109 (Pd-109)	100
Phosphorus-32 (P-32)	10
Platinum-191 (Pt-191)	100
Platinum-193m (Pt-193m)	100
Platinum-193 (Pt-193)	100
Platinum-197m (Pt-197m)	100
Platinum-197 (Pt-197)	100
Polonium-210 (Po-210)	0.1
Potassium-42 (K-42)	10
Potassium-43 (K-43)	10
Praseodymium-142 (Pr-142)	100
Praseodymium-143 (Pr-143)	100
Promethium-147 (Pm-147)	10
Promethium-149 (Pm-149)	10
Rhenium-186 (Re-186)	100
Rhenium-188 (Re-188)	100
Rhodium-103m (Rh-103m)	100
Rhodium-105 (Rh-105)	100
Rubidium-81 (Rb-81)	10
Rubidium-86 (Rb-86)	10
Rubidium-87 (Rb-87)	10
Ruthenium-97 (Ru-97)	100
Ruthenium-103 (Ru-103)	10
Ruthenium-105 (Ru-105)	10
Ruthenium-106 (Ru-106)	1
Samarium-151 (Sm-151)	10
Samarium-153 (Sm-153)	100
Scandium-46 (Sc-46)	10
Scandium-47 (Sc-47)	100
Scandium-48 (Sc-48)	10
Selenium-75 (Se-75)	10
Silicon-31 (Si-31)	100

Material	Microcuries
Silver-105 (Ag-105)	10
Silver-110m (Ag-110m)	1
Silver-111 (Ag-111)	100
Sodium-22 (Na-22)	10
Sodium-24 (Na-24)	10
Strontium-85 (Sr-85)	10
Strontium-89 (Sr-89)	1
Strontium-90 (Sr-90)	0.1
Strontium-91 (Sr-91)	10
Strontium-92 (Sr-92)	10
Sulfur-35 (S-35)	100
Tantalum-182 (Ta-182)	10
Technetium-96 (Tc-96)	10
Technetium-97m (Tc-97m)	100
Technetium-97 (Tc-97)	100
Technetium-99m (Tc-99m)	100
Technetium-99 (Tc-99)	10
Tellurium-125m (Te-125m)	10
Tellurium-127m (Te-127m)	10
Tellurium-127 (Te-127)	100
Tellurium-129m (Te-129m)	10
Tellurium-129 (Te-129)	100
Tellurium-131m (Te-131m)	10
Tellurium-132 (Te-132)	10
Terbium-160 (Tb-160)	10
Thallium-200 (Tl-200)	100
Thallium-201 (Tl-201)	100
Thallium-202 (Tl-202)	100
Thallium-204 (Tl-204)	10
Thulium-170 (Tm-170)	10
Thulium-171 (Tm-171)	10
Tin-113 (Sn-113)	10
Tin-125 (Sn-125)	10
Tungsten-181 (W-181)	10
Tungsten-185 (W-185)	10
Tungsten-187 (W-187)	100
Vanadium-43 (V-48)	10
Xenon-131m (Xe-131m)	1,000
Xenon-133 (Xe-133)	100
Xenon-135 (Xe-135)	100
Ytterbium-175 (Yb-175)	100
Yttrium-87 (Y-87)	10
Yttrium-88 (Y-88)	10
Yttrium-90 (Y-90)	10
Yttrium-91 (Y-91)	10
Yttrium-92 (Y-92)	100
Yttrium-93 (Y-93)	100
Zinc-65 (Zn-65)	10
Zinc-69m (Zn-69m)	100
Zinc-69 (Zn-69)	1,000
Zirconium-93 (Zr-93)	10
Zirconium-95 (Zr-95)	10
Zirconium-97 (Zr-97)	10
Any radionuclide material not listed above other than alpha-emitting radioactive material	0.1

Historical Note

Adopted effective June 30. 1977 (Supp. 77-3). Amended effective December 20, 1985 (Supp. 85-6). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

Exhibit C. Limits for Class B and C Broad Scope Licenses (R12-1-310)

Radioactive Material	Col. I curies	Col. II curies
Antimony-122	1	0.01
Antimony-124	1	0.01
Antimony-125	1	0.01
Arsenic-73	10	0.1
Arsenic-74	1	0.01
Arsenic-76	1	0.01
Arsenic-77	10	0.1
Barium-131	10	0.1
Barium-140	1	0.01
Beryllium-7	10	0.1
Bismuth-210	0.1	0.001
Bromine-82	10	0.1
Cadmium-109	1	0.01
Cadmium-115m	1	0.01
Cadmium-115	10	0.1
Calcium-45	1	0.01
Calcium-47	10	0.1
Carbon-14	100	1.
Cerium-141	10	0.1
Cerium-143	10	0.1
Cerium-144	0.1	0.001
Cesium-131	100	1.
Cesium-134m	100	1.
Cesium-134	0.1	0.001
Cesium-135	1	0.01
Cesium-136	10	0.1
Cesium-137	0.1	0.001
Chlorine-36	1	0.01
Chlorine-38	100	1.
Chromium-51	100	1.
Cobalt-57	10	0.1
Cobalt-58m	100	1.
Cobalt-58	1	0.01
Cobalt-60	0.1	0.001
Copper-64	10	0.1
Dysprosium-165	100	1.
Dysprosium-166	10	0.1
Erbium-169	10	0.1
Erbium-171	10	0.1
Europium-152 (9.2 h)	10	0.1
Europium-152 (13 yr)	0.1	0.001
Europium-154	0.1	0.001
Europium-155	1	0.01
Fluorine-18	100	1.
Gadolinium-153	1	0.1
Gadolinium-159	10	0.1
Gallium-72	10	0.1
Germanium-71	100	1.
Gold-198	10	0.1
Gold-199	10	0.1
Hafnium-181	1	0.1
Holmium-166	10	0.1
Hydrogen-3	100	1.
Indium-113m	100	1.
Indium-114m	1	0.1
Indium-115m	100	1.
Indium-115	1	0.1
Iodine-125	0.1	0.001
Iodine-126	0.1	0.001
Iodine-129	0.1	0.001
Iodine-131	0.1	0.001
Iodine-132	10	0.1
Iodine-133	1	0.1
Iodine-134	10	0.1
Iodine-135	1	0.1
Iridium-192	1	0.1
Iridium-194	10	0.1
Iron-55	10	0.1
Iron-59	1	0.1
Krypton-85	100	1.
Krypton-87	10	0.1
Lanthanum-140	1	0.1
Lutetium-177	10	0.1
Manganese-52	1	0.1
Manganese-54	1	0.1
Manganese-56	10	0.1
Mercury-197m	10	0.1
Mercury-197	10	0.1
Mercury-203	1	0.1
Molybdenum-99	10	0.1
Neodymium-147	10	0.1
Neodymium-149	10	0.1
Nickel-59	10	0.1
Nickel-63	1	0.1
Nickel-65	10	0.1
Niobium-93m	1	0.1
Niobium-95	1	0.1
Niobium-97	100	1.
Osmium-185	1	0.1
Osmium-191m	100	1.
Osmium-191	10	0.1
Osmium-193	10	0.1
Palladium-103	10	0.1
Palladium-109	10	0.1
Phosphorus-32	1	0.01
Platinum-191	10	0.1
Platinum-193m	100	1.
Platinum-193	10	0.1
Platinum-197m	100	1.
Platinum-197	10	0.1
Polonium-210	0.01	0.0001
Potassium-42	1	0.01
Praseodymium-142	10	0.1
Praseodymium-143	10	0.1
Promethium-147	1	00.1
Promethium-149	10	0.1
Radium-226	0.01	0.0001
Rhenium-186	10	0.1
Rhenium-188	10	0.1
Rhodium-103m	1,000	10
Rhodium-105	10	0.1
Rubidium-86	1	0.01
Rubidium-87	1	0.01
Ruthenium-97	100	1.
Ruthenium-103	1	0.01
Ruthenium-105	10	0.1
Ruthenium-106	0.1	0.001
Samarium-151	1	0.01
Samarium-153	10	0.1
Scandium-46	1	0.01
Scandium-47	10	0.1
Scandium-48	1	0.01
Selenium-75	1	0.01
Silicon-31	10	0.1
Silver-105	1	0.01
Silver-110m	0.1	0.001

Silver-111	10	0.1
Sodium-22	0.1	0.001
Sodium-24	1	0.01
Strontium-85	1,000	10
Strontium-85	1	0.01
Strontium-89	1	0.01
Strontium-90	0.01	0.0001
Strontium-91	10	0.1
Strontium-92	10	0.1
Sulfur-35	100	0.1
Tantalum-182	1	0.01
Technetium-96	10	0.1
Technetium-97m	10	0.1
Technetium-97	10	0.1
Technetium-99m	100	1.
Technetium-99	1	0.01
Tellurium-125m	1	0.01
Tellurium-127m	1	0.01
Tellurium-127	10	0.1
Tellurium-129m	1	0.01
Tellurium-129	100	1.
Tellurium-131m	10	0.1
Tellurium-132	1	0.01
Terbium-160	1	0.01
Thallium-200	10	0.1
Thallium-201	10	0.1
Thallium-202	10	0.1
Thallium-204	1	0.01
Thulium-170	1	0.01
Thulium-171	1	0.01
Tin-113	1	0.01
Tin-125	1	0.01
Tungsten-181	1	0.01
Tungsten-185	1	0.01
Tungsten-197	10	0.1
Vanadium-43	1	0.01
Xenon-131m	1,000	10
Xenon-133	100	1.
Xenon-135	100	1.
Ytterbium-175	10	0.1
Yttrium-90	1	0.01
Yttrium-91	1	0.01
Yttrium-92	10	0.1
Yttrium-93	1	0.01
Zinc-65	1	0.01
Zinc-69m	10	0.1
Zinc-69	100	1.
Zirconium-93	1	0.01
Zirconium-95	1	0.01
Zirconium-97	1	0.01
Any radioactive material other than source material, special nuclear material, or alpha emitting radioactive material not listed above.	0.1	0.001

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Amended effective December 20, 1985 (Supp. 85-6). Former Schedule C repealed; new Exhibit C renumbered from Exhibit D and amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

Exhibit D. Radioactive Material Quantities Requiring Consideration for an Emergency Plan (R12-1-322)

Radioactive Material	Release Fraction	Quantity (Ci)
Actinium-228	0.001	4,000
Americium-241	.001	2
Americium-242	.001	2
Americium-243	.001	2
Antimony-124	.01	4,000
Antimony-126	.01	6,000
Barium-133	.01	10,000
Barium-140	.01	30,000
Bismuth-207	.01	5,000
Bismuth-210	.01	600
Cadmium-109	.01	1,000
Cadmium-113	.01	80
Calcium-45	.01	20,000
Californium-252	.001	9 (20 mg)
Carbon-14 (Non CO)	.01	50,000
Cerium-141	.01	10,000
Cerium-144	.01	300
Cesium-134	.01	2,000
Cesium-137	.01	3,000
Chlorine-36	.5	100
Chromium-51	.01	300,000
Cobalt-60	.001	5,000
Copper-64	.01	200,000
Curium-242	.001	60
Curium-243	.001	3
Curium-244	.001	4
Curium-245	.001	2
Europium-152	.01	500
Europium-154	.01	400
Europium-155	.01	3,000
Gadolinium-153	.01	5,000
Germanium-68	.01	2,000
Gold-198	.01	30,000
Hafnium-172	.01	400
Hafnium-181	.01	7,000
Holmium-166m	.01	100
Hydrogen-3	.5	20,000
Indium-114m	.01	1,000
Iodine-125	.5	10
Iodine-131	.5	10
Iridium-192	.001	40,000
Iron-55	.01	40,000
Iron-59	.01	7,000
Krypton-85	1.0	6,000,000
Lead-210	.01	8
Manganese-56	.01	60,000
Mercury-203	.01	10,000
Molybdenum-99	.01	30,000
Neptunium-237	.001	2
Nickel-63	.01	20,000
Niobium-94	.01	300
Phosphorus-32	.5	100
Phosphorus-33	.5	1,000
Polonium-210	.01	10
Potassium-42	.01	9,000
Promethium-145	.01	4,000
Promethium-147	.01	4,000
Ruthenium-106	.01	200
Samarium-151	.01	4,000
Scandium-46	.01	3,000

Selenium-75	.01	10,000
Silver-110m	.01	1,000
Sodium-22	.01	9,000
Sodium-24	.01	10,000
Strontium-89	.01	3,000
Strontium-90	.01	90
Sulfur-35	.5	900
Technetium-99	.01	10,000
Technetium-99m	.01	400,000
Tellurium-127m	.01	5,000
Tellurium-129m	.01	5,000
Terbium-160	.01	4,000
Thulium-170	.01	4,000
Tin-113	.01	10,000
Tin-123	.01	3,000
Tin-126	.01	1,000
Titanium-44	.01	100
Vanadium-48	.01	7,000
Xenon-133	1.0	900,000
Yttrium-91	.01	2,000
Zinc-65	.01	5,000
Zirconium-93	.01	400
Zirconium-95	.01	5,000
Any other beta-gamma emitter	.01	10,000
Mixed fission products	.01	1,000
Mixed corrosion products	.01	10,000
Contaminated equipment beta-gamma	.001	10,000
Irradiated material, any form other than solid non-combustible	.01	1,000
Irradiated material, solid noncombustible	.001	10,000
Mixed radioactive waste, beta-gamma	.01	1,000
Packaged mixed waste, beta gamma	.001	10,000
Any other alpha emitter	.001	2
Contaminated equipment, alpha	.0001	20
Packaged waste, alpha	.0001	20

Combinations of radioactive materials listed above:

For combinations of radioactive materials, consideration of the need for an emergency plan is required if the sum of the ratios of the quantity of each radioactive material authorized to the quantity listed for that material in Exhibit D exceeds 1.

NOTE: Waste packaged in Type B containers does not require an emergency plan.

Historical Note

Adopted effective December 20, 1985 (Supp. 85-6). Former Schedule D renumbered to Exhibit C; new Exhibit D renumbered from Schedule E and amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

Exhibit E. Application Information

1. Radioactive Material (RAM) Specific License Application Information

An applicant shall provide the following information in a specific license application before a license is issued to the applicant. The Agency shall provide an application form to an applicant with a guide, when possible, to ensure that correct information is provided in the application:

Name and mailing address of applicant	Use location
Contact person	Telephone number
Users of RAM	Training of users
Radiation Safety Officer identity (RSO)	Duties of RSO
Description of RAM and uses	Description of radiation detection/measurement instruments and their calibration
Personnel monitoring	Bioassay program
Facility description	Survey program
Leak test program	Records management program
Instruction to personnel	Waste disposal program
Emergency procedures	Procedures for ordering, receiving, and opening packages
Description of animal use	Licensing fee provided with application
Copy of letter-of-intent to local governing body	Description of ALARA and quality management programs
Description of transportation procedures	Certifying signature
Legal structure of licensee's operation	

Other licensing requirements listed in: R12-1-310, R12-1-311, R12-1-312, R12-1-511, R12-1-703, and R12-1-1721

2. Radioactive Material (RAM) General License Application Information

An applicant shall provide the following information on a registration certificate. The certificate will be validated and returned to the applicant if the information provided is complete.

Name and address	Telephone number
Where will the radioactive material be used	Address of use location
Description of radioactive material use	Date
Authorizing signature and printed name	Position of person signing the form

Historical Note

Adopted effective February 18, 1994 (Supp. 94-1). Former Schedule E renumbered to Exhibit D; new Exhibit adopted by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

ARTICLE 4. STANDARDS FOR PROTECTION AGAINST IONIZING RADIATION

R12-1-401. Purpose

A. Article 4 establishes standards for protection against ionizing radiation resulting from activities conducted according to licenses or registrations issued by the Agency. These rules are issued according to A.R.S. Title 30, Chapter 4, as amended.

B. The requirements of Article 4 are designed to control the receipt, possession, use, transfer, and disposal of sources of radiation by any licensee or registrant so the total dose equivalent to an individual, including radiation exposure resulting from all sources of radiation other than radiation prescribed by a physician in the practice of medicine, radiation received while voluntarily participating in a medical research program, and background radiation, does not exceed the standards for

protection against radiation prescribed in this Article. However, this Article does not limit actions that may be necessary to protect health and safety.

Historical Note

Former Rule Section D.1; Former Section R12-1-401 repealed, new Section R12-1-401 adopted effective June 30, 1977 (Supp. 77-3). Amended effective February 25, 1985 (Supp. 85-1). Section repealed, new Section adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-402. Scope

Except as specifically provided in other Articles of these rules, Article 4 applies to persons licensed or registered by the Agency to receive, possess, use, transfer, or dispose of sources of ionizing radiation.

Historical Note

Former Rule Section D.2; Former Section R12-1-402 repealed, new Section R12-1-402 adopted effective June 30, 1977 (Supp. 77-3). Amended effective February 25, 1985 (Supp. 85-1). Amended subsection (A) effective June 26, 1987 (Supp. 87-2). Section repealed, new Section adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-403. Definitions

"Air-purifying respirator" means respiratory protective equipment with an air-purifying filter, cartridge, or canister that removes specific air contaminants by passing ambient air through the air-purifying element.

"ALI" means annual limit on intake, the derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by the Reference Man that would result in a committed effective dose equivalent of 0.05 Sv (5 rem) or a committed dose equivalent of 0.5 Sv (50 rem) to any individual organ or tissue. ALI values for intake by ingestion and by inhalation of selected radionuclides are given in Appendix B, Table I, Columns 1 and 2.

"Assigned protection factor (APF)" means the expected workplace level of respirator protection that would be provided by a properly functioning respirator or a class of respirators to properly fitted and trained users. Operationally, the inhaled concentration can be estimated by dividing the ambient airborne concentration by the APF.

"Atmosphere-supplying respirator" means respiratory protective equipment that supplies the equipment user with breathing air from a source independent of the ambient atmosphere, and includes supplied-air respirators (SARs) and self-contained breathing apparatus (SCBA) units.

"Class" means a classification scheme for inhaled material according to the material's rate of clearance from the lung. Materials are classified as D, W, or Y, which applies to a range of clearance half-times: for Class D, days, of less than 10 days, for Class W, weeks, from 10 to 100 days, and for Class Y, years, of greater than 100 days (See Introduction, Appendix B). For purposes of these rules, "lung class" and "inhalation class" are equivalent terms.

"Constraint" or "dose constraint" means a value above which specified licensee or registrant actions are required.

"Critical group" means the group of individuals reasonably expected to receive the greatest exposure to residual radioactivity for any applicable set of circumstances.

"DAC" means derived air concentration, the concentration of a given radionuclide in air which, if breathed by Reference Man for a working year of 2,000 hours under conditions of light work, results in an intake of one ALI. For purposes of these rules, the condition of light work is an inhalation rate of 1.2 cubic meters of air per hour for 2,000 hours in a year. DAC values are given in Appendix B, Table I, Column 3.

"DAC-hour" means derived air concentration-hour, the product of the concentration of radioactive material in air, expressed as a fraction or multiple of the derived air concentration for each radionuclide, and the time of exposure to that radionuclide, in hours. A licensee or registrant may take 2,000 DAC-hours to represent one ALI, equivalent to a committed effective dose equivalent of 0.05 Sv (5 rem).

"Declared pregnant woman" means a woman who has voluntarily informed the licensee or registrant in writing of her pregnancy and the estimated date of conception. The declaration remains in effect until the declared pregnant woman withdraws the declaration in writing or is no longer pregnant.

"Decommission" means to remove a facility or site safely from service and reduce residual radioactivity to a level that permits release of the property for unrestricted use and termination of the license or release of the property under restricted conditions and the termination of the license.

"Demand respirator" means an atmosphere-supplying respiratory protective equipment that admits breathing air to the face piece only when a negative pressure is created inside the face piece by inhalation.

"Deterministic effect" [see "Nonstochastic effect"].

"Disposable respirator" means respiratory protective equipment for which maintenance is not intended and that is designed to be discarded after excessive breathing resistance, sorbent depletion, physical damage, or end-of-service-life renders it unsuitable for use. Examples of this type of device include a disposable half-mask respirator or a disposable, escape-only, self-contained breathing apparatus (SCBA).

"Distinguishable from background" means that the detectable concentration of a radionuclide is statistically greater than the background concentration of that radionuclide in the vicinity of a site or, in the case of structures, in similar materials using accepted measurement, survey, and statistical techniques.

"Dosimetry processor" means an individual or an organization that processes and evaluates individual monitoring devices in order to determine the radiation dose delivered to the monitoring devices.

"Filtering face piece (dust mask)" means a particulate respirator that operates under a negative pressure with a filter as an integral part of the face piece or with the entire face piece composed of the filtering medium, not equipped with elastomeric sealing surfaces and adjustable straps.

"Fit factor" means a quantitative estimate of the fit of a particular respirator to a specific individual, and typically estimates the ratio of the concentration of a substance in ambient air to its concentration inside the respirator when worn.

"Fit test" means the use of protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual.

"Helmet" means a rigid respiratory inlet covering that also provides head protection against impact and penetration.

"Hood" means a respiratory inlet covering that completely covers the head, neck, and may also cover portions of the shoulders and torso.

"Inhalation class" [see "Class"].

"Loose-fitting face piece" means a respiratory inlet covering that is designed to form a partial seal with the face.

"Lung class" [see "Class"].

"Negative pressure respirator (tight fitting)" means respiratory protective equipment in which the air pressure inside the face piece is negative during inhalation with respect to the ambient air pressure outside the respirator.

"Nonstochastic effect" means a health effect, the severity of which varies with the dose and for which a threshold is believed to exist. Radiation-induced cataract formation is an example of a nonstochastic effect. For purposes of these rules, "deterministic effect" is an equivalent term and "threshold" means that which if not exceeded, poses no risk or likelihood of an effect to occur.

"Planned special exposure" means an infrequent exposure to radiation received while employed, but separate from and in addition to the annual occupational dose limits.

"Positive pressure respirator" means respiratory protective equipment in which the pressure inside the respiratory inlet covering exceeds the ambient air pressure outside the respirator.

"Powered air-purifying respirator (PAPR)" means an air-purifying respirator that uses a blower to force the ambient air through air-purifying elements to the inlet covering.

"Pressure demand respirator" means a positive pressure, atmosphere-supplying respirator that admits breathing air to the face piece when the positive pressure is reduced inside the face piece by inhalation.

"Probabilistic effect" [see "Stochastic effect"].

"Qualitative fit test (QLFT)" means a pass or fail fit test to assess the adequacy of respirator fit that relies on the individual's response to the test agent.

"Quantitative fit test (QNFT)" means an assessment of the adequacy of respirator fit by numerically measuring the amount of leakage into the respirator.

"Reference Man" means a hypothetical aggregation of human physical and physiological characteristics determined by international consensus. These characteristics may be used by researchers and public health workers to standardize results of experiments and to relate biological insult to a common base. A description of Reference Man is contained in the International Commission on Radiological Protection report, ICRP Publication 23, "Report of the Task Group on Reference Man," published in 1975 by Pergammon Press, incorporated by reference and on file with the Agency and the Office of the Secretary of State. This incorporation by reference contains no future editions or amendments.

"Residual radioactivity" means radioactivity in structures, materials, soils, groundwater, or other media at a site, resulting from activities under a licensee's control. This includes radioactivity from all licensed and unlicensed sources used by the licensee, but excludes background radiation. It also includes radioactive materials that remain at the site because of routine or accidental release of radioactive material at the site or a previous burial at the site, even if the licensee complied with reagent provisions of A.A.C. Title 12, Chapter1.

"Respiratory protective equipment" means an apparatus, such as a respirator, used to reduce an individual's intake of airborne radioactive materials.

"Sanitary sewerage" means a system of public sewers for carrying off waste water and refuse, but excluding sewage treatment facilities, septic tanks, and leach fields owned or operated by the licensee or registrant.

"Self-contained breathing apparatus (SCBA)" means an atmosphere-supplying respirator for which the breathing air source is designed to be carried by the user.

"Stochastic effect" means a health effect that occurs randomly and for which the probability of the effect occurring, rather than its severity, is assumed to be a linear function of dose without a threshold. Hereditary effects and cancer incidence are examples of stochastic effects. For purposes of these rules, "probabilistic effect" is an equivalent term.

"Supplied-air respirator (SAR) or airline respirator" means an atmosphere-supplying respirator for which the source of breathing air is not designed to be carried by the user

"Tight-fitting face piece" means a respiratory inlet covering that forms a complete seal with the face.

"User seal check (fit check)" means an action conducted by the respirator user to determine if the respirator is properly seated to the face. Examples include negative pressure check, positive pressure check, irritant smoke check, or isoamyl acetate check.

"Very-high radiation area" means an area, accessible to individuals, in which radiation levels from radiation sources external to an individual's body could result in the individual receiving an absorbed dose in excess of 5 Gy (500 rad) in one hour at one meter from a radiation source or one meter from any surface that the radiation penetrates. (At very high doses received at high dose rates, units of absorbed dose, the gray and rad should be used, rather than units of dose equivalent, the sievert and rem)

"Weighting factor" w_T for an organ or tissue (T) means the proportion of the risk of stochastic effects resulting from irradiation of that organ or tissue to the total risk of stochastic effects when the whole body is irradiated uniformly. For calculating the effective dose equivalent, the values of w_T are:

ORGAN DOSE WEIGHTING FACTORS

Organ or Tissue	w_T
Gonads	0.25
Breast	0.15
Red bone marrow	0.12
Lung	0.12
Thyroid	0.03
Bone surfaces	0.03
Remainder	0.30[a]
Whole Body	1.00[b]

[a] 0.30 results from 0.06 for each of five "remainder" organs, excluding the skin and the lens of the eye, that receive the highest doses.

[b] For the purpose of weighting the external whole body dose, for adding it to the internal dose, a single weighting factor, $w_T = 1.0$, has been specified. The use of other weighting factors for external exposure will be approved by the Agency on a case-by-case basis.

Historical Note

Former Rule Section D.3, Former Section R12-1-403 repealed, new Section R12-1-403 adopted effective June 30, 1977 (Supp. 77-3). Amended effective February 25,

1985 (Supp. 85-1). Section repealed, new Section adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Amended by final rulemaking at 9 A.A.R. 1126, effective May 9, 2003 (Supp. 03-1). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-404. Units and Quantities

A. Each licensee or registrant shall use the Standard International (SI) units becquerel, gray, sievert, and coulomb per kilogram, or the special units curie, rad, rem, and roentgen, including multiples and subdivisions, and shall clearly indicate the units of all quantities on records required by this Article.

B. The licensee or registrant shall make a clear distinction among the quantities entered on the records required by this Article, such as, total effective dose equivalent, total organ dose equivalent, shallow dose equivalent, lens dose equivalent, deep dose equivalent, or committed effective dose equivalent.

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Amended effective February 25, 1985 (Supp 85-1). Section repealed, new Section adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-405. Form of Records

A licensee or registrant shall ensure that each record required by this Article is legible throughout the specified retention period. The record shall be the original, a reproduced copy, or a microform, provided that the copy or microform is authenticated by authorized personnel and that the microform is capable of producing a clear copy throughout the required retention period. As an alternative the record may be stored in electronic media capable of producing legible records during the required retention period. Records, such as letters, drawings, and specifications, shall include all pertinent information, such as stamps, initials, and signatures. A licensee or registrant shall maintain adequate safeguards against tampering with and loss of records.

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Amended effective February 25, 1985 (Supp. 85-1). Section repealed, new Section adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-406. Implementation

Any existing license or registration condition that is more restrictive than this Article remains in force until amendment or renewal of the license or registration.

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Amended effective February 25, 1985 (Supp. 85-1). Section repealed, new Section adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-407. Radiation Protection Programs

A. Each licensee or registrant shall develop, document, and implement a radiation protection program sufficient to ensure compliance with the provisions of Article 4.

B. The licensee or registrant shall use, to the extent practical, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and public doses that are as low as is reasonably achievable (ALARA).

C. The licensee or registrant shall, at intervals not to exceed 12 months, review the radiation protection program content and implementation.

D. To implement the ALARA requirements in subsection (B), and notwithstanding the requirements in R12-1-416, each licensee or registrant governed by A.A.C. Title 12, Chapter 1, Article 3 shall limit air emissions of radioactive material to the environment so that individual members of the public likely to receive the highest dose will not receive a total effective dose equivalent in excess of 0.1mSv (10 mrem) per year from the emissions. If a licensee or registrant subject to this requirement exceeds this limit, the licensee or registrant shall report the incident to the Agency, in accordance with R12-1-444, and take prompt corrective action to prevent additional violations.

E. Records.

1. Each licensee or registrant shall maintain records of the radiation protection program, including:
   a. The provisions of the program; and
   b. Audits and other reviews of program content and implementation.
2. A licensee or registrant shall retain the records required by subsection (E)(1)(a) for three years after the termination of the license or registration. The licensee or registrant shall retain the records required by subsection (E)(1)(b) for three years after the record is made.
3. The following licensees and registrants are exempt from the record requirements contained in this subsection:
   B6-General Medical
   C9-Gas Chromatograph
   C10-General Industrial
   D15-Possession Only
   E2-X-ray Machine class B
   E3-X-ray Machine class C

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Amended effective February 25. 1985 (Supp. 85-1). Section repealed, new Section adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 5 A.A.R. 1812, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-408. Occupational Dose Amounts for Adults

A. Each licensee or registrant shall control the occupational dose to individual adults, except for planned special exposures required in R12-1-413, to the following dose limits:

1. An annual limit, which is the more limiting of:
   a. The total effective dose equivalent being equal to 0.05 Sv (5 rem): or
   b. 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 Sv (50 rem).
2. The annual limits to the lens of the eye, to the skin, and to the extremities which are:
   a. A lens dose equivalent of 0.15 Sv (15 rem), and
   b. A shallow dose equivalent of 0.5 Sv (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 R12-1-413.

C. The assigned deep-dose equivalent and shallow-dose equivalent is, for the portion of the body receiving the highest exposure, determined as follows:
1. 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.
2. If a protective apron is worn and monitoring is conducted as specified in R12-1-419(B), the effective dose equivalent for external radiation shall be determined as follows:
   a. If only one individual monitoring device is used and it is located at the neck outside the protective apron, and the reported dose exceeds 25% of the limit specified in R12-1-408(A), the reported deep-dose equivalent value multiplied by 0.3 is the effective dose equivalent for external radiation; or
   b. When individual monitoring devices are worn, both under the protective apron at the waist and outside the protective apron at the neck, the effective dose equivalent for external radiation is 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.

D. Derived air concentration (DAC) and annual limit on intake (ALI) values are presented in Table I of Appendix B and may be used to determine the individual's dose and to demonstrate compliance with the occupational dose limits.

E. Notwithstanding 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.

F. The licensee or registrant shall reduce the dose that an individual may receive in the current year by the amount of occupational dose received while employed occupationally as a radiation worker by all previous employers. See R12-1-412.

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Amended effective February 25, 1985 (Supp. 85-1). Section repealed, new Section adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 5 A.A.R. 1812, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-409. Summation of External and Internal Doses

A. If a licensee or registrant is required to monitor according to both R12-1-419(B) and (C), the licensee or registrant shall add external and internal doses, and use the sum to demonstrate compliance with dose limits. If the licensee or registrant is required to monitor only according to R12-1-419(B) or only according to R12-1-419(C), summation is not required to demonstrate compliance with dose limits. The licensee or registrant may demonstrate compliance with the requirements for summation of external and internal doses according to subsections (B), (C), and (D). The dose equivalents for the lens of the eye, the skin, and the extremities are not included in the summation but are subject to separate limits (See R12-1-408(A)(2)).

B. If the only intake of radionuclides is by inhalation, the total effective dose equivalent limit is not exceeded if the sum of the deep-dose equivalent divided by the total effective dose equivalent limit, and one of the following, does not exceed unity (1):
1. The sum of the fractions of the inhalation ALI for each radionuclide, or
2. The total number of derived air concentration-hours (DAC-hours) for all radionuclides divided by 2,000, or
3. The sum of the calculated committed effective dose equivalents to all significantly irradiated organs or tissues (T) calculated from bioassay data using applicable biological models and expressed as a fraction of the annual limit. For purposes of this requirement, an organ or tissue is deemed to be significantly irradiated if, for that organ or tissue, the product of the weighting factors, W_T, and the committed dose equivalent, $H_{T,50}$, per unit intake is greater than 10% of the maximum weighted value of $H_{T,50}$, that is, $w_T H_{T,50}$, per unit intake for any organ or tissue.

C. If the occupationally exposed individual also receives an intake of radionuclides by oral ingestion greater than 10% of the applicable oral ALI, the licensee or registrant shall account for this intake and include it in demonstrating compliance with the limits.

D. The licensee or registrant shall evaluate and, to the extent practical, account for intakes through wounds or skin absorption. The intake through intact skin has been included in the calculation of DAC for Hydrogen-3 and does not need to be evaluated or accounted for according to this subsection.

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Amended effective February 25, 1985 (Supp. 85-1). Section repealed, new Section adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 5 A.A.R. 1812, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-410. Determination of External Dose from Airborne Radioactive Material

A. Each licensee 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, footnotes 1 and 2.

B. Airborne radioactivity measurements and DAC values shall 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 shall be based upon measurements using instruments or individual monitoring devices.

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Amended effective February 25, 1985 (Supp. 85-1). Amended effective June 20, 1990 (Supp. 90-2). Section repealed, new Section adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-411. Determination of Internal Exposure

A. For purposes of assessing dose used to determine compliance with occupational dose equivalent limits, each licensee or registrant shall, when required according to R12-1-419, take suitable and timely measurements of:

1. Concentrations of radioactive materials in air in work areas,
2. Quantities of radionuclides in the body,
3. Quantities of radionuclides excreted from the body, or
4. Combinations of these measurements,

B. Unless respiratory protective equipment is used, as provided in R12-1-425, or the assessment of intake is based on bioassays, the licensee or registrant 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 or registrant may:
1. Use that information to calculate the committed effective dose equivalent, and, if used, the licensee or registrant shall document that information in the individual's record;
2. Upon prior approval of the Agency, adjust the DAC or ALI values to reflect the actual physical and chemical characteristics of airborne radioactive material, for example, 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 to the committed effective dose equivalent. See Appendix B.

D. If the licensee or registrant chooses to assess intakes of Class Y material using the measurements given in subsection (A)(2) or (3), the licensee or registrant may delay the recording and reporting of the assessments for periods up to seven months, unless otherwise required by R12-1-444 or R12-1-445. This delay permits the licensee or registrant 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 is either:
1. The sum of the ratios of the concentration to the appropriate DAC value, that is, D, W, or Y from Appendix B 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 is the most restrictive DAC of any radionuclide in the mixture.

G. If a mixture of radionuclides in air exists, a licensee may disregard certain radionuclides in the mixture if:
1. The licensee uses the total activity of the mixture to demonstrate compliance with the dose limits in R12-1-408 and complies with the monitoring requirements in R12-1-419;
2. The concentration of any radionuclide disregarded is less than 10% of its DAC; and
3. The sum of these percentages for all of the radionuclides disregarded in the mixture does not exceed 30%.

H. When determining the committed effective dose equivalent, the following information may be considered:
1. In order to calculate the committed effective dose equivalent, the licensee may assume that the inhalation of 1 ALI, or an exposure of 2,000 DAC-hours, results in a committed effective dose equivalent of 0.05 Sv (5 rem) for radionuclides that have their ALls or DACs based on the committed effective dose equivalent.
2. For an ALI and the associated DAC determined by the nonstochastic organ dose limit of 0.5 Sv (50 rem), the intake of radionuclides that would result in a committed effective dose equivalent of 0.05 Sv (5 rem), that is, the stochastic ALI, is listed in parentheses in Table I of Appendix B. The licensee may, as a simplifying assumption, use the stochastic ALI to determine committed effective dose equivalent. However, if the licensee or registrant uses the stochastic ALI, the licensee shall also demonstrate that the limit in R12-1-408(A)(1)(b) is met.

Historical Note

Former Rule Section D.101; Former Section R12-1-411 repealed, new Section R12-1-411 adopted effective June 30, 1977 (Supp. 77-3). Amended effective February 25, 1985 (Supp. 85-1). Amended subsection (F) effective June 26, 1987 (87-2). Section repealed, new Section adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 5 A.A.R. 1812, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-412. Determination of Prior Occupational Dose

A. For each individual who may enter a licensee's or registrant's restricted area and is likely to receive, in a year, an occupational dose requiring monitoring according to R12-1-419, the licensee or registrant shall:
1. Determine the occupational radiation dose received during the current year, and
2. Attempt to obtain the records of lifetime cumulative occupational radiation dose.

B. Before permitting an individual to participate in a planned special exposure, the licensee or registrant shall determine:
1. The internal and external doses from all previous planned special exposures; and
2. All doses in excess of the limits received during the lifetime of the individual, including doses received during accidents and emergencies; and
3. All lifetime, cumulative, occupational radiation doses.

C. In complying with the requirements of subsection (A), a licensee or registrant shall:
1. Accept, as a record of the occupational dose that the individual received during the current year, a written and signed statement from the individual, or from the individual's most recent employer for work involving radiation exposure, that discloses the nature and the amount of any occupational dose that the individual received during the current year; and
2. Accept, as the record of lifetime cumulative radiation dose, an up-to-date Agency Form Y (available from the Agency) or equivalent, signed by the individual and countersigned by an appropriate official of the most recent employer for work involving radiation exposure, or the individual's current employer, if the individual is not employed by the licensee or registrant; and
3. Obtain reports of the individual's dose equivalent from the most recent employer for work involving radiation exposure, or the individual's current employer, if the individual is not employed by the licensee or registrant, by telephone, telegram, facsimile, or letter. The licensee or registrant shall request a written verification of the dose data if the authenticity of the transmitted report cannot be established.

D. Records.
1. The licensee or registrant shall record the exposure history, as required by subsection (A), on Agency Form Y (available from the Agency) or a similar clear and legible record of all the information required by this subsection. The form or record shall show each period in which the

individual received occupational exposure to radiation or radioactive material and shall be signed by the individual who received the exposure. For each period for which the licensee or registrant obtains reports, the licensee or registrant shall use the dose shown in the report for preparing Agency Form Y or its equivalent. For any period in which the licensee or registrant does not obtain a report, the licensee or registrant shall place a notation on Agency Form Y or its equivalent indicating each period of time for which there is no data.

2. The licensee or registrant is not required to reevaluate the separate external dose equivalents and internal committed dose equivalents or intakes of radionuclides assessed according to the rules in Article 4 in effect before January 1, 1994. Occupational exposure histories obtained and recorded on Agency Form Y or its equivalent before January 1, 1994, would not have included effective dose equivalent but may be used in the absence of specific information on the intake of radionuclides by the individual.
3. If the licensee or registrant is unable to obtain a complete record of an individual's current and previously accumulated occupational dose, the licensee or registrant shall:
   a. In establishing administrative controls under R12-1-408(F) for the current year, reduce the allowable dose limit for the individual by 12.5 mSv (1.25 rem) for each quarter for which records were unavailable and the individual was engaged in activities that could have resulted in occupational radiation exposure; and
   b. Not subject the individual to planned special exposures.
4. The licensee or registrant shall retain current and prior records on Agency Form Y or its equivalent for three years after the Agency terminates each pertinent license or registration requiring this record. The licensee or registrant shall retain records used in preparing Agency Form Y or its equivalent for three years after the record is made.

Historical Note

Former Rule Section D.102; Former Section R12-1-412 repealed, new Section R12-1-412 adopted effective June 30, 1977 (Supp. 77-3). Section repealed, new Section adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-413. Planned Special Exposures

A. 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 R12-1-408, provided that each of the following conditions is satisfied:
1. The licensee or registrant authorizes a planned special exposure only in an exceptional situation when alternatives that might avoid the higher exposure are unavailable or impractical.
2. 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.
3. Before a planned special exposure, the licensee or registrant ensures that each individual involved is:
   a. Informed in writing of the purpose of the planned special exposure;
   b. Informed in writing of the estimated doses, associated potential risks, and specific radiation levels or other conditions that might be involved in performing the task; and
   c. Instructed in the measures to be taken to keep the dose ALARA, considering other risks that may be present.
4. Before permitting an individual to participate in a planned special exposure, the licensee or registrant shall ascertain prior doses as required by R12-1-412(B) for each individual involved.
5. Subject to R12-1-408(B), 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 that exceed:
   a. The numerical value of any of the dose limits in R12-1-408(A) in any year, and
   b. Five times the annual dose limits in R12-1-408(A) during the individual's lifetime.
6. The licensee or registrant shall maintain records of a planned special exposure in accordance with subsections (B) and (C) and submit a written report to the Agency within 30 days after the date of any planned special exposure conducted in accordance with this Section, informing the Agency that a planned special exposure was conducted and indicating the date the planned special exposure occurred and the information required by subsection (B).
7. The licensee or registrant shall record the best estimate of the dose resulting from the planned special exposure in the individual's record and inform the individual, in writing, of the dose within 30 days after the date of the planned special exposure. The dose from a planned special exposure shall not be considered in controlling future occupational dose of the individual according to R12-1-408(A) but shall be included in evaluations required by subsections (A)(4) and (A)(5).

B. Records.
1. For each planned special exposure, the licensee or registrant shall maintain records that describe:
   a. The exceptional circumstances requiring the use of a planned special exposure,
   b. The name of the management official who authorized the planned special exposure and a copy of the signed authorization,
   c. What actions were necessary,
   d. Why the actions were necessary,
   e. What precautions were taken to assure that doses were minimized in accordance with R12-1-407(B),
   f. What individual and collective doses were expected,
   g. The doses actually received in the planned special exposure, and
   h. The process through which the employee involved in the planned special exposure has been informed in writing of the information contained in subsection (A)(3).
2. The licensee or registrant shall retain the records for three years after the Agency terminates each pertinent license or registration.

C. A licensee shall submit a report to the Agency no later than 30 days after a planned special exposure conducted in accordance with subsection (A). The report shall contain the date of the planned exposure and the information required by subsection (B).

Historical Note

Former Rule Section D.103. Former Section R12-1-413 repealed, new Section R12-1-413 adopted effective June 30, 1977 (Supp. 77-3). Section repealed, new Section

adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-414. Occupational Dose Limits for Minors

The annual occupational dose limits for minors are 10% of the annual occupational dose limits specified for adult workers in R12-1-408.

Historical Note

Former Rule Section D. 104; Former Section R12-1-414 repealed, new Section R12-1-414 adopted effective June 30, 1977 (Supp. 77-3). Section repealed, new Section adopted effective August 10, 1994 (Supp. 94-3).

R12-1-415. Dose Limits for an Embryo or Fetus

A. A licensee or registrant shall ensure that the dose equivalent to an embryo or fetus during the entire pregnancy, due to occupational exposure of a declared pregnant woman, does not exceed 5 mSv (0.5 rem). Records shall be maintained according to R12-1-419(D)(4) and (5).

B. The licensee or registrant shall make efforts to avoid substantial variation above a uniform monthly exposure rate to a declared pregnant woman to satisfy the limit in subsection (A).

C. The dose equivalent to an embryo or fetus is the sum of:
1. The deep-dose equivalent to the declared pregnant woman, and
2. The dose equivalent to the embryo or fetus from radionuclides in the embryo or fetus and radionuclides in the declared pregnant woman.

D. If by the time the woman declares pregnancy to the licensee or registrant, the dose equivalent to the embryo or fetus has exceeded 4.5 mSv (0.45 rem), the licensee or registrant is deemed to be in compliance with subsection (A), if the additional dose equivalent to the embryo or fetus does not exceed 0.5 mSv (0.05 rem) during the remainder of the pregnancy.

E. A declaration of pregnancy shall remain in effect until the declared pregnant woman withdraws the declaration in writing or is no longer pregnant.

Historical Note

Former Rule Section D. 105; Former Section R12-1-415 repealed, new Section R12-1-415 adopted effective June 30, 1977 (Supp. 77-3). Amended effective February 25, 1985 (Supp. 85-1). Section repealed, new Section adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 5 A.A.R. 1812, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-416. Dose Limits for Individual Members of the Public

A. Each licensee or registrant shall conduct operations so that:
1. The total effective dose equivalent to any individual member of the public from the licensed or registered operation does not exceed 1 mSv (0.1 rem) in a year, excluding the dose contribution from background radiation, medical administration of radiation, exposure to an individual who has been administered radioactive material and released in accordance with R12-1-719, voluntary participation in a medical research program, and the licensee's or registrant's disposal of radioactive material into sanitary sewerage in accordance with R12-1-436; and
2. The dose in any unrestricted area from an external source excluding the dose contribution from an individual who has been administered radioactive material and released in accordance with R12-1-719, does not exceed 0.02 mSv (0.002 rem) in any one hour.

B. Registrants possessing radiation machines in operation before August 10, 1994, are exempt from the requirement in subsection (A)(1). Operation of these machines shall be conducted so that the total effective dose equivalent to any individual member of the public does not exceed 5 mSv (0.5 rem) in a year.

C. A licensee, registrant, or an applicant for a license or registration may apply for Agency authorization to operate with an annual dose limit of 5 mSv (0.5 rem) for an individual member of the public. The application shall include the following information:
1. An explanation of the need for and the expected duration of operations in excess of the limit in subsection (A), and
2. The licensee's or registrant's program to assess and control dose within the 5 mSv (0.5 rem) annual limit; and
3. The procedures to be followed to maintain the dose in accordance with R12-1-407(B).

D. A licensee or registrant shall comply with the U.S. Environmental Protection Agency's applicable environmental radiation standards in 40 CFR 190, 2003 edition, published July 1, 2003, by the Office of the Federal Register, National Archives and Records Administration, Washington, D.C. 20408, which are incorporated by reference, on file with the Agency and contain no future editions or amendments.

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.

F. Each licensee or registrant shall make or cause to be made surveys of radiation levels in unrestricted areas and radioactive materials contained in effluents released to unrestricted areas.

G. Each licensee or registrant shall:
1. Demonstrate 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
2. Demonstrate that:
   a. 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 Appendix B, Table II; and
   b. If an individual were continually present in an unrestricted area, the dose from external sources would not exceed 0.02 mSv (0.002 rem) in an hour and 0.5 mSv (0.05 rem) in a year.

H. 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.

I. Each licensee or registrant shall maintain records sufficient to demonstrate compliance with the dose limit for individual members of the public and shall retain the records for three years after the Agency terminates each pertinent license or registration.

Historical Note

Former Rule Section D. 106; Former Section R12-1-416 repealed, new Section R12-1-416 adopted effective June 30, 1977 (Supp. 77-3). Section repealed, new Section adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-417. Testing for Leakage or Contamination of Sealed Sources

A. A licensee in possession of any sealed source shall ensure that:
1. Each sealed source, except as specified in subsection (B), is tested for leakage or contamination and the test results are received before the sealed source is put into use unless the licensee has a certificate from the transferor indicating that the sealed source was tested within six months before transfer to the licensee or registrant.
2. Each sealed source that is not designed to emit alpha particles is tested for leakage or contamination at intervals not to exceed six months or at alternative intervals approved by the Agency, after evaluation of information specified by R12-1-311(D)(2) and (D)(3), or equivalent information specified by an Agreement State, a Licensing State, or the U.S. Nuclear Regulatory Commission.
3. Each sealed source that is designed to emit alpha particles is tested for leakage or contamination at intervals not to exceed three months or at alternative intervals approved by the Agency, after evaluation of information specified by R12-1-311(D)(2) and (D)(3), or equivalent information specified by an Agreement State, a Licensing State, or the Nuclear Regulatory Commission.
4. Each sealed source suspected of damage or leakage is tested for leakage or contamination before further use.
5. Tests for leakage for all sealed sources, except brachytherapy sources manufactured to contain radium, are capable of detecting the presence of 185 Bq (0.005 μCi) of radioactive material on a test sample. The person conducting the test shall take test samples from the sealed source or from the surfaces of the container in which the sealed source is stored or mounted on which contamination could accumulate. For a sealed source contained in a device, the person conducting the test shall obtain test samples when the source is in the "off" position.
6. The test for leakage from brachytherapy sources containing radium is capable of detecting an absolute leakage rate of 37 Bq (0.001 μCi) of Radon-222 in a 24-hour period when the collection efficiency for Radon-222 and its daughters has been determined with respect to collection method, volume, and time.
7. Tests for contamination from radium daughters are taken on the interior surface of brachytherapy source storage containers and are capable of detecting the presence of 185 Bq (0.005 μCi) of a radium daughter which has a half-life greater than four days.

B. A licensee need not perform tests for leakage or contamination on the following sealed sources:
1. Sealed sources containing only radioactive material with a half-life of less than 30 days;
2. Sealed sources containing only radioactive material as a gas;
3. Sealed sources containing 3.7 MBq (100 μCi) or less of beta or photon-emitting material or 370 kBq (10 μCi) or less of alpha-emitting material;
4. Sealed sources containing only Hydrogen-3;
5. Seeds of Iridium-192 encased in nylon ribbon; and
6. Sealed sources, except teletherapy and brachyherapy sources, which are stored, not being used, and identified as in storage. The licensee shall test each sealed source for leakage or contamination and receive the test results before any use or transfer unless it has been tested for leakage or contamination within six months before the date of use or transfer.

C. Persons specifically authorized by the Agency, an Agreement State, a Licensing State, or the U.S. Nuclear Regulatory Commission shall perform tests for leakage or contamination from sealed sources.

D. A licensee shall maintain for Agency inspection test results in units of becquerel or microcurie.

E. The following is considered evidence that a sealed source is leaking:
1. The presence of 185 Bq (0.005 μCi) or more of removable contamination on any test sample.
2. Leakage of 37 Bq (0.001 μCi) of Radon-222 per 24 hours for brachytherapy sources manufactured to contain radium.
3. The presence of removable contamination resulting from the decay of 185 Bq (0.005 μCi) or more of radium.

F. A licensee shall immediately withdraw a leaking sealed source from use and shall take action to prevent the spread of contamination. The leaking sealed source shall be repaired or disposed of in accordance with this Article.

G. A licensee shall file a report with the Agency within five days if the test for leakage or contamination indicates a sealed source is leaking or contaminated. The report shall include the equipment involved, the test results, and the corrective action taken.

H. A licensee shall maintain records of the tests for leakage required in subsection (A) for three years after the records are made.

Historical Note

Former Rule Section D. 107; Former Section R12-1-417 repealed, new Section R12-1-417 adopted effective June 30, 1977 (Supp. 77-3). Amended effective February 25, 1985 (Supp. 85-1). Section repealed, new Section adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-418. Surveys and Monitoring

A. Each licensee or registrant shall make, or cause to be made, surveys that are necessary:
1. For the licensee or registrant to comply with Article 4, and
2. Under the circumstances to evaluate:
   a. The magnitude and extent of radiation levels,
   b. Concentrations or quantities of radioactive material, and
   c. The potential radiological hazards that could be present.

B. All personnel dosimeters, except for direct and indirect reading pocket ionization chambers and those dosimeters used to measure the dose to any extremity, that require processing to determine the radiation dose and that are used by licensees and registrants to comply with R12-1-408, with other applicable provisions of these rules, or with conditions specified in a license or registration shall be processed and evaluated by a dosimetry processor:
1. Holding current personnel dosimetry accreditation from the National Voluntary Laboratory Accreditation Program (NVLAP) of the National Institute of Standards and Technology, according to NVLAP procedures published March 1994 as NIST Handbook 150, and NIST Handbook 150-4 published August 1994, by the U.S. Department of Commerce, incorporated by reference and on file with the Agency and the Office of the Secretary of State, containing no future editions or amendments; and
2. Approved in this accreditation process for the type of radiation or radiations included in the NVLAP program that most closely approximates the type of radiation or

radiations for which the individual wearing the dosimeter is monitored.

C. The licensee or registrant shall ensure that adequate precautions are taken to prevent a deceptive exposure of an individual monitoring device and that personnel monitoring devices are issued to, and used by only the individual to whom the monitoring device has been first issued during any reporting period.

D. Records.

1. Each licensee or registrant shall maintain records showing the results of surveys required by this Section and R12-1-433(B). The licensee or registrant shall retain these records for three years after the record is made.
2. The licensee or registrant shall retain each of the following records for three years after the Agency terminates the license or registration:
   a. Records of the survey results used to determine the dose from external sources of radiation, in the absence of or in combination with individual monitoring data, and provide an assessment of individual dose equivalents;
   b. Records of the results of measurements and calculations used to determine individual intakes of radioactive material and to assess an internal dose;
   c. Records showing the results of air sampling, surveys, and bioassays required according to R12-1-425(A)(3)(a) and (b); and
   d. Records of the measurement and calculation results used to evaluate the release of radioactive effluents to the environment.

Historical Note

Former Rule Section D. 108; Former Section R12-1-418 repealed, new Section R12-1-418 adopted effective June 30, 1977 (Supp. 77-3). Amended effective February 25, 1985 (Supp. 85-1). Section repealed, new Section adopted effective August 10, 1994 (Supp. 94-3). Amended effective June 13, 1997 (Supp. 97-2). Amended by final rulemaking at 5 A.A.R. 1812, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-419. Conditions Requiring Individual Monitoring of External and Internal Occupational Dose

A. Each licensee or registrant shall monitor exposures from sources of radiation at levels sufficient to demonstrate compliance with the occupational dose limits of this Article.

B. At a minimum each licensee or registrant shall supply and require the use of individual monitoring devices by:

1. Adults likely to receive, in one year from sources external to the body, a dose in excess of 10% of the limits in R12-1-408(A);
2. Minors likely to receive, in one year, from radiation sources external to the body, a deep dose equivalent in excess of 1 mSv (0.1 rem), a lens dose equivalent in excess of 1.5 mSv (0.15 rem), or a shallow dose equivalent to the skin or to the extremities in excess of 5 mSv (0.5 rem).
3. Declared pregnant women likely to receive during the entire pregnancy, from radiation sources external to the body, a deep dose equivalent in excess of 1 mSv (0.1 rem).
4. The following personnel:
   a. Individuals operating mobile x-ray equipment; except dental intraoral systems, as described in R12-1-608;
   b. Individuals holding animals for diagnostic x-ray procedures, as described in R12-1-613;
   c. Individuals servicing enclosed beam x-ray systems with bypassed interlocks, as described in R12-1-803;
   d. Individuals operating open beam fluoroscopic systems and ancillary personnel working in the room when the fluoroscopic system is in use, except when relieved of this requirement by license or registration condition under A.R.S. § 30-654(B)(13);
   e. Individuals on their extremities when operating analytical x-ray machines with no safety devices, or if service is performed in the primary beam of the analytical x-ray machine, as described in R12-1-806(D).
   f. Individuals performing industrial radiography or operating an uncertified enclosed x-ray machine, as described in Article 5;
   g. Individuals performing well logging, as described in Article 17; and
5. Individuals entering a high or very high radiation area.

C. Each licensee or registrant shall require that all individual monitoring devices be located on individuals according to the following requirements:

1. An individual monitoring device used for the dose to an embryo or fetus of a declared pregnant woman, according to R12-1-415(A), shall be located under the protective apron at the waist. A qualified expert shall be consulted to determine the dose to the embryo or fetus for the rare occasion in which this individual monitoring device has a monthly reported dose equivalent value in excess of 0.5 mSv (50 mrem). For purposes of these rules, the value to be used for determining the dose to an embryo or fetus according to R12-1-415(C)(1), for occupational exposure to radiation from medical fluoroscopic equipment, is the value reported by the individual monitoring device worn at the waist underneath the protective apron which has been corrected for the particular individual and the work environment by a qualified expert;
2. An individual monitoring device used for lens dose equivalent shall be located at the neck, or an unshielded location closer to the eye, outside the protective apron;
3. If only one individual monitoring device is used to determine the effective dose equivalent for external radiation according to R12-1-408(C)(2), it shall be located at the neck outside the protective apron. If a second individual monitoring device is used for the same purpose, it shall be located under the protective apron at the waist. (Note: The second individual monitoring device is required for a declared pregnant woman.)

D. At a minimum, each licensee or registrant shall monitor, to determine compliance with R12-1-411, the occupational intake of radioactive material and assess the committed effective dose equivalent to:

1. Adults likely to receive, in one year, an intake in excess of 10% of the applicable ALI in Table I, Columns 1 and 2, of Appendix B; and
2. Minors likely to receive, in one year, a committed effective dose equivalent in excess of 1 mSv (0.1 rem); and
3. Declared pregnant women likely to receive, during the entire pregnancy, a committed effective dose equivalent in excess of 1 mSv (0.1 rem).

E. Records.

1. Each licensee or registrant shall maintain records of doses received by all individuals for whom monitoring is required according to this Section, and records of doses received during planned special exposures, accidents, and emergency conditions. Assessments of dose equivalent and records made using units in effect before January 1, 1994, need not be changed. These records shall include, when applicable:
   a. The deep-dose equivalent to the whole body, lens dose equivalent, shallow dose equivalent to the skin, and shallow dose equivalent to the extremities;
   b. The estimated intake of radionuclides, see R12-1-409:
   c. The committed effective dose equivalent assigned to the intake of radionuclides;
   d. The specific information used to calculate the committed effective dose equivalent according to R12-1-411(C):
   e. The total effective dose equivalent when required by R12-1-409: and
   f. The total of the deep-dose equivalent and the committed dose to the organ receiving the highest total dose;
2. The licensee or registrant shall make entries of the records specified in subsection (D)(1), at intervals not to exceed one year;
3. The licensee or registrant shall maintain at the inspection site the records specified in subsection (D)(1), on Agency Form Z (available from the Agency), in accordance with the instructions for Agency Form Z, or in clear and legible records containing all the information required by this subsection;
4. The licensee or registrant shall maintain the records of dose to an embryo or fetus with the records of dose to the declared pregnant woman. The declaration of pregnancy, including the estimated date of conception, shall also be kept on file but may be maintained separately from the dose records;
5. The licensee or registrant shall retain each required form or record for three years after the Agency terminates each pertinent license or registration requiring the record.

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Amended effective February 25, 1985 (Supp. 85-1). Section repealed, new Section adopted effective August 10, 1994 (Supp. 94-3). Amended effective June 13, 1997 (Supp. 97-2). Amended by final rulemaking at 5 A.A.R. 1812, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Amended by final rulemaking at 9 A.A.R. 1126, effective May 9, 2003 (Supp. 03-1). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-420. Control of Access to High Radiation Areas

A. A licensee or registrant shall ensure that each entrance or access point to a high radiation area has one or more of the following features:
1. A control device that, upon entry into the area, causes the level of radiation to be reduced below the level at which an individual might receive a deep-dose equivalent of 1 mSv (0.1 rem) in one hour at 30 centimeters from the source from any surface that the radiation penetrates;
2. A control device that energizes a conspicuous visible or audible alarm signal so that the individual entering the high radiation area and the supervisor of the activity are made aware of the entry; or
3. Entryways that are locked, except during periods when access to the areas is required, with positive control over each individual entity.

B. In place of the controls required by subsection (A) for a high radiation area, the licensee or registrant may substitute continuous direct or electronic surveillance that is capable of preventing unauthorized entry.

C. The licensee or registrant may apply to the Agency for approval of alternative methods for controlling access to high radiation areas.

D. The licensee or registrant shall establish the controls required by subsections (A) and (C) in a way that does not prevent individuals from leaving a high radiation area.

E. The licensee or registrant is not required to control each entrance or access point to a room or other area that is a high radiation area solely because of the presence of radioactive materials prepared for transport and packaged and labeled in accordance with the regulations of the U.S. Department of Transportation, provided that:
1. The packages do not remain in the area longer than three days, and
2. The dose rate at 1 meter from the external surface of any package does not exceed 0.1 mSv (0.01 rem) per hour.

F. The licensee or registrant is not required to control entrance or access to rooms or other areas in hospitals solely because of the presence of patients containing radioactive material, provided that there are personnel in attendance who are taking the necessary precautions to prevent the exposure of individuals to radiation or radioactive material in excess of the established limits in Article 4 and operate in accordance with R12-1-407(B) and the provisions of the licensee's or registrant's radiation protection program.

G. The registrant is not required to control entrance or access to rooms or other areas containing sources of radiation capable of producing a high radiation area if the registrant has met all the specific requirements for access and control specified in other applicable Articles of these rules, such as Article 5 for industrial radiography, Article 6 for x-rays in the healing arts, and Article 9 for particle accelerators.

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Amended effective February 25, 1985 (Supp. 85-1). Section repealed, new Section adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-421. Control of Access to Very-high Radiation Areas

A. In addition to the requirements in R12-1-420, a licensee or registrant shall institute measures to ensure that an individual is not able to gain unauthorized or inadvertent access to areas in which radiation levels could be encountered at 5 Gy (500 rad) or more in one hour at 1 meter from a source or from any surface that the radiation penetrates. This requirement does not apply to rooms or areas in which diagnostic x-ray systems are the only source of radiation or non-self-shielded irradiators.

B. The registrant is not required to control entrance or access to rooms or other areas containing sources of radiation capable of producing a very high radiation area, described in subsection (A), if the registrant has met all requirements for access and control specified in other applicable Articles of these rules, such as Article 5 for industrial radiography, Article 6 for x-rays in the healing arts, and Article 9 for particle accelerators.

C. Each licensee or registrant shall maintain records of tests made according to R12-1-422(B)(9) on entry control devices for

very-high radiation areas. These records shall include the date, time, and results of each test of function.

D. The licensee or registrant shall retain the records required by this Section for three years after the record is made.

Historical Note

Former Rule Section D.201; Former Section R12-1-421 repealed, new Section R12-1-421 adopted effective June 30, 1977 (Supp. 77-3). Amended effective February 25, 1985 (Supp. 85-1). Section repealed, new Section adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-422. Control of Access to Irradiators (Very-high Radiation Areas)

A. This Section applies to licensees or registrants with sources of radiation in non-self-shielded irradiators. This Section does not apply to sources of radiation that are used in teletherapy, industrial radiography, or completely self-shielded irradiators in which the source of radiation is both stored and operated within the same shielding radiation barrier and, in the designed configuration of the irradiator, is always physically inaccessible to any individual and cannot create high levels of radiation in an area that is accessible to any individual.

B. A licensee or registrant shall ensure that each area in which radiation levels may exceed 5 Gy (500 rad) in one hour at 1 meter from a source that is used to irradiate materials meets the following requirements:

1. Each entrance or access point shall be equipped with entry control devices that:
   a. Function automatically to prevent any individual from inadvertently entering a very high radiation area;
   b. Permit deliberate entry into the area only after a control device is actuated that causes the radiation level within the area, from the source of radiation, to be reduced below that at which it would be possible for an individual to receive a deep-dose equivalent in excess of 1 mSv (0.1 rem) in one hour; and
   c. Prevent operation of the source of radiation if it would produce radiation levels in the area that could result in a deep-dose equivalent to an individual in excess of 1 mSv (0.1 rem) in one hour.
2. If the control devices required in subsection (B)(1) fail to function, additional control devices shall be provided so that:
   a. The radiation level within the area, from the source of radiation, is reduced below that at which it would be possible for an individual to receive a deep-dose equivalent in excess of 1 mSv (0.1 rem) in one hour; and
   b. Conspicuous visible and audible alarm signals are generated so that an individual entering the area is aware of the hazard. The individual who enters the very-high radiation area after an alarm signals shall be familiar with the process and equipment. Before entering, the individual shall ensure that a second individual is present and aware of the first person's actions.
3. The licensee or registrant shall provide control devices so that, upon failure or removal of physical radiation barriers other than the sealed source's shielded storage container:
   a. The radiation level from the source of radiation is reduced below that at which it would be possible for an individual to receive a deep-dose equivalent in excess of 1 mSv (0.1 rem) in one hour; and
   b. Conspicuous visible and audible alarm signals are generated so that potentially affected individuals are aware of the hazard. Potentially affected individuals shall notify the licensee or registrant of the failure or removal of the physical barriers.
4. When the shield for stored sealed sources is a liquid, the licensee or registrant shall provide means to monitor the integrity of the shield and to signal, automatically, loss of adequate shielding.
5. Physical radiation barriers that comprise permanent structural components, such as walls, that have no credible probability of failure or removal in ordinary circumstances need not meet the requirements of subsections (B)(3) and (B)(4).
6. The licensee or registrant shall equip each area with devices that will automatically generate conspicuous visible and audible alarm signals to alert personnel in the area before the source of radiation can be put into operation and in time for any individual in the area to operate a clearly identified control device, installed in the area, and which can prevent the source of radiation from being put into operation.
7. The licensee or registrant shall control each area by use of administrative procedures and devices necessary to ensure that the area is cleared of personnel before each use of the source of radiation.
8. The licensee or registrant shall check each area by radiation measurement to ensure that, before the first individual's entry into the area after any use of the source of radiation, the radiation level from the source of radiation in the area is below that at which it would be possible for an individual to receive a deep-dose equivalent in excess of 1 mSv (0.1 rem) in one hour.
9. The licensee or registrant shall test the entry control devices required in subsection (B)(1) for proper functioning and keep records according to R12-1-421.
   a. Testing shall be conducted before initial operation with the source of radiation on any day, unless operations were continued uninterrupted from the previous day;
   b. Testing shall be conducted before resumption of operation of the source of radiation after any unintentional interruption: and
   c. The licensee or registrant shall submit to the Agency and adhere to a schedule for periodic tests of the entry control and warning systems.
10. The licensee or registrant shall not conduct operations, other than those necessary to place the source of radiation in a safe condition or effect repairs on controls, unless control devices are functioning properly.
11. The licensee or registrant shall control entry and exit portals that are used in transporting materials to and from the irradiation area, and that are not intended for use by individuals, with devices and administrative procedures necessary to physically protect and warn against inadvertent entry by any individual through these portals. Exit portals for irradiated materials shall be equipped to detect and signal the presence of any uncontained radioactive material that is carried toward an exit and automatically prevent contained radioactive material from being carried out of the area.

C. A licensee, registrant, or applicant seeking a license or registration for a source of radiation within the purview of subsection (B) that will be used in a variety of positions or in

locations, such as open fields or forests, that make it impractical to comply with certain requirements of subsection (B) may apply to the Agency for approval of alternative safety measures. Alternative safety measures shall provide personnel protection at least equivalent to that specified in subsection (B). At least one of the alternative measures shall be an entry-preventing interlock control, based on a measurement of the radiation that ensures the absence of high radiation levels before an individual can gain access to the area where the sources of radiation are used.

D. A licensee or registrant shall provide the entry control devices required by subsections (B) and (C) in such a way that no individual will be prevented from leaving the area.

E. Records.
1. Each licensee or registrant shall maintain records of tests made according to subsection (B)(9) on entry control devices for very-high radiation areas. These records shall include the date and results of each test of function.
2. The licensee or registrant shall retain the records for three years from the date the record is made.

Historical Note
Former Rule Section D.202; Former Section R12-1-422 repealed, new Section R12-1-422 adopted effective June 30, 1977 (Supp. 77-3). Section repealed, new Section adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-423. Use of Process or Other Engineering Controls
A licensee shall use, to the extent practicable, process or other engineering controls, such as containment, decontamination, or ventilation, to control the concentration of radioactive material in air.

Historical Note
Former Rule Section D.203. Former Section R12-1-423 repealed, new Section R12-1-423 adopted effective June 30, 1977 (Supp. 77-3). Amended effective February 25, 1985 (Supp. 85-1). Section repealed, new Section adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Amended by final rulemaking at 9 A.A.R. 1126, effective May 9, 2003 (Supp. 03-1).

R12-1-424. Use of Other Controls
When it is not practical to apply process or other engineering controls to control concentrations of radioactive material in the air to values below those that define an airborne radioactivity area, the licensee shall, consistent with maintaining the total effective dose equivalent according to R12-1-407(B), increase monitoring and limit intakes by one or more of the following means:
1. Control access,
2. Limit exposure times,
3. Use respiratory protection equipment, or
4. Use other controls.

Historical Note
Adopted effective June 30, 1977 (Supp. 77-3). Section repealed, new Section adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-425. Use of Individual Respiratory Protection Equipment

A. If a licensee uses respiratory protection equipment to limit intakes according to R12-1-424:
1. Except as provided in subsection (A)(2), the licensee shall use only respiratory protection equipment that is tested and certified by the National Institute for Occupational Safety and Health and the Mine Safety and Health Administration (NIOSH/MSHA).
2. If the licensee wishes to use equipment that has not been tested or certified by NIOSH/MSHA, or for which there is no schedule for testing or certification, the licensee shall submit an application for authorized use of the equipment, including a demonstration by testing, or a demonstration on the basis of reliable test information, that the material and performance characteristics of the equipment are capable of providing the proposed degree of protection under anticipated conditions of use.
3. The licensee shall implement and maintain a respiratory protection program that includes:
   a. Air sampling sufficient to identify the potential hazard, permit proper equipment selection, and estimate exposures;
   b. Surveys and bioassays, as appropriate, to evaluate actual intakes;
   c. Testing of respirators for operability immediately before each use;
   d. Written procedures regarding selection, fitting, issuance, maintenance, and testing of respirators, including testing for operability immediately prior to each use; supervision and training of personnel; monitoring, including air sampling and bioassays; and recordkeeping: and
   e. Determination by a physician that each individual user is physically fit to use respiratory protective equipment:
      i. Before the initial fitting of a face-sealing respirator with a tight-fitting face piece;
      ii. Before the first field use of non-face sealing respirator without a tight-fitting face piece, and
      iii. Every 12 months after initial fitting or first use, or periodically, at a frequency determined by the physician.
4. The licensee shall issue a written policy statement on respirator usage covering:
   a. The use of process or other engineering controls, instead of respirators;
   b. The routine, nonroutine, and emergency use of respirators; and
   c. The length of periods of respirator use and relief from respirator use.
5. The licensee shall advise each respirator user that the user may leave the area at any time for relief from respirator use in the event of equipment malfunction, physical or psychological distress, procedural or communication failure, significant deterioration of operating conditions, or any other conditions that might require relief from respirator use.
6. The licensee shall use respiratory protection equipment within the equipment manufacturer's expressed limitations for type and mode of use and shall provide proper visual, communication, and other special capabilities, such as adequate skin protection, when needed.

B. When estimating exposure of individuals to airborne radioactive materials, the licensee may take credit for respiratory protection equipment used to limit intakes as allowed in R12-1-424, provided that the following conditions, in addition to those in subsection (A), are satisfied:
1. The licensee selects respiratory protection equipment from Appendix A, that provides a protection factor that will afford the user protection from the peak concentration of airborne radioactive material and requires its use when peak concentrations of airborne radioactive materi-

als in the working area are expected to exceed the values specified in Appendix B, Table I, Column 3. However, if the selection of respiratory protection equipment, with a protection factor greater than the peak concentration, is inconsistent with the goal of maintaining the total effective dose equivalent ALARA as specified in R12-1-407(B), a licensee may select respiratory protection equipment with a lower protection factor, provided the equipment selection and other controls authorized in R12-1-424 result in a total effective dose equivalent that is ALARA as specified in R12-1-407(B). The concentration of radioactive material in the air that is inhaled when respirators are worn may be initially estimated by dividing the average concentration in the air, during each period of uninterrupted use, by the protection factor. If the exposure is later found to be greater than initially estimated, the corrected value shall be used; if the exposure is later found to be less than initially estimated, the corrected value may be used.

2. The licensee shall obtain authorization from the Agency before assigning respiratory protection factors in excess of those specified in Appendix A. The Agency may authorize a licensee to use higher protection factors on receipt of an indication that:
   a. Describes the situation for which a need exists for higher protection factors, and
   b. Demonstrates that the respiratory protection equipment provides these higher protection factors under the proposed conditions of use.

C. In an emergency, the licensee shall use as emergency equipment only respiratory protection equipment that has been specifically certified or has certification for emergency use by the National Institute for Occupational Safety and Health and the Mine Safety and Health Administration NIOSH/MSHA.

D. A licensee shall apply to the Agency for authorization to use assigned protection factors in excess of those specified in Appendix A. To apply for authorization the licensee shall:
1. State the reason for the higher protection factors; and
2. Demonstrate that the requested respiratory protective equipment provides the higher protection factors under the proposed conditions of use.

E. The licensee shall notify the Agency in writing at least 30 days before the date that respiratory protective equipment is first used according to subsection (A) or (B).

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Amended effective February 25, 1985 (Supp. 85-1). Section repealed, new Section adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Amended by final rulemaking at 9 A.A.R. 1126, effective May 9, 2003 (Supp. 03-1).

R12-1-426. Security of Stored Sources of Radiation

A licensee or registrant shall secure from unauthorized removal or access licensed or registered sources of radiation that are stored in unrestricted areas.

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Amended effective February 25, 1985 (Supp. 85-1). Section repealed, new Section adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-427. Control of Sources of Radiation Not in Storage

A. A licensee shall control and maintain constant surveillance of licensed radioactive material that is in an unrestricted area and is not in storage or in a patient.

B. A registrant shall maintain control of radiation machines that are in an unrestricted area and not in storage.

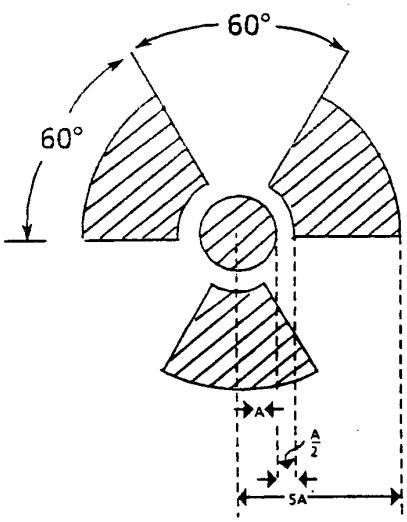
Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Section repealed, new Section adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-428. Caution Signs

A. Unless otherwise authorized by the Agency, a licensee or registrant shall use the symbol prescribed by this Section with the colors magenta, or purple, or black on yellow background as the standard radiation symbol. The symbol prescribed is the three-bladed design as follows:

RADIATION SYMBOL
1. Cross-hatched area is to be magenta, purple, or black; and
2. The background is to be yellow.



B. Notwithstanding the requirements of subsection (A), licensees or registrants are authorized to label sources of radiation, source holders, or device components containing sources of radiation that are subjected to high temperatures, with conspicuously etched or stamped radiation caution symbols that lack the color scheme required in subsection A.

C. In addition to the contents of signs and labels prescribed in this Article, the licensee or registrant shall provide, on or near the required signs and labels, additional information to make individuals aware of potential radiation exposures and to minimize the exposures.

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Former Section R12-1-428 repealed, new Section R12-1-428 adopted effective June 26, 1987 (Supp. 87-2). Section repealed, new Section adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-429. Posting

A. A licensee or registrant shall post each radiation area with a conspicuous sign or signs bearing the radiation symbol and the words “CAUTION, RADIATION AREA.”

B. The licensee or registrant shall post each high radiation area with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, HIGH RADIATION AREA" or "DANGER, HIGH RADIATION AREA."

C. The licensee or registrant shall post each very-high radiation area with a conspicuous sign or signs bearing the radiation symbol and the words "GRAVE DANGER, VERY HIGH RADIATION AREA."

D. The licensee shall post each airborne radioactivity area with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, AIRBORNE RADIOACTIVITY AREA" or "DANGER, AIRBORNE RADIOACTIVITY AREA."

E. The licensee shall post each area or room in which there is used or stored an amount of licensed material exceeding 10 times the quantity of licensed material specified in Appendix C with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, RADIOACTIVE MATERIAL(S)" or "DANGER, RADIOACTIVE MATERIAL(S)."

Historical Note

Former Section R12-1-429 repealed effective June 30, 1977 (Supp. 77-3). New Section 12-1-429 adopted effective June 26, 1987 (Supp. 87-2). Section repealed, new Section adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-430. Exceptions to Posting Requirements

A. A licensee or registrant is not required to post caution signs in areas or rooms containing sources of radiation for periods of less than eight hours, if each of the following conditions is met:

1. The sources of radiation are constantly attended during these periods by an individual who takes precautions necessary to prevent exposure of individuals to sources of radiation in excess of limits established in this Article; and
2. The area or room is subject to the licensee's or registrant's control.

B. A licensee or registrant is not required to post a caution sign in a room or other area in a hospital that is occupied by an individual who has been administered radioactive material, if the individual meets the criteria for release in R12-1-719.

C. A licensee or registrant is not required to post a caution sign in a room or area because of the presence of a sealed source, provided the radiation level at 30 centimeters from the surface of the sealed source container or housing does not exceed 0.05 mSv (0.005 rem) per hour.

D. A licensee or registrant is not required to post a caution sign in a room or area because of the presence of radiation machines used solely for diagnosis in the healing arts.

Historical Note

Former Section R12-1-430 repealed effective June 30, 1977 (Supp. 77-3). New Section R12-1-430 adopted effective June 26, 1987 (Supp. 87-2). Section repealed, new Section adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-431. Labeling Containers and Radiation Machines

A. A licensee shall ensure that each container of licensed material is labeled with a durable, clearly visible radiation symbol and the words "CAUTION, RADIOACTIVE MATERIAL" or "DANGER, RADIOACTIVE MATERIAL." The label shall also provide information, such as the radionuclides present, an estimate of the quantity of radioactivity, the date for which the radioactivity is estimated, radiation level, kind of material, and mass enrichment, to permit an individual handling or using a container, or working in the vicinity of a container, to take precautions to avoid or minimize exposure.

B. Each licensee shall, before removal or disposal of an empty, uncontaminated container to an unrestricted area, remove or deface the radioactive material label or otherwise clearly indicate that the container no longer contains radioactive materials.

C. Each registrant shall ensure that each radiation machine is labeled in a conspicuous manner to caution an individual that radiation is produced when it is energized.

D. A licensee shall label each syringe and each vial that contains a radiopharmaceutical, used in the practice of medicine, to identify its radiopharmaceutical content. Each syringe shield and vial shield shall also be labeled, unless the label on the syringe or vial is visible when shielded. The label shall indicate the radiopharmaceutical name or its abbreviation, the clinical procedure to be performed, or the name of the person being administered the radiopharmaceutical. Color-coding syringe shields and vial shields does not meet the labeling requirement.

Historical Note

Former Section R12-1-431 repealed effective June 30, 1977 (Supp. 77-3). New Section R12-1-431 adopted effective June 26, 1987 (Supp. 87-2). Amended effective November 5, 1993 (Supp. 93-4). Section repealed, new Section adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-432. Labeling Exemptions

A licensee is not required to label:

1. Containers holding licensed material in quantities less than the quantities listed in Appendix C;
2. Containers holding licensed material in concentrations less than those specified in Table III of Appendix B;
3. Containers attended by an individual who takes precautions necessary to prevent exposure of individuals to radiation in excess of the limits established in this Article;
4. Containers holding radioactive material that does not exceed the limits for excepted quantity or article as defined and limited in 49 CFR 173.403, and 173.421 through 173.424, and are transported, packaged, and labeled in accordance with 49 CFR 172.436 through 172.440, 1999 Edition, published October 1, 1999 by the Office of Federal Register National Archives and Records Administration, incorporated by reference and on file with the Agency and Office of Secretary of State. This incorporation by reference contains no future editions or amendments;
5. Containers that are accessible only to individuals authorized to handle, use, or work in the vicinity of the containers, if the contents are identified to these individuals by a readily available written record. Examples of containers of this type are containers in locations such as water-filled canals, storage vaults, or hot cells. A licensee shall retain the record as long as the containers are in use for the purpose indicated on the record; or
6. Installed manufacturing or process equipment, such as piping and tanks.

Historical Note

Repealed effective June 30, 1977 (Supp. 77-3). Section repealed, new Section adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R.

2584, effective June 8, 2001 (Supp. 01-2).

R12-1-433. Procedures for Receiving and Opening Packages

A. Each licensee who expects to receive a package containing quantities of radioactive material in excess of a Type A quantity, as defined in 10 CFR 71.4, 2000 Edition, published January 1, 2000 by the Office of the Federal Register, National Archives and Records Administration, incorporated by reference and on file with the Agency and the Office of the Secretary of State, containing no future editions or amendments, shall make arrangements to receive:
1. The package when the carrier offers it for delivery; or
2. The 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 package, labeled with a Radioactive White I, Yellow II, or Yellow III as specified in 49 CFR 172.403 and 172.436 through 172.440, 1999 Edition, published October 1, 1999 by the Office of Federal Register, National Archives and Records Administration, incorporated by reference and on file with the Agency and the Office of the Secretary of State, containing no future editions or amendments, for radioactive contamination unless the package contains only radioactive material in the form of gas or in special form as defined in R12-1-102; and
2. Monitor the external surfaces of a package, labeled with a Radioactive White I, Yellow II, or Yellow III as specified in subsection (B)(1), for radiation levels unless the package contains quantities of radioactive material that are less than or equal to the Type A quantity, defined in 10 CFR 71, and referenced in subsection (A); 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 subsection (B) as soon as practical after receipt of the package, but not later than three 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 three 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, by telephone and telegram, mailgram, or facsimile, the Agency when:
1. Removable radioactive surface contamination exceeds 22 dpm/cm^2 for beta-gamma emitting radionuclides or 2.2 dpm/cm^2 for alpha-emitting radionuclides, wiping a minimum surface area of 300 square centimeters (46 square inches), or the entire surface if less than 300 square centimeters (46 square inches); or
2. External radiation levels exceed the limits of 2 millisieverts (200 millirem) per hour.

E. Each licensee shall:
1. Establish, maintain, and retain written procedures for safely opening packages that contain radioactive material, 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 vehicles owned or operated by the licensee to and from a work site are exempt from the contamination monitoring requirements of subsection (B) but are not exempt from the monitoring requirement in subsection (B) for measuring radiation levels that ensures that the source of radiation is still properly lodged in its shield.

Historical Note

Repealed effective June 30, 1977 (Supp. 77-3). Section repealed, new Section adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-434. General Requirements for Waste Disposal

A. A licensee shall dispose of licensed material only:
1. By transfer to an authorized recipient as provided in R12-1-439 or in Article 3 of these rules, or to the U.S. Department of Energy;
2. By decay in storage, according to subsection (C);
3. By release in effluents within the limits in R12-1-416; or
4. As authorized according to R12-1-435, R12-1-436, R12-1-437, or R12-1-438;

B. A person shall be specifically licensed to receive waste containing licensed material from other persons for:
1. Treatment prior to disposal,
2. Treatment or disposal by incineration,
3. Decay in storage,
4. Disposal at a land disposal facility licensed according to Article 3 of these rules, or
5. Storage until transferred to a storage or disposal facility authorized to receive the waste.

C. A licensee is authorized to hold radioactive waste with a physical half-life of less than 120 days for decay-in-storage before disposal in ordinary trash provided:
1. The radioactive waste is held for decay a minimum of 10 half-lives;
2. The radioactive waste is surveyed with a survey meter, appropriate for the type of radiation being detected, to determine that its emitted radiation level cannot be distinguished from the background radiation; and
3. All radiation warning labels are removed or obliterated.

Historical Note

Repealed effective June 30, 1977 (Supp. 77-3). Section repealed, new Section adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Amended by final rulemaking at 9 A.A.R. 1126, effective May 9, 2003 (Supp. 03-1).

R12-1-435. Method for Obtaining Approval of Proposed Disposal Procedures

A licensee or applicant for a license may apply to the Agency for approval of proposed procedures, not otherwise authorized in this Chapter for disposal of licensed material generated in the licensee's operations. Each application shall include:
1. A description of the waste containing licensed material to be disposed of, including the physical and chemical properties that have an impact on risk evaluation:
2. The proposed manner and conditions of waste disposal;
3. An analysis and evaluation of pertinent information on the nature of the environment;
4. The nature and location of other potentially affected facilities; and
5. An analysis and procedure to ensure that doses comply with R12-1-407(B), and are within the dose limits in this Article.

Historical Note

Adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-436. Disposal by Release into Sanitary Sewerage System

A. A licensee may discharge licensed material into sanitary sewerage if each of the following conditions is satisfied:
1. The material is readily soluble or is readily dispersible biological material, in water;
2. The quantity of licensed radioactive material that the licensee releases into the sewer in one month divided by the average monthly volume of water released into the sewer by the licensee or registrant does not exceed the concentration listed in Appendix B, Table III,
3. If more than one radionuclide is released, the following conditions shall also be satisfied:
   a. The licensee shall determine the fraction of the limit in Appendix B, Table III represented by discharges into sanitary sewerage by dividing the actual monthly average concentration of each radionuclide released by the licensee or registrant into the sewer by the concentration of that radionuclide listed in Appendix B, Table III, and
   b. The sum of the fractions for each radionuclide required by subsection (A)(3)(a) does not exceed unity; and
   c. The total quantity of licensed radioactive material that the licensee releases into the sanitary sewerage in a year does not exceed 185 GBq (5 Ci) of Hydrogen-3, 37 GBq (1 Ci) of Carbon-14, and 37 GBq (1 Ci) of all other radioactive materials combined.

B. Excreta from individuals undergoing medical diagnosis or therapy with radioactive material are not subject to the limitations contained in subsection (A).

Historical Note
Adopted effective August 10, 1994 (Supp. 94-3).
Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-437. Treatment or Disposal by Incineration

A licensee shall treat or dispose of licensed material by incineration only in the amounts and forms specified in R12-1-438 or as specifically approved by the Agency according to R12-1-435.

Historical Note
Adopted effective August 10, 1994 (Supp. 94-3).
Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-438. Disposal of Specific Wastes

A. A licensee may dispose of the following licensed material as if it were not radioactive:
1. 1.85 kBq (0.05 μCi), or less, of Hydrogen-3 or Carbon-14 per gram of medium used for liquid scintillation counting; and
2. 1.85 kBq (0. 05 μCi), or less, of Hydrogen-3 or Carbon-14 per gram of animal tissue, averaged over the weight of the entire animal.
3. 1.85 kBq (0.05 μCi), or less, of Iodine-125 per gram of medium used in analyzing in vitro laboratory samples and associated sample holders contaminated during the laboratory procedure.

B. A licensee shall not dispose of tissue, contaminated with radioactive material, according to subsection (A)(2) in a manner that would permit its use either as food for humans or as animal feed.

C. A licensee is authorized to hold radioactive material with a physical half-life of 120 days or less for decay in storage before disposal in ordinary trash, and is exempt from the requirements of R12-1-434, provided:
1. Radioactive material held for disposal is permitted to decay for a minimum period of 10 half-lives;
2. The container of radioactive material is surveyed at its surface with no interposed shielding, before disposal as ordinary trash with a radiation detection survey meter set on its most sensitive scale and appropriate for the type of radiation being detected.
3. The radioactivity of the container, determined by survey, is less than two times background; and
4. All radiation labels are removed or obliterated.

D. The licensee shall maintain records in accordance with R12-1-441.

Historical Note
Adopted effective August 10, 1994 (Supp. 94-3).
Amended effective June 13, 1997 (Supp. 97-2). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-439. Transfer for Disposal and Manifests

A. Any licensee shipping radioactive waste intended for ultimate disposal at a licensed land disposal facility (for purposes of this rule "land disposal facility" means the land, buildings, structures, and equipment that are intended to be used for the disposal of radioactive waste. A geologic repository is not a land disposal facility) shall comply with 10 CFR 20 Appendix G, 2003 edition, published January 1, 2003, by the Office of the Federal Register, National Archives and Records Administration, Washington, D.C. 20408 which is incorporated by reference and on file with the Agency. This incorporation by reference contains no future editions or amendments.

B. An authorized representative of the waste generator shall provide the certification required in 10 CFR 20, Appendix G, Section II, which is incorporated by reference under subsection (A).

Historical Note
Adopted effective August 10, 1994 (Supp. 94-3).
Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-440. Compliance with Environmental and Health Protection Regulations

Nothing in R12-1-434, R12-1-435, R12-1-436, R12-1-437, R12-1-438, or R12-1-439 relieves the licensee from complying with other applicable federal, state, and local regulations governing any other toxic or hazardous properties of materials that may be disposed of according to R12-1-434, R12-1-435, R12-1-436, R12-1-437, R12-1-438, or R12-1-439.

Historical Note
Adopted effective August 10, 1994 (Supp. 94-3).
Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-441. Records of Waste Disposal

A. Each licensee shall maintain records of the disposal of licensed materials made in accordance with R12-1-435, R12-1-436, R12-1-437, R12-1-438, and disposal by burial in soil, including burials authorized before February 25, 1985.

B. The records required by subsection (A) shall be maintained for three years after the Agency terminates the applicable license or registration.

Historical Note
Adopted effective August 10, 1994 (Supp. 94-3).
Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-442. Agency Inspection of Shipments of Waste

Each shipment of waste to a disposal facility, licensed under R12-1-1302(D)(11), is subject to inspection by the Agency before shipment or transportation. The waste shipper shall notify the Agency not less than five working days before the scheduled shipment or transportation of waste to a licensed disposal facility.

Historical Note

Adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 5 A.A.R. 1812, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-443. Reports of Stolen, Lost, or Missing Licensed or Registered Sources of Radiation

A. Each licensee or registrant shall report to the Agency by telephone as follows:
1. Immediately after it becomes known to the licensee that licensed radioactive material in an aggregate quantity equal to or greater than 1,000 times the quantity specified in Appendix C is stolen, lost, or missing under circumstances that indicate to the licensee that an exposure could result to individuals in unrestricted areas;
2. Within 30 days after it becomes known to the licensee that licensed radioactive material in an aggregate quantity greater than 10 times the quantity specified in Appendix C is stolen, lost, or missing, and is still missing.
3. Immediately after it becomes known to the registrant that a radiation machine is stolen, lost, or missing.

B. Each licensee or registrant required to make a report according to subsection (A) shall, within 30 days after making the telephone report, make a written report to the Agency that contains the following information:
1. A description of the licensed or registered source of radiation involved, including, for radioactive material, the kind, quantity, and chemical and physical form; and, for radiation machines, the manufacturer, model, serial number, type, and maximum energy of radiation emitted;
2. A description of the circumstances under which the loss or theft occurred;
3. A statement of disposition, or probable disposition, of the licensed or registered source of radiation;
4. Exposures of individuals to radiation, circumstances under which the exposures occurred, and the possible total effective dose equivalent to persons in unrestricted areas;
5. Actions that have been taken, or will be taken, to recover the source of radiation; and
6. Procedures or measures that have been, or will be, adopted to ensure against a recurrence of the loss or theft of licensed or registered sources of radiation.

C. After filing the written report, the licensee or registrant shall also report additional substantive information on the loss or theft within 30 days after the licensee or registrant learns of the information.

D. The licensee or registrant shall provide the names of individuals who may have received an exposure to radiation as a result of an incident as required in subsection (B).

Historical Note

Adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-444. Reports of Exposures, Radiation Levels, and Concentrations of Radioactive Material Exceeding the Limits

A. In addition to the notification required by R12-1-445, each licensee or registrant shall submit a written report within 30 days after learning of any of the following:
1. Incidents for which notification is required by R12-1-445;
2. Doses in excess of any of the following:
   a. The occupational dose limits for adults in R12-1-408;
   b. The occupational dose limits for a minor in R12-1-414;
   c. The limits for an embryo or fetus of a declared pregnant woman in R12-1-415;
   d. The limits for an individual member of the public in R12-1-416;
   e. Any applicable limit in the license or registration; or
   f. The ALARA limit on air emissions in R12-1-407;
3. Levels of radiation or concentrations of radioactive material in:
   a. A restricted area in excess of applicable limits in the license or registration, or
   b. An unrestricted area in excess of 10 times the applicable limit in this Article or in the license or registration, whether or not this involves an exposure of any individual to a dose in excess of the limits in R12-1-416;
4. Radiation levels or concentrations of radioactive material in excess of the standards in 40 CFR 190, 2003 edition, published July 1, 2003, by the Office of the Federal Register, National Archives and Records Administration, Washington, D.C. 20408 which is incorporated by reference and on file with the Agency, if the licensee is subject to these federal standards, or there is a license condition referencing the 40 CFR 190 standards. This incorporation by reference contains no future editions or amendments.

B. Contents of reports.
1. Each report shall contain a description of each individual's exposure to radiation and radioactive material, including as applicable:
   a. Estimates of each individual's dose;
   b. The levels of radiation and concentrations of radioactive material involved;
   c. The cause of the elevated exposures, dose rates, or concentrations; and
   d. Corrective steps taken or planned to ensure against a recurrence, including the schedule for achieving conformance with applicable limits, generally applicable environmental standards, and associated license or registration conditions.
2. Each report filed according to subsection (A) shall include for each occupationally overexposed individual: name, social security number, and date of birth. With respect to the limit for an embryo or fetus in R12-1-415, the identifiers in the report should be those of the declared pregnant woman. The report shall be prepared so that information regarding each overexposed individual is stated in a separate and detachable part of the report.

C. All licensees or registrants who make reports according to subsection (A) shall submit the report in writing to the Agency.

Historical Note

Adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-445. Notification of Incidents

A. Immediate notification: Each licensee or registrant shall immediately report to the Agency any event involving a radiation source that may have caused or threatens to cause any of the following conditions:
1. An individual to receive:

a. A total effective dose equivalent of 0.25 Sv (25 rem) or more;
b. A lens dose equivalent of 0.75 Sv (75 rem) or more; or
c. A shallow-dose equivalent to the skin or extremities of 2.5 Gy (250 rads) or more; or

2. The release of radioactive material, inside or outside of a restricted area, so if an individual had been present for 24 hours, the individual could have received five times the annual limit on intake (this subsection do not apply to a location where personnel are not normally stationed during routine operations, such as a hot-cell or process enclosure).

B. Twenty-four hour notification: Each licensee or registrant shall, within 24 hours of discovery of the event, report to the Agency any event involving loss of control of a radiation source possessed by the licensee or registrant that may have caused, or threatens to cause, any of the following conditions:

1. An individual to receive, in a period of 24 hours
   a. A total effective dose equivalent exceeding 0.05 Sv (5 rem);
   b. A lens dose equivalent exceeding 0.15 Sv (15 rem); or
   c. A shallow-dose equivalent to the skin or extremities exceeding 0.5 Gy (50 rads); or
2. The release of radioactive material, inside or outside of a restricted area, so, if an individual had been present for 24 hours, the individual could have received an intake in excess of one occupational annual limit of intake (this subsection does not apply to a location where personnel are not normally stationed during routine operations, such as a hot-cell or process enclosure).

C. A licensee or registrant shall prepare any report filed with the Agency according to this Section so that names of individuals who have received exposure to radiation or radioactive material are stated in a separate and detachable part of the report.

D. A licensee or registrant shall report to the Agency by telephone in response to the requirements of this Section.

E. If the Agency does not respond to the initial telephone call, the licensee or registrant shall report to the Department of Public Safety and continue with reasonable efforts to contact the Agency Duty Officer until contact is made.

F. The provisions of this Section do not apply to a dose that results from a planned special exposure, if the dose is within the limits for planned special exposures and reported according to R12-1-413(C).

Historical Note
Adopted effective August 10, 1994 (Supp. 94-3).
Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-446. Notifications and Reports to Individuals

A. Requirements for notification and reports to individuals of exposure to radiation or radioactive material are specified in R12-1-1004.

B. Each licensee or registrant shall notify the individual exposed to radiation or radioactive material in the report to the Agency required in R12-1-445. A separate notice to the exposed individual shall be provided no later than the date the report is submitted to the Agency and shall comply with R12-1-1004(A).

Historical Note
Adopted effective August 10, 1994 (Supp. 94-3).
Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-447. Vacating Premises

A. If a facility has been used for activities involving radioactive material each licensee shall notify the Agency in writing of the intent to vacate the facility no less than 45 days before relinquishing possession or control of the facility.

B. If a facility is contaminated with radioactive material, the licensee vacating the facility shall decontaminate it using Agency-approved procedures.

C. The Agency shall inspect a vacated facility to determine whether it is contaminated with radioactive material.

Historical Note
Adopted effective August 10, 1994 (Supp. 94-3).
Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-448. Additional Reporting

A. Each licensee shall notify the Agency as soon as possible, but not later than four hours after the discovery of an event, and take immediate protective actions necessary to avoid exposures to radiation or radioactive materials that could exceed the limits specified in this Chapter or releases of licensed material that could exceed the limits specified in this Chapter. For purposes of this Section, event means a radiation accident involving a fire, explosion, gas release, or similar occurrence.

B. Each licensee shall notify the Agency within 24 hours after the discovery of any of the following events involving licensed material:

1. A contamination event that:
   a. Requires access to the contaminated area, by workers or the public, being restricted for more than 24 hours by the imposition of additional radiological controls to prohibit entry into the area; and
   b. Involves a quantity of radioactive material greater than five times the lowest annual limit on intake specified in Appendix B of this Article; and
   c. Results in access to the contaminated area being restricted for a reason other than to allow radionuclides with a half-life of less than 24 hours to decay prior to decontamination.
2. An event in which equipment is disabled or fails to function as designed when;
   a. The equipment is part of a system designed to prevent releases exceeding the limits specified in this Chapter, to prevent exposures to radiation and radioactive materials exceeding limits specified in this Chapter, or to mitigate the consequences of an accident; and
   b. The equipment performs a safety function; and
   c. No redundant equipment is available and operable to perform the required safety function.
3. An event that requires urgent medical treatment of an individual with radioactive contamination on the individual's clothing or body.
4. A fire or explosion damaging any licensed material or any device, container, or equipment containing licensed material when;
   a. The quantity of material involved is greater than five times the lowest annual limit on intake specified in Appendix B of this Article; and
   b. The damage affects the integrity of the licensed material or its container.

C. Each licensee shall make reports required by subsections (A) and (B) above by telephone to the Agency. To the extent that the information is available at the time of notification, the information provided in these reports shall include:

1. The callers's name and call back telephone number;

2. A description of the event, including date and time;
3. The exact location of the event;
4. The isotopes, quantities, and chemical and physical form of the licensed material involved; and
5. Any personnel radiation exposure data available.

D. Each licensee who makes a report required by subsection (A) or (B) shall submit a written follow-up report within 30 days of the initial report. Written reports prepared as required by other rules may be submitted to fulfill this requirement if the reports contain all of the required information in this Section. The licensee shall send the written report to the Agency. The report shall include the following:
1. A description of the event, including the probable cause and the manufacturer and model number (if applicable) of any equipment that failed or malfunctioned;
2. The exact location of the event;
3. The isotopes, quantities, and chemical and physical form of the licensed material involved;
4. Date and time of the event;
5. Corrective actions taken or planned and the results of any evaluations or assessments; and
6. The extent of exposure of individuals to radiation or to radioactive materials without identification of individuals by name.

Historical Note

Adopted effective June 13, 1997 (Supp. 97-2). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-449. Survey Instruments and Pocket Dosimeters

A. Each licensee or registrant shall ensure that survey instruments used to show compliance with this Article have been calibrated before first use, annually, and following repair, unless otherwise specified in this Chapter.

B. To satisfy the requirements of subsection (A), the licensee or registrant shall:
1. For each scale to be calibrated, calibrate two readings separated by at least 50 percent of scale rating; and
2. Conspicuously note on the instrument the apparent radiation level, in appropriate units for the type of survey instrument being used and the date of calibration.

C. Each licensee or registrant shall check each survey instrument for proper operation with the dedicated check source after calibration and before each use.

D. The licensee or registrant shall retain a record of each calibration required in subsection (A) for three years. The record shall include:
1. A description of the calibration procedure; and
2. A description of the source used, the certified dose rates from the source, the rates indicated by the instrument being calibrated, the correction factors deduced from the calibration data, the signature of the individual who performed the calibration, and the date of calibration.

E. To meet the requirements of subsections (A), (B), and (C), the licensee or registrant may obtain the services of persons licensed or registered by the Agency, the NRC, an Agreement State, or a Licensing State to perform calibrations of survey instruments. Licensing records of the service person authorization shall be maintained for three years by the licensee or registrant obtaining the service.

F. Each licensee or registrant shall ensure that pocket dosimeters used to show compliance with this Article:
1. Have been evaluated, using a procedure acceptable to the Agency, for proper operation annually, and following repair, unless a more frequent evaluation is required by license condition. With the exception of electronic pocket dosimeters, which are exempted from the drift test, the evaluation shall include a check for drift over a 24-hour period, and
2. Meet the performance criteria listed in R12-1-523(B).

G. Records of personnel dosimeter operational checks shall be maintained for three years.

Historical Note

New Section adopted by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-450. Sealed Sources

A. A licensee shall only receive, possess, and use radioactive materials contained in a sealed source that has been manufactured, labeled, packaged, and distributed in accordance with a specific license for its manufacture and distribution. The license to manufacture and distribute a sealed source shall be issued by the Agency, U.S. Nuclear Regulatory Commission, a Licensing State, or another Agreement State.

B. A licensee who possesses and uses a sealed source, or any device or equipment that contains a sealed source, shall follow the radiation safety and handling instructions approved by the Agency or follow the radiation safety and handling instructions furnished by the manufacturer on the label attached to the source, on the permanent container of the source, or in a leaflet or brochure that accompanies the source, and maintain the instructions in a legible and conveniently available form. If the handling instructions, leaflet, or brochure is no longer available and a copy cannot be obtained from the manufacturer, the licensee shall notify the Agency that the source handling information is no longer available.

C. Inventories:
1. An inventory shall be conducted at intervals not to exceed six months, unless a shorter interval is specified by license condition.
2. The records of the inventory shall be maintained for three years from the date of the inventory, and shall be available for inspection by the Agency.
3. The information recorded shall include:
   a. The kind and quantity of radioactive material,
   b. The model and serial number of the source or the device in which it is mounted,
   c. The location of the sealed source,
   d. The date of the inventory, and
   e. The signature of the person performing the inventory.

D. Any licensee who possesses and uses sealed sources in the practice of medicine shall conduct a physical inventory according to the requirements in 12 A.A.C. 1, Article 7.

E. Sealed sources, containing radioactive material, shall not be opened unless authorized by license condition.

F. Sealed sources and machines, devices, or equipment containing sealed sources shall be used in accordance with procedures described in the manufacturer's instructions and the safety precautions described in the Nuclear Regulatory Commission Sealed Sources and Device Registry, unless the instructions or precautions conflict with these rules or license condition.

Historical Note

New Section adopted by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

Appendix A. Assigned Protection Factors for Respirators[a]

	Operating mode	Assigned Protection Factors
I. Air Purifying Respirators [Particulate [b] only] [c]:		
Filtering face piece disposable [d]	Negative	([d])
Face piece, half [e]	Negative Pressure	10
Face piece, full	Negative Pressure	100
Face piece, half	Powered Air-purifying Respirators	50
Face piece, full	Powered Air-purifying Respirators	1000
Helmet/hood	Powered Air-purifying Respirators	1000
Face piece, loose-fitting	Powered Air-purifying Respirators	25
II. Atmosphere supplying respirators [particulate, gases and vapors[f]]:		
1. Air-line respirator:		
Face piece, half	Demand	10
Face piece, half	Continuous Flow	50
Face piece, half	Pressure Demand	50
Face piece, full	Demand	100
Face piece, full	Continuous Flow	1000
Face piece, full	Pressure Demand	1000
Helmet/hood	Continuous Flow	1000
Face piece, loose-fitting	Continuous Flow	25
Suit	Continuous Flow	([g])
2. Self-contained breathing Apparatus (SCBA):		
Face piece, full	Demand	[h]100
Face piece, full	Pressure Demand	[i]10,000
Face piece, full	Demand, Recirculating	[h]100
Face piece, full	Positive Pressure Recirculating	[i]10,000
III. Combination Respirators:		
Any combination of air-purifying and atmosphere-supplying respirators	Assigned protection factor for type and mode of operation as listed above	

[a] These assigned protection factors apply only in a respiratory protection program that meets the requirements of this Article. They are applicable only to airborne radiological hazards and may not be appropriate if chemical or other respiratory hazards exist instead of, or in addition to, radioactive hazards. A licensee shall comply with Department of Labor regulations, regarding selection and use of respirators for those circumstances.

Radioactive contaminants for which the concentration values in Table 1, Column 3 of Appendix B are based on internal dose due to inhalation may, in addition, present external exposure hazards at higher concentrations. Under these circumstances, limitations on occupancy may have to be governed by external dose limits.

[b] A licensee shall equip air purifying respirators of APF<100 with particulate filters that are at least 95 percent efficient. The licensee shall equip air purifying respirators of APF=100 with particulate filters that are at least 99 percent efficient. The licensee shall equip air purifying respirators of APF>100 with particulate filters that are at least 99.97 percent efficient.

[c] A licensee may apply to the Commission for the use of an APF greater than 1 for sorbent cartridges as protection against airborne radioactive gases and vapors, similar to radioiodine.

[d] A Licensee may permit an individual to use this type of respirator if the individual has not been medically screened or fit tested on the device, provided that no credit is taken for use of these respirators in estimation of intake or dose. It is also recognized that it is difficult to perform an effective positive or negative pressure pre-use user seal check on this type of device. All other respiratory protection program requirements listed in 10 CFR 20.1703, January 2000 Edition, and published January 1, 2000, apply and are incorporated by reference and available for review at the Agency and Secretary of State. This incorporation by reference contains no future editions or amendments. There is no assigned protection factor for these devices. However, a licensee may use an APF equal to 10 if the licensee can demonstrate a fit factor of at least 100 by use of a validated or evaluated, qualitative or quantitative fit test.

[e] Under-chin type only. No distinction is made in this appendix between elastomeric half-masks with replaceable cartridges and those designed with the filter medium as an integral part of the face piece (disposable or reusable disposable). Both types are acceptable as long as the seal area of the latter contains some substantial type of seal-enhancing material, such as rubber or plastic, two or more suspension straps are adjustable, the filter medium is at least 95 percent efficient, and all other requirements of this Article are met.

[f] The assigned protection factors for gases and vapors are not applicable to radioactive contaminants that present an absorption or submersion hazard. For tritium oxide vapor, approximately one-third of the intake occurs by absorption through the skin so that an overall protection factor of 3 is appropriate when atmosphere-supplying respirators are used to protect against tritium oxide. Exposure to radioactive noble gases is not considered a significant respiratory hazard and protective actions for these contaminants should be based on external (submersion) dose considerations.

[g] No NIOSH approval schedule is currently available for atmosphere supplying suits. This equipment may be used in an acceptable respiratory protection program as long as all the other minimum program requirements, with the exception of fit testing, are met. The minimum program requirements are provided in 10 CFR 20.1703.

[h] The licensee shall implement institutional controls to assure that these devices are not used in areas immediately dangerous to life or health (IDLH).

[i] This type of respirator may be used as an emergency device in unknown concentrations for protection against inhalation hazards. External radiation hazards and other limitations to permitted exposure such as skin absorption shall be taken into account in these circumstances. This device may not be used by any individual who experiences perceptible outward leakage of breathing gas while wearing the device.

Historical Note

Former Appendix A repealed; new Appendix A adopted effective June 30, 1977 (Supp. 77-3). Section repealed; new Section adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 9 A.A.R. 1126, effective May 9, 2003 (Supp. 03-1).

Appendix B. Annual Limits on Intake (ALI) and Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sanitary Sewerage

Introduction

For each radionuclide, Table I indicates the chemical form which is to be used for selecting the appropriate ALI or DAC value. The ALls and DACs for inhalation are given for an aerosol with an activity median aerodynamic diameter (AMAD) of 1 μm, micron, and for three classes (D,W,Y) of radioactive material, which refer to their retention (approximately days, weeks, or years) in the pulmonary region of the lung. This classification applies to a range of clearance half-times for D if less than 10 days, for W from 10 to 100 days, and for Y greater than 100 days. Table II provides concentration limits for airborne and liquid effluents released to the general environment. Table III provides concentration limits for discharges to sanitary sewerage.

Note:

The values in Tables I, II, and III are presented in the computer "E" notation. In this notation a value of 6E-02 represents a value of 6×10^{-2} or 0.06, 6E+2 represents 6×10^{2} or 600, and 6E+0 represents 6×10^{0} or 6.

Table I "Occupational Values"

Note that the columns in Table I of this Appendix captioned "Oral Ingestion ALI," "Inhalation ALI," and "DAC" are applicable to occupational exposure to radioactive material.

The ALIs in this Appendix are the annual intakes of given radionuclide by "Reference Man" which would result in either (1) a committed effective dose equivalent of 0.05 Sv (5 rem), stochastic ALI, or (2) a committed dose equivalent of 0.5 Sv (50 rem) to an organ or tissue, nonstochastic ALI. The stochastic ALIs were derived to result in a risk, due to irradiation of organs and tissues, comparable to the risk associated with deep-dose equivalent to the whole body of 0.05 Sv (5 rem). The derivation includes multiplying the committed dose equivalent to an organ or tissue by a weighting factor, W_T. This weighting factor is the proportion of the risk of stochastic effects resulting from irradiation of the organ or tissue, T, to the total risk of stochastic effects when the whole body is irradiated uniformly. The values of W_T are listed under the definition of weighting factor in R12-1-403. The nonstochastic ALIs were derived to avoid nonstochastic effects, such as prompt damage to tissue or reduction in organ function.

A value of $W_T = 0.06$ is applicable to each of the five organs or tissues in the "remainder" category receiving the highest dose equivalents, and the dose equivalents of all other remaining tissues may be disregarded. The following portions of the GI tract -- stomach, small intestine, upper large intestine, and lower large intestine -- are to be treated as four separate organs.

Note that the dose equivalents for an extremity, skin, and lens of the eye are not considered in computing the committed effective dose equivalent but are subject to limits that shall be met separately.

When an ALI is defined by the stochastic dose limit, this value alone is given. When an ALI is determined by the nonstochastic dose limit to an organ, the organ or tissue to which the limit applies is shown, and the ALI for the stochastic limit is shown in parentheses. Abbreviated organ or tissue designations are used:

LLI wall	=	lower large intestine wall,
St. wall	=	stomach wall,
Blad wall	=	bladder wall, and
Bone surf	=	Bone surface.

The use of the ALIs listed first, the more limiting of the stochastic and nonstochastic ALIs, will ensure that nonstochastic effects are avoided and that the risk of stochastic effects is limited to an acceptably low value. If, in a particular situation involving a radionuclide for which the nonstochastic ALI is limiting, use of that nonstochastic ALI is considered unduly conservative, the licensee may use the stochastic ALI to determine the committed effective dose equivalent. However, the licensee shall also ensure that the 0.5 Sv (50 rem) dose equivalent limit for any organ or tissue is not exceeded by the sum of the external deep-dose equivalent plus the internal committed dose equivalent to that organ, not the effective dose. For the case where there is no external dose contribution, this would be demonstrated if the sum of the fractions of the nonstochastic ALIs (ALI_{ns}) that contribute to the committed dose equivalent to the organ receiving the highest dose does not exceed unity, that is, Σ (intake (in μCi) of each radionuclide/ALI_{ns}) ≤ 1.0. If there is an external deep dose equivalent contribution of H_d, then this sum must be less than $1 - (H_d/50)$, instead of ≤ 1.0.

Note that the dose equivalents for an extremity, skin, and lens of the eye are not considered in computing the committed effective dose equivalent but are subject to limits that must be met separately.

The derived air concentration (DAC) values are derived limits intended to control chronic occupational exposures. The relationship between the DAC and the ALI is given by:

DAC = ALI(in μCi)/(2000 hours per working year x 60 minutes/hour x 2 x 10^4 ml per minute) = [ALI/2.4 x 10^9] μCi/ml,

where 2 x 10^4 ml is the volume of air breathed per minute at work by Reference Man under working conditions of light work.

The DAC values relate to one of two modes of exposure: either external submersion or the internal committed dose equivalents resulting from inhalation of radioactive materials. DACs based upon submersion are for immersion in a semi-infinite cloud of uniform concentration and apply to each radionuclide separately.

The ALI and DAC values include contributions to exposure by the single radionuclide named and any in-growth of daughter radionuclides produced in the body by decay of the parent. However, intakes that include both the parent and daughter radionuclides shall be treated by the general method appropriate for mixtures.

The values of ALI and DAC do not apply directly when the individual both ingests and inhales a radionuclide, when the individual is exposed to a mixture of radionuclides by either inhalation or ingestion or both, or when the individual is exposed to both internal and external irradiation. See R12-1-407. When an individual is exposed to radioactive materials which fall under several of the translocation classifications of the same radionuclide, such as Class D, Class W, or Class Y, the exposure may be evaluated as if it were a mixture of different radionuclides.

It should be noted that the classification of a compound as Class D, W, or Y is based on the chemical form of the compound and does not take into account the radiological half-life of different radionuclides. For this reason, values are given for Class D, W, and Y compounds, even for very short-lived radionuclides.

Table II "Effluent Concentrations"

The columns in Table II of this Appendix captioned "Effluents," "Air," and "Water" are applicable to the assessment and control of dose to the public, particularly in the implementation of the provisions of R12-1-415. The concentration values given in Columns 1 and 2 of Table II are equivalent to the radionuclide concentrations which, if inhaled or ingested continuously over the course of a year, would produce a total effective dose equivalent of 0.5 mSv (0.05 rem).

Consideration of nonstochastic limits has not been included in deriving the air and water effluent concentration limits because nonstochastic effects are presumed not to occur at or below the dose levels established for individual members of the public. For radionuclides, where the nonstochastic limit was governing in deriving the occupational DAC, the stochastic ALI was used in deriving the corresponding airborne effluent limit in Table II. For this reason, the DAC and airborne effluent limits are not always proportional as they were in earlier versions of Appendix A of Article 4.

The air concentration values listed in Table II, Column 1 were derived by one of two methods. For those radionuclides for which the stochastic limit is governing, the occupational stochastic inhalation ALI was divided by 2.4 x 10^9, relating the inhalation ALI to the DAC, as explained above, and then divided by a factor of 300. The factor of 300 includes the following components: a factor of 50 to relate the 0.05 Sv (5 rem) annual occupational dose limit to the 0.1 rem limit for members of the public, a factor of 3 to adjust for the difference in exposure time and the inhalation rate for a worker and that for members of the public; and a factor of 2 to adjust the occupational values, derived for adults, so that they are applicable to other age groups.

For those radionuclides for which submersion, that is external dose, is limiting, the occupational DAC in Table I, Column 3 was divided by 219. The factor of 219 is composed of a factor of 50, as described above, and a factor of 4.38 relating occupational exposure for 2,000 hours per year to full-time exposure (8,760 hours per year). Note that an additional factor of 2 for age considerations is not warranted in the submersion case.

The water concentrations were derived by taking the most restrictive occupational stochastic oral ingestion ALI and dividing by 7.3 x 10^7. The factor of 7.3 x 10^7 (ml) includes the following components: the factors of 50 and 2 described above and a factor of 7.3 x 10^5 (ml) which is the annual water intake of Reference Man.

Note 2 of this Appendix provides groupings of radionuclides which are applicable to unknown mixtures of radionuclides. These groupings, including occupational inhalation ALIs and DACS, air and water effluent concentrations, and releases to sewer, require demonstrating that the most limiting radionuclides in successive classes are absent. The limit for the unknown mixture is defined when the presence of one of the listed radionuclides cannot be definitely excluded as being present either from knowledge of the radionuclide composition of the source or from actual measurements.

Table III "Releases to Sewers"

The monthly average concentrations for release to sanitary sewerage are applicable to the provisions in R12-1-435. The concentration values were derived by taking the most restrictive occupational stochastic oral ingestion ALI and dividing by 7.3 x 10^6 (ml). The factor of 7.3 x 10^6 (ml) is composed of a factor of 7.3 x 10^5 (ml), the annual water intake by Reference Man, and a factor of 10, such that the concentrations, if the sewage released by the licensee were the only source of water ingested by a Reference Man during a year, would result in a committed effective dose equivalent of 0.5 rem.

LIST OF ELEMENTS

Name	Symbol	Atomic Number	Name	Symbol	Atomic Number
Actinium	Ac	89	Mendelevium	Md	101
Aluminum	Al	13	Mercury	Hg	80
Americium	Am	95	Molybdenum	Mo	42
Antimony	Sb	51	Neodymium	Nd	60
Argon	Ar	18	Neptunium	Np	93
Arsenic	As	33	Nickel	Ni	28
Astatine	At	85	Niobium	Nb	41
Barium	Ba	56	Osmium	Os	76
Berkelium	Bk	97	Palladium	Pd	46
Beryllium	Be	4	Phosphorus	P	15
Bismuth	Bi	83	Platinum	Pt	78
Bromine	Br	35	Plutonium	Pu	94
Cadmium	Cd	48	Polonium	Po	84
Calcium	Ca	20	Potassium	K	19
Californium	Cf	98	Praseodymium	Pr	59
Carbon	C	6	Promethium	Pm	61
Cerium	Ce	58	Protactinium	Pa	91
Cesium	Cs	55	Radium	Ra	88
Chlorine	Cl	17	Radon	Rn	86
Chromium	Cr	24	Rhenium	Re	75
Cobalt	Co	27	Rhodium	Rh	45
Copper	Cu	29	Rubidium	Rb	37
Curium	Cm	96	Ruthenium	Ru	44
Dysprosium	Dy	66	Samarium	Sm	62
Einsteinium	Es	99	Scandium	Sc	21
Erbium	Er	68	Selenium	Se	34
Europium	Eu	63	Silicon	Si	14
Fermium	Fm	100	Silver	Ag	47
Fluorine	F	9	Sodium	Na	11
Francium	Fr	87	Strontium	Sr	38
Gadolinium	Gd	64	Sulfur	S	16
Gallium	Ga	31	Tantalum	Ta	73
Germanium	Ge	32	Technetium	Tc	43
Gold	Au	79	Tellurium	Te	52
Hafnium	Hf	72	Terbium	Tb	65
Holmium	Ho	67	Thallium	Tl	81
Hydrogen	H	1	Thorium	Th	90
Indium	In	49	Thulium	Tm	69
Iodine	I	53	Tin	Sn	50
Iridium	Ir	77	Titanium	Ti	22
Iron	Fe	26	Tungsten	W	74
Krypton	Kr	36	Uranium	U	92
Lanthanum	La	57	Vanadium	V	23
Lead	Pb	82	Xenon	Xe	54
Lutetium	Lu	71	Ytterbium	Yb	70
Magnesium	Mg	12	Yttrium	Y	39
Manganese	Mn	25	Zinc	Zn	30
			Zirconium	Zr	40

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col.3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	Oral Ingestion ALI (μCi)	Inhalation ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
1	Hydrogen-3	Water, DAC includes skin absorption	8E+4	8E+4	2E-5	1E-7	1E-3	1E-2
		Gas (HT or T_2) Submersion[1]: Use above values as HT and T_2 oxidize in air and in the body to HTO.						
4	Beryllium-7	W, all compounds except those given for Y	4E+4	2E+4	9E-6	3E-8	6E-4	6E-3
		Y, oxides, halides, and nitrates	-	2E+4	8E-6	3E-8	-	-
4	Beryllium-10	W, see ^{7}Be	1E+3	2E+2	6E-8	2E-10	-	--
		LLI wall	(1E+3)	-	-	-	2E-5	2E-4
		Y, see ^{7}Be	-	1E+1	6E-9	2E-11	-	-
6	Carbon-11[2]	Monoxide	-	1E+6	5E-4	2E-6	-	-
		Dioxide	-	6E+5	3E-4	9E-7	-	-
		Compounds	4E+5	4E+ 5	2E-4	6E-7	6E-3	6E-2
6	Carbon-14	Monoxide	-	2E+6	7E-4	2E-6	-	-
		Dioxide	-	2E+5	9E-5	3E-7	-	-
		Compounds	2E+3	2E+3	1E-6	3E-9	3E-5	3E-4
9	Fluorine-18[2]	D, fluorides of H, Li, Na, K, Rb, Cs, and Fr	5E+4	7E+4	3E-5	1E-7	-	-
		St wall	(5E+4)	-	-	-	7E-4	7E-3
		W, fluorides of Be, Mg, Ca, Sr, Ba, Ra, Al, Ga, In, Tl, As, Sb, Bi, Fe, Ru, Os, Co, Ni, Pd, Pt, Cu, Ag, Au, Zn, Cd, Hg, Sc, Y, Ti, Zr, V, Nb, Ta, Mn, Tc, and Re	-	9E+4	4E-5	1E-7	-	-
		Y, Lanthanum fluoride	-	8E+-4	3E-5	1E-7	-	-
11	Sodium-22	D, all compounds	4E+2	6E+2	3E-7	9E-10	6E-6	6E-5
11	Sodium-24	D, all compounds	4E+3	5E+3	2E-6	7E-9	5E-5	5E-4
12	Magnesium-28	D, all compounds except those given for W	7E+2	2E+3	7E-7	2E-9	9E-6	9E-5
		W, oxides, hydroxides, carbides, halides, and nitrates	-	1E+3	5E-7	2E-9	-	-
13	Aluminum-26	D, all compounds except those given for W	4E+2	6E+1	3E-8	9E-11	6E-6	6E-5
		W, oxides, hydroxides, carbides, halides, and nitrates	-	9E+1	4E-8	1E-10	-	-
14	Silicon-31	D, all compounds except those given for W and Y	9E+3	3E+4	1E-5	4E-8	1E-4	1E-3
		W, oxides, hydroxides, carbides, and nitrates	-	3E+4	1E-5	5E-8	-	-
		Y, aluminosilicate glass	-	3E+4	1E-5	4E-8	-	-
14	Silicon-32	D. see ^{31}Si	2E+3	2E+2	1E-7	3E-10	-	-
		LLI wall	(3E+3)	-	-	-	4E-5	4E-4
		W, see ^{31}Si	-	1E+2	5E-8	2E-10	-	-
		Y, see ^{31}Si	-	5E+0	2E-9	7E-12	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col.3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Concentration (μCi/ml)
15	Phosphorus-32	D, all compounds except phosphates given for W	6E+2	9E+2	4E-7	1E-9	9E-6	9E-5
		W, phosphates of Zn^{2+}, S^{3+}, Mg^{2+}, Fe^{3+}, Bi^{3+}, and Lanthanides	-	4E+2	2E-7	5E-10	-	-
15	Phosphorus-33	D, see ^{32}P	6E+3	8E+3	4E-6	1E-8	8E-5	8E-4
		W, see ^{32}P	-	3E+3	1E-6	4E-9	-	-
16	Sulfur-35	Vapor	1E+4	6E-6	2E-8	-	-	
		D, sulfides and sulfates except those given for W	1E+4	2E+4	7E-6	2E-8	-	-
			LLI wall (8E+3)	-	-	-	1E-4	1E-3
		W, elemental sulfur, sulfides of Sr, Ba, Ge, Sn, Pb, As, Sb, Bi, Cu, Ag, Au, Zn, Cd, Hg, W, and Mo. Sulfates of Ca, Sr, Ba, Ra, As, Sb, and Bi	6E+3 -	2E+3	9E-7	3E-9	-	-
17	Chlorine-36	D, chlorides of H, Li, Na, K, Rb, Cs, and Fr	2E+3	2E+3	1E-6	3E-9	2E-5	2E-4
		W, chlorides of Lanthanides, Be, Mg, Ca, Sr, Ba, Ra, Al, Ga, In, Tl, Ge, Sn, Pb, As, Sb, Bi, Fe, Ru, Os, Co, Rh, Ir, Ni, Pd, Pt, Cu, Ag, Au, Zn, Cd, Hg, Sc, Y, Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W, Mn, Tc, and Re	-	2E+2	1E-7	3E-10-	-	
17	Chlorine-38[2]	D, see ^{36}Cl	2E+4	4E+4	2E-5	6E-8-	-	
			St wall (3E+4)	-	-	-3E-4	3E-3	
		W, see ^{36}Cl	-	5E+4	2E-5	6E-8-	-	
17	Chlorine-39[2]	D, see ^{36}Cl	2E+4	5E+4	2E-5	7E-8-		-
			St wall (4E+4)	-	-	-5E-4	5E-3	
		W, see ^{36}Cl	-	6E+4	2E-5	8E-8-	-	
18	Argon-37	Submersion[1]	-	-	1E+0	6E-3-	-	
18	Argon-39	Submersion[1]	-	-	2E-4	8E-7-	-	
18	Argon-41	Submersion[1]	-	-	3E-6	1E-8-	-	
19	Potassium-40	D, all compounds	3E+2	4E+2	2E-7	6E-10	4E-6	4E-5
19	Potassium-42	D, all compounds	5E+3	5E+3	2E-6	7E-9	6E-5	6E-4
19	Potassium-43	D, all compounds	6E+3	9E+3	4E-6	1E-8	9E-5	9E-4
19	Potassium-44[2]	D, all compounds	2E+4	7E+4	3E-5	9E-8	-	-
			St wall (4E+4)	-	-	-	5E-4	5E-3
19	Potassium-45[2]	D, all compounds	3E+4	1E+5	5E-5	2E-7	-	-
			St watt (5E+4)	-	-	-	7E-4	7E-3

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col.3 DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
20	Calcium-41	W, all compounds	3E+3	4E+3	2E-6	-	-	-
			Bone surf (4E+3)	Bone surf (4E+3)	-	5E-9	6E-5	6E-4
20	Calcium-45	W, all compounds	2E+3	8E+2	4E-7	1E-9	2E-5	2E-4
20	Calcium-47	W, all compounds	8E+2	9E+2	4E-7	1E-9	1E-5	1E-4
21	Scandium-43	Y, all compounds	7E+3	2E+4	9E-6	3E-8	1E-4	1E-3
21	Scandium-44m	Y, all compounds	5E+2	7E+2	3E-7	1E-9	7E-6	7E-5
21	Scandium-44	Y, all compounds	4E+3	1E+4	5E-6	2E-8	5E-5	5E-4
21	Scandium-46	Y, all compounds	9E+2	2E+2	1E-7	3E-10	1E-5	1E-4
21	Scandium-47	Y, all compounds	2E+3	3E+3	1E-6	4E-9	-	-
			LLI wall (3E+3)	-	-	-	4E-5	4E-4
21	Scandium-48	Y, all compounds	8E+2	1E+3	6E-7	2E-9	1E-5	1E-4
21	Scandium-49[2]	Y, all compounds	2E+4	5E+4	2E-5	8E-8	3E-4	3E-3
22	Titanium-44	D, all compounds except those given for W and Y	3E+2	1E+1	5E-9	2E-11	4E-6	4E-5
		W, oxides, hydroxides, carbides, halides, and nitrates	-	3E+1	1E-8	4E-11	-	-
		Y, SrTiO	-	6E+0	2E-9	8E-12	-	-
22	Titanium-45	D, see ^{44}Ti	9E+3	3E+4	1E-5	3E-8	1E-4	1E-3
		W, see ^{44}Ti	-	4E+4	1E-5	5E-8	-	-
		Y, see ^{44}Ti	-	3E+4	1E-5	4E-8	-	-
23	Vanadium-47[2]	D, all compounds except those given for W	3E+4	8E+4	3E-5	1E-7	-	-
			St wall (3E+4)	-	-	-	4E-4	4E-3
		W, oxides, hydroxides, carbides, and halides	-	1E+5	4E-5	1E-7	-	-
23	Vanadium-48	D, see ^{47}V	6E+2	1E+3	5E-7	2E-9	9E-6	9E-5
		W, see ^{47}V	-	6E+2	3E-7	9E-10	-	-
23	Vanadium-49	D, see ^{47}V	7E+4	3E+4	1E-5	-	-	-
			LLI wall (9E+4)	Bone surf (3E+4)	-	5E-8	1E-3	1E-2
		W, see ^{47}V	-	2E+4	8E-6	2E-8	-	-
24	Chromium-48	D, all compounds except those given for W and Y	6E+3	1E+4	5E-6	2E-8	8E-5	8E-4
		W, halides and nitrates	-	7E+3	3E-6	1E-8	-	-
		Y, oxides and hydroxides	-	7E+3	3E-6	1E-8	-	-
24	Chromium-49[2]	D, see ^{48}Cr	3E+4	8E+4	4E-5	1E-7	4E-4	4E-3
		W, see ^{48}Cr	-	1E+5	4E-5	1E-7	-	-
		Y, see ^{48}Cr	-	9E+4	4E-5	1E-7	-	-
24	Chromium-51	D, see ^{48}Cr	4E+4	5E+4	2E-5	6E-8	5E-4	5E-3
		W, see ^{48}Cr	-	2E+4	1E-5	3E-8	-	-
		Y, see ^{48}Cr	-	2E+4	8E-6	3E-8	-	-
25	Manganese-51[2]	D, all compounds except those given for W	2E+4	5E+4	2E-5	7E-8	3E-4	3E-3
		W, oxides, hydroxides, halides, and nitrates	-	6E+4	3E-5	8E-8	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col.3 DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
25	Manganese-52m[2]	D, see ^{51}Mn	3E+4	9E+4	4E-5	1E-7	-	-
			St wall (4E+4)	-	-	-	5E-4	5E-3
		W, see ^{51}Mn	-	1E+5	4E-5	1E-7	-	-
25	Manganese-52	D, see ^{51}Mn	7E+2	1E+3	5E-7	2E-9	1E-5	1E-4
		W, see ^{51}Mn	-	9E+2	4E-7	1E-9	-	-
25	Manganese-53	D, see ^{51}Mn	5E+4	1E+4	5E-6	-	7E-4	7E-3
			-	Bone surf (2E+4)	-	3E-8	-	-
		W, see ^{51}Mn	-	1E+4	5E-6	2E-8	-	-
25	Manganese-54	D, see ^{51}Mn	2E+3	9E+2	4E-7	1E-9	3E-5	3E-4
		W, see ^{51}Mn	-	8E+2	3E-7	1E-9	-	-
25	Manganese-56	D, see ^{51}Mn	5E+3	2E+4	6E-6	2E-8	7E-5	7E-4
		W, see ^{51}Mn	-	2E+4	9E-6	3E-8	-	-
26	Iron-52	D, all compounds except those given for W	9E+2	3E+3	1E-6	4E-9	1E-5	1E-4
		W, oxides, hydroxides, and halides	-	2E+3	1E-6	3E-9	-	-
26	Iron-55	D, see ^{52}Fe	9E+3	2E+3	8E-7	3E-9	1E-4	1E-3
		W, see ^{52}Fe	-	4E+3	2E-6	6E-9	-	-
26	Iron-59	D, see ^{52}Fe	8E+2	3E+2	1E-7	5E-10	1E-5	1E-4
		W, see ^{52}Fe	-	5E+2	2E-7	7E-10	-	-
26	Iron-60	D, see ^{52}Fe	3E+1	6E+0	3E-9	9E-12	4E-7	4E-6
		W, see ^{52}Fe	-	2E+1	8E-9	3E-11	-	-
27	Cob9alt-55	W, all compounds except those given for Y	1E+3	3E+3	1E-6	4E-9	2E-5	2E-4
		Y, oxides, hydroxides, halides, and nitrates	-	3E+3	1E-6	4E-9	-	-
27	Cobalt-56	W, see ^{55}Co	5E+2	3E+2	1E-7	4E-10	6E-6	6E-5
		Y, see ^{55}Co	4E+2	2E+2	8E-8	3E-10	-	-
27	Cobalt-57	W, see ^{55}Co	8E+3	3E+3	1E-6	4E-9	6E-5	6E-4
		Y, see ^{55}Co	4E+3	7E+2	3E-7	9E-10	-	-
27	Cobalt-58m	W, see ^{55}Co	6E+4	9E+4	4E-5	1E-7	8E-4	8E-3
		Y, see ^{55}Co	-	6E+4	3E-5	9E-8	-	-
27	Cobalt-58	W, see ^{55}Co	2E+3	1E+3	5E-7	2E-9	2E-5	2E-4
		Y, see ^{55}Co	1E+3	7E+2	3E-7	1E-9	-	-
27	Cobalt-60m[2]	W, see ^{55}Co	1E+6	4E+6	2E-3	6E-6	-	-
			St wall (1E+6)	-	-	-	2E-2	2E-1
		Y, see ^{55}Co	-	3E+6	1E-3	4E-6	-	-
27	Cobalt-60	W, see ^{55}Co	5E+2	2E+2	7E-8	2E-10	3E-6	3E-5
		Y, see ^{55}Co	2E+2	3E+1	1E-8	5E-11	-	-
27	Cobalt-61[2]	W, see ^{55}Co	2E+4	6E+4	3E-5	9E-8	3E-4	3E-3
		Y, see ^{55}Co	2E+4	6E+4	2E-5	8E-8	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col.3 DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
27	Cobalt-62m[2]	W, see ^{55}Co	4E+4	2E+5	7E-5	2E-7	-	-
		St wall	(5E+4)	-	-	-	7E-4	7E-3
		Y, see ^{55}Co	-	2E+5	6E-5	2E-7	-	-
28	Nickel-56	D, all compounds except those given for W	1E+3	2E+3	8E-7	3E-9	2E-5	2E-4
		W, oxides, hydroxides, and carbides	-	1E+3	5E-7	2E-9	-	-
		Vapor	-	1E+3	5E-7	2E-9	-	-
28	Nickel-57	D, see ^{56}Ni	2E+3	5E+3	2E-6	7E-9	2E-5	2E-4
		W, see ^{56}Ni	-	3E+3	1E-6	4E-9	-	-
		Vapor	-	6E+3	3E-6	9E-	-	-
28	Nickel-59	D, see ^{56}Ni	2E+4	4E+3	2E-6	5E-9	3E-4	3E-3
		W, see ^{56}Ni	-	7E+3	3E-6	1E-8	-	-
		Vapor	-	2E+3	8E-7	3E-9	-	-
28	Nickel-63	D, see ^{56}Ni	9E+3	2E+3	7E-7	2E-9	1E-4	1E-3
		W, see ^{56}Ni	-	3E+3	1E-6	4E-9	-	-
		Vapor	-	8E+2	3E-7	1E-9	-	-
28	Nickel-65	D, see ^{56}Ni	8E+3	2E+4	1E-5	3E-8	1E-4	1E-3
		W, see ^{56}Ni	-	3E+4	1E-5	4E-8	-	-
		Vapor	-	2E+4	7E-6	2E-8	-	-
28	Nickel-66	D, see ^{56}Ni	4E+2	2E+3	7E-7	2E-9	-	-
		LLI wall	(5E+2)	-	-	-	6E-6	6E-5
		W, see ^{56}Ni	-	6E+2	3E-7	9E-10	-	-
		Vapor	-	3E+3	1E-6	4E-9	-	-
29	Copper-60[2]	D, all compounds except those given for W and Y	3E+4	9E+4	4E-5	1E-7	-	-
		St wall	(3E+4)	-	-	-	4E-4	4E-3
		W, sulfides, halides, and nitrates	-	1E+5	5E-5	2E-7	-	-
		Y, oxides and hydroxides	-	1E+5	4E-5	1E-7	-	-
29	Copper-61	D, see ^{60}Cu	1E+4	3E+4	1E-5	4E-8	2E-4	2E-3
		W, see ^{60}Cu	-	4E+4	2E-5	6E-8	-	-
		Y, see ^{60}Cu	-	4E+4	1E-5	5E-8	-	-
29	Copper-64	D, see ^{60}Cu	1E+4	3E+4	1E-5	4E-8	2E-4	2E-3
		W, see ^{60}Cu	-	2E+4	1E-5	3E-8	-	-
		Y, see ^{60}Cu	-	2E+4	9E-6	3E-8	-	-
29	Copper-67	D, see ^{60}Cu	5E+3	8E+3	3E-6	1E-8	6E-5	6E-4
		W, see ^{60}Cu	-	5E+3	2E-6	7E-9	-	-
		Y, see ^{60}Cu	-	5E+3	2E-6	6E-9	-	-
30	Zinc-62	Y, all compounds	1E+3	3E+3	1E-6	4E-9	2E-5	2E-4
30	Zinc-63[2]	Y, all compounds	2E+4	7E+4	3E-5	9E-8	-	-
		St wall	(3E+4)	-	-	-	3E-4	3E-3

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col.3 DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
30	Zinc-65	Y, all compounds	4E+2	3E+2	1E-7	4E-10	5E-6	5E-5
30	Zinc-69m	Y, all compounds	4E+3	7E+3	3E-6	1E-8	6E-5	6E-4
30	Zinc-69[2]	Y, all compounds	6E+4	1E+5	6E-5	2E-7	8E-4	8E-3
30	Zinc-71m	Y, all compounds	6E+3	2E+4	7E-6	2E-8	8E-5	8E-4
30	Zinc-72	Y, all compounds	1E+3	1E+3	5E-7	2E-9	1E-5	1E-4
31	Gallium-65[2]	D, all compounds except those given for W	5E+4	2E+5	7E-5	2E-7	-	-
			St wall (6E+4),	-	-	-	9E-4	9E-3
		W, oxides, hydroxides, carbides, halides, and nitrates	-	2E+5	8E-5	3E-7	-	-
31	Gallium-66	D, see ^{65}Ga	1E+3	4E+3	1E-6	5E-9	1E-5	1E-4
		W, see ^{65}Ga	-	3E+3	1E-6	4E-9	-	-
31	Gallium-67	D, see ^{65}Ga	7E+3	1E+4	6E-6	2E-8	1E-4	1E-3
		W, see ^{65}Ga	-	1E+4	4E-6	1E-8	-	-
31	Gallium-68[2]	D, see ^{65}Ga	2E+4	4E+4	2E-5	6E-8	2E-4	2E-3
		W, see ^{65}Ga	-	5E+4	2E-5	7E-8	-	-
31	Gallium-70[2]	D, see ^{65}Ga	5E+4	2E+5	7E-5	2E-7	-	-
			St wall (7E+4)	-	-	-	1E-3	1E-2
		W, see ^{65}Ga	-	2E+5	8E-5	3E-7	-	-
31	Gallium-72	D, see ^{65}Ga	1E+3	4E+3	1E-6	5E-9	2E-5	2E-4
		W, see ^{65}Ga	-	3E+3	1E-6	4E-9	-	-
31	Gallium-73	D, see ^{65}Ga	5E+3	2E+4	6E-6	2E-8	7E-5	7E-4
		W, see ^{65}Ga	-	2E+4	6E-6	2E-8	-	-
32	Germanium-66	D, all compounds except those given for W	2E+4	3E+4	1E-5	4E-8	3E-4	3E-3
		W, oxides, sulfides, and halides	-	2E+4	8E-6	3E-8	-	-
32	Germanium-67[2]	D, see ^{66}Ge	3E+4	9E+4	4E-5	1E-7	-	-
			St wait (4E+4)	-	-	-	6E-4	6E-3
		W, see ^{66}Ge	-	1E+5	4E-5	1E-7	-	-
32	Germanium-68	D, see ^{66}Ge	5E+3	4E+3	2E-6	5E-9	6E-5	6E-4
		W, see ^{66}Ge	-	1E+2	4E-8	1E-10	-	-
32	Germanium-69	D, see ^{66}Ge	1E+4	2E+4	6E-6	2E-8	2E-4	2E-3
		W, see ^{66}Ge	-	8E+3	3E-6	1E-8	-	-
32	Germanium-71	D, see ^{66}Ge	5E+5	4E+5	2E-4	6E-7	7E-3	7E-2
		W, see ^{66}Ge	-	4E+4	2E-5	6E-8	-	-
32	Germanium-75[2]	D, see ^{66}Ge	4E+4	8E+4	3E-5	1E-7	-	-
			St wall (7E+4)	-	-	-	9E-4	9E-3
		W, see ^{66}Ge	-	8E+4	4E-5	1E-7	-	-
32	Germanium-77	D, see ^{66}Ge	9E+3	1E+4	4E-6	1E-8	1E-4	1E-3
		W, see ^{66}Ge	-	6E+3	2E-6	8E-9	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col.3 DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
32	Germanium-78[2]	D, see ^{66}Ge	2E+4	2E+4	9E-6	3E-8	-	-
			St wall (2E+4)	-	-	-	3E-4	3E-3
		W, see ^{66}Ge	-	2E+4	9E-6	3E-8	-	-
33	Arsenic-69[2]	W, all compounds	3E+4	1E+5	5E-5	2E-7	-	-
			St wall (4E+4)	-	-	-	6E-4	6E-3
33	Arsenic-70[2]	W, all compounds	1E+4	5E+4	2E-5	7E-8	2E-4	2E-3
33	Arsenic-71	W, all compounds	4E+3	5E+3	2E-6	6E-9	5E-5	5E-4
33	Arsenic-72	W, all compounds	9E+2	1E+3	6E-7	2E-9	1E-5	1E-4
33	Arsenic-73	W, all compounds	8E+3	2E+3	7E-7	2E-9	1E-4	1E-3
33	Arsenic-74	W, all compounds	1E+3	8E+2	3E-7	1E-9	2E-5	2E-4
33	Arsenic-76	W, all compounds	1E+3	1E+3	6E-7	2E-9	1E-5	1E-4
33	Arsenic-77	W, all compounds	4E+3	5E+3	2E-6	7E-9	-	-
			LLI wall (5E+3)	-	-	-	6E-5	6E-4
33	Arsenic-78[2]	W, all compounds	8E+3	2E+4	9E-6	3E-8	1E-4	1E-3
34	Selenium-70[2]	D, all compounds except those given for W	2E+4	4E+4	2E-5	5E-8	1E-4	1E-3
		W, oxides, hydroxides, carbides, and elemental Se	1E+4	4E+4	2E-5	6E-8	-	-
34	Selenium-73m[2]	D, see ^{70}Se	6E+4	2E+5	6E-5	2E-7	4E-4	4E-3
		W, see ^{70}Se	3E+4	1E+5	6E-5	2E-7	-	-
34	Selenium-73	D, see ^{70}Se	3E+3	1E+4	5E-6	2E-8	4E-5	4E-4
		W, see ^{70}Se	-	2E+4	7E-6	2E-8	-	-
34	Selenium-75	D, see ^{70}Se	5E+2	7E+2	3E-7	1E-9	7E-6	7E-5
		W, see ^{70}Se	-	6E+2	3E-7	8E-10	-	-
34	Selenium-79	D, see ^{70}Se	6E+2	8E+2	3E-7	1E-9	8E-6	8E-5
		W, see ^{70}Se	-	6E+2	2E-7	8E-10	-	-
34	Selenium-81m[2]	D, see ^{70}Se	4E+4	7E+4	3E-5	9E-8	3E-4	3E-3
		W, see ^{70}Se	2E+4	7E+4	3E-5	1E-7	-	-
34	Selenium-81[2]	D, see ^{70}Se	6E+4	2E+5	9E-5	3E-7	-	-
			St wall (8E+4)	-	-	-	1E-3	1E-2
		W, see ^{70}Se	-	2E+5	1E-4	3E-7	-	-
34	Selenium-83[2]	D, see ^{70}Se	4E+4	1E+5	5E-5	2E-7	4E-4	4E-3
		W, see ^{70}Se	3E+4	1E+5	5E-5	2E-7	-	-
35	Bromine-74m[2]	D, bromides of H, Li, Na, K, Rb, Cs, and Fr	1E+4	4E+4	2E-5	5E-8	-	-
			St wall (2E+4)	-	-	-	3E-4	3E-3

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col.3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	Oral Ingestion ALI (μCi)	Inhalation ALI (μCi)	Inhalation DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
		W, Bromides of lanthanides, Be, Mg, Ca, Sr, Ba, Ra, Al, Ga, In, Tl, Ge, Sn, Pb, As, Sb, Bi, Fe, Ru, Os, Co, Rh, Ir, Ni, Pd, Pt, Cu, Ag, Au, Zn, Cd, Hg, Sc, Y, Ti, Zr, Hf, V, Nb, Ta, Mn, Tc, and Re	-	4E+4	2E-5	6E-8	-	-
35	Bromine-74[2]	D, see ^{74m}Br	2E+4	7E+4	3E-5	1E-7	-	-
			St wall (4E+4)	-	-	-	5E-4	5E-3
		W, see ^{74m}Br	-	8E+4	4E-5	1E-7	-	-
35	Bromine-75[2]	D, see ^{74m}Br	3E+4	5E+4	2E-5	7E-8	-	-
			St wall (4E+4)	-	-	-	5E-4	5E-3
		W, see ^{74m}Br	-	5E+4	2E-5	7E-8	-	-
35	Bromine-76	D, see ^{74m}Br	4E+3	5E+3	2E-6	7E-9	5E-5	5E-4
		W, see ^{74m}Br	-	4E+3	2E-6	6E-9	-	-
35	Bromine-77	D, see ^{74m}Br	2E+4	2E+4	1E-5	3E-8	2E-4	2E-3
		W, see ^{74m}Br	-	2E+4	8E-6	3E-8	-	-
35	Bromine-80m	D, see ^{74m}Br	2E+4	2E+4	7E-6	2E-8	3E-4	3E-3
		W, see ^{74m}Br	-	1E+4	6E-6	2E-8	-	-
35	Bromine-80[2]	D, see ^{74m}Br	5E+4	2E+5	8E-5	3E-7	-	-
			St wall (9E+4)	-	-	-	1E-3	1E-2
		W, see ^{74m}Br	-	2E+5	9E-5	3E-7	-	-
35	Bromine-82	D, see ^{74m}Br	3E+3	4E+3	2E-6	6E-9	4E-5	4E-4
		W, see ^{74m}Br	-	4E+3	2E-6	5E-9	-	-
35	Bromine-83	D, see ^{74m}Br	5E+4	6E+4	3E-5	9E-8	-	-
			St wall (7E+4)	-	-	-	9E-4	9E-3
		W, see ^{74m}Br	-	6E+4	3E-5	9E-8	-	-
35	Bromine-84[2]	D, see ^{74m}Br	2E+4	6E+4	2E-5	8E-8	-	-
			St wall (3E+4)	-	-	-	4E-4	4E-3
		W, see ^{74m}Br	-	6E+4	3E-5	9E-8	-	-
36	Krypton-74[2]	Submersion[1]	-	-	3E-6	1E-8	-	-
36	Krypton-76	Submersion[1]	-	-	9E-6	4E-8	-	-
36	Krypton-77[2]	Submersion[1]	-	-	4E-6	2E-8	-	-
36	Krypton-79	Submersion[1]	-	-	2E-5	7E-8	-	-
36	Krypton-81	Submersion[1]	-	-	7E-4	3E-6	-	-
36	Krypton-83m[2]	Submersion[1]	-	-	1E-2	5E-5	-	-
36	Krypton-85m	Submersion[1]	-	-	2E-5	1E-7	-	-
36	Krypton-85	Submersion[1]	-	-	1E-4	7E-7	-	-
36	Krypton-87[2]	Submersion[1]	-	-	5E-6	2E-8	-	-
36	Krypton-88	Submersion[1]	-	-	2E-6	9E-9	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col.3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
37	Rubidium-79[2]	D, all compounds	4E+4	1E+5	5E-5	2E-7	-	-
			St wall (6E+4)	-	-	-	8E-4	8E-3
37	Rubidium-81m[2]	D, all compounds	2E+5	3E+5	1E-4	5E-7	-	-
			St wall (3E+5)	-	-	-	4E-3	4E-2
37	Rubidium-81	D, all compounds	4E+4	5E+4	2E-5	7E-8	5E-4	5E-3
37	Rubidium 82m	D, all compounds	1E+4	2E+4	7E-6	2E-8	2E-4	2E-3
37	Rubidium-83	D, all compounds	6E+2	1E+3	4E-7	1E-9	9E-6	9E-5
37	Rubidium-84	D, all compounds	5E+2	8E+2	3E-7	1E-9	7E-6	7E-5
37	Rubidium-86	D, all compounds	5E+2	8E+2	3E-7	1E-9	7E-6	7E-5
37	Rubidium-87	D, all compounds	1E+3	2E+3	6E-7	2E-9	1E-5	1E-4
37	Rubidium-88[2]	D, all compounds	2E+4	6E+4	3E-5	9E-8	-	-
			St wall (3E+4)	-	-	-	4E-4	4E-3
37	Rubidium-89[2]	D, all compounds	4E+4	1E+5	6E-5	2E-7	-	-
			St wall (6E+4)	-	-	-	9E-4	9E-3
38	Strontium-80[2]	D, all soluble compounds except SrTi0	4E+3	1E+4	5E-6	2E-8	6E-5	6E-4
		Y, all insoluble compounds and SrTi0	-	1E+4	5E-6	2E-8	-	-
38	Strontium-81[2]	D, see ^{80}Sr	3E+4	8E+4	3E-5	1E-7	3E-4	3E-3
		Y, see ^{80}Sr	2E+4	8E+4	3E-5	1E-7	-	-
38	Strontium-82	D, see ^{80}Sr	3E+2	4E+2	2E-7	6E-10	-	-
			LLI wall (2E+2)	-	-	-	3E-6	3E-5
		Y, see ^{80}Sr	2E+2	9E+1	4E-8	1E-10	-	-
38	Strontium-83	D, see ^{80}Sr	3E+3	7E+3	3E-6	1E-8	3E-5	3E-4
		Y, see ^{80}Sr	2E+3	4E+3	1E-6	5E-9	-	-
38	Strontium-85m[2]	D, see ^{80}Sr	2E+5	6E+5	3E-4	9E-7	3E-3	3E-2
		Y, see ^{80}Sr	-	8E+5	4E-4	1E-6	-	-
38	Strontium-85	D, see ^{80}Sr	3E+3	3E+3	1E-6	4E-9	4E-5	4E-4
		Y, see ^{80}Sr	-	2E+3	6E-7	2E-9	-	-
38	Strontium-87m	D, see ^{80}Sr	5E+4	1E+5	5E-5	2E-7	6E-4	6E-3
		Y, see ^{80}Sr	4E+4	2E+5	6E-5	2E-7	-	-
38	Strontium-89	D, see ^{80}Sr	6E+2	8E+2	4E-7	1E-9	-	-
			LLI wall (6E+2)	-	-	-	8E-6	8E-5
		Y, see ^{80}Sr	5E+2	1E+2	6E-8	2E-10	-	-
38	Strontium-90	D, see ^{80}Sr	3E+1	2E+1	8E-9	-	-	-
			Bone surf (4E+1)	Bone surf (2E+1)	-	3E-11	5E-7	5E-6
		Y, see ^{80}Sr	-	4E+0	2E-9	6E-12	-	-
38	Strontium-91	D, see ^{80}Sr	2E+3	6E+3	2E-6	8E-9	2E-5	2E-4
		Y, see ^{80}Sr	-	4E+3	1E-6	5E-9	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col.3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
38	Strontium-92	D, see ^{80}Sr	3E+3	9E+3	4E-6	1E-8	4E-5	4E-4
		Y, see ^{80}Sr	-	7E+3	3E-6	9E-9	-	-
39	Yttrium-86m[2]	W, all compounds except those given for Y	2E+4	6E+4	2E-5	8E-8	3E-4	3E-3
		Y, oxides and hydroxides	-	5E+4	2E-5	8E-8	-	-
39	Yttrium-86	W, see ^{86m}Y	1E+3	3E+3	1E-6	5E-9	2E-5	2E-4
		Y, see ^{86m}Y	-	3E+3	1E-6	5E-9	-	-
39	Yttrium-87	W, see ^{86m} Y	2E+3	3E+3	1E-6	5E-9	3E-5	3E-4
		Y, see ^{86m}Y	-	3E+3	1E-6	5E-9	-	-
39	Yttrium-88	W, see ^{86m}Y	1E+3	3E+2	1E-7	3E-10	1E-5	1E-4
		Y, see ^{86m}Y	-	2E+2	1E-7	3E-10	-	-
39	Yttrium-90m	W, see ^{86m}Y	8E+3	1E+4	5E-6	2E-8	1E-4	1E-3
		Y, see ^{86m}Y	-	1E+4	5E-6	2E-8	-	-
39	Yttrium-90	W, see ^{86m}Y	4E+2	7E+2	3E-7	9E-10	-	-
			LLI wall (5E+2)	-	-	-	7E-6	7E-5
		Y, see ^{86m}Y	-	6E+2	3E-7	9E-10	-	-
39	Yttrium-91m[2]	W, see ^{86m}Y	1E+5	2E+5	1E-4	3E-7	2E-3	2E-2
		Y, see ^{86m}Y	-	2E+5	7E-5	2E-7	-	-
39	Yttrium-91	W, see ^{86m}Y	5E+2	2E+2	7E-8	2E-10	-	-
			LLI wall (6E+2)	-	-	-	8E-6	8E-5
		Y, see ^{86m}Y	-	1E+2	5E-8	2E-10	-	-
39	Yttrium-92	W, see ^{86m}Y	3E+3	9E+3	4E-6	1E-8	4E-5	4E-4
		Y, see ^{86m}Y	-	8E+3	3E-6	1E-8	-	-
39	Yttrium-93	W, see ^{86m}Y	1E+3	3E+3	1E-6	4E-9	2E-5	2E-4
		Y, see ^{86m}Y	-	2E+3	1E-6	3E-9	-	-
39	Yttrium-94[2]	W, see ^{86m}Y	2E+4	8E+4	3E-5	1E-7	-	-
			St wall (3E+4)	-	-	-	4E-4	4E-3
		Y, see ^{86m}Y	-	8E+4	3E-5	1E-7	-	-
39	Yttrium-95[2]	W, see ^{86m}Y	4E+4	2E+5	6E-5	2E-7	-	-
			St wall (5E+4)	-	-	-	7E-4	7E-3
		Y, see ^{86m}Y	-	1E+5	6E-5	2E-7	-	-
40	Zirconium-86	D, all compounds except those given for W and Y	1E+3	4E+3	2E-6	6E-9	2E-5	2E-4
		W, oxides, hydroxides, halides, and nitrates	-	3E+3	1E-6	4E-9	-	-
		Y, carbide	-	2E+3	1E-6	3E-9	-	-
40	Zirconium-88	D, see ^{86}Zr	4E+3	2E+2	9E-8	3E-10	5E-5	5E-4
		W, see ^{86}Zr	-	5E+2	2E-7	7E-10	-	-
		Y, see ^{86}Zr	-	3E+2	1E-7	4E-10	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col.3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
40	Zirconium-89	D, see ^{86}Zr	2E+3	4E+3	1E-6	5E-9	2E-5	2E-4
		W, see ^{86}Zr	-	2E+3	1E-6	3E-9	-	-
		Y, see ^{86}Zr	-	2E+3	1E--6	3E-9	-	-
40	Zirconium-93	D, see ^{86}Zr	1E+3	6E+0	3E-9	-	-	-
			Bone surf (3E+3)	Bone surf (2E+1)	-	2E-11	4E-5	4E-4
		W, see ^{86}Zr	-	2E+1	1E-8	-	-	-
			-	Bone surf (6E+1)	-	9E-11	-	-
		Y, see ^{86}Zr	-	6E+1	2E-8	-	-	-
			-	Bone surf (7E+1)	-	9E-11	-	-
40	Zirconium-95	D, see ^{86}Zr	1E+3	1E+2	5E-8	-	2E-5	2E-4
			-	Bone surf (3E+2)	-	4E-10	-	-
		W, see ^{86}Zr	-	4E+2	2E-7	5E-10	-	-
		Y, see ^{86}Zr	-	3E+2	1E-7	4E-10	-	-
40	Zirconium-97	D, see ^{86}Zr	6E+2	2E+3	8E-7	3E-9	9E-6	9E-5
		W, see ^{86}Zr	-	1E+3	6E-7	2E-9	-	-
		Y, see ^{86}Zr	-	1E+3	5E-7	2E-9	-	-
41	Niobium-88[2]	W, all compounds except those given for Y	5E+4	2E+5	9E-5	3E-7	-	-
			St wall (7E+4)	-	-	-	1E-3	1E-2
		Y, oxides and hydroxides	-	2E+5	9E-5	3E-7	-	-
41	Niobium-89[2] (66 min)	W, see ^{88}Nb	1E+4	4E+4	2E-5	6E-8	1E-4	1E-3
		Y, see ^{88}Nb	-	4E+4	2E-5	5E-8	-	-
41	Niobium-89 (122 min)	W, see ^{88}Nb	5E+3	2E+4	8E-6	3E-8	7E-5	7E-4
		Y, see ^{88}Nb	-	2E+4	6E-6	2E-8	-	-
41	Niobium-90	W, see ^{88}Nb	1E+3	3E+3	1E-6	4E-9	1E-5	1E-4
		Y, see ^{88}Nb	-	2E+3	1E-6	3E-9	-	-
41	Niobium-93m	W, see ^{88}Nb	9E+3	2E+3	8E-7	3E-9	-	-
			LLI wall (1E+4)	-	-	-	2E-4	2E-3
		Y, see ^{88}Nb	-	2E+2	7E-8	2E-10	-	-
41	Niobium-94	W, see ^{88}Nb	9E+2	2E+2	8E-8	3E-10	1E-5	1E-4
		Y, see ^{88}Nb	-	2E+1	6E-9	2E-11	-	-
41	Niobium-95m	W, see ^{88}Nb	2E+3	3E+3	1E-6	4E-9	-	-
			LLI wall (2E+3)	-	-	-	3E-5	3E-4
		Y, see ^{88}Nb	-	2E+3	9E-7	3E-9-	-	
41	Niobium-95	W, see ^{88}Nb	2E+3	1E+3	5E-7	2E-9	3E-5	3E-4
		Y, see ^{88}Nb	-	1E+3	5E-7	2E-9-	-	

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col.3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Concentration (μCi/ml)
41	Niobium-96	W, see ^{88}Nb	1E+3	3E+3	1E-6	4E-9	2E-5	2E-4
		Y, see ^{88}Nb	-	2E+3	1E-6	3E-9	-	-
41	Niobium-97[2]	W, see ^{88}Nb	2E+4	8E+4	3E-5	1E-7	3E-4	3E-3
		Y, see ^{88}Nb	-	7E+4	3E-5	1E-7	-	-
41	Niobium-98[2]	W, see ^{88}Nb	1E+4	5E+4	2E-5	8E-8	2E-4	2E-3
		Y, see ^{88}Nb	-	5E+4	2E-5	7E-8	-	-
42	Molybdenum-90	D, all compounds except those given for Y	4E+3	7E+3	3E-6	1E-8	3E-5	3E-4
		Y, oxides, hydroxides, and MoS	2E+3	5E+3	2E-6	6E-9	-	-
42	Molybdenum-93m	D, see ^{90}Mo	9E+3	2E+4	7E-6	2E-8	6E-5	6E-4
		Y, see ^{90}Mo	4E+3	1E+4	6E-6	2E-8	-	-
42	Molybdenum-93	D, see ^{90}Mo	4E+3	5E+3	2E-6	8E-9	5E-5	5E-4
		Y, see ^{90}Mo	2E+4	2E+2	8E-8	2E-10	-	-
42	Molybdenum-99	D, see ^{90}Mo	2E+3	3E+3	1E-6	4E-9	-	-
			LLI wall (1E+3)	-	-	-	2E-5	2E-4
		Y, see ^{90}Mo	1E+3	1E+3	6E-7	2E-9	-	-
42	Molybdenum-101[2]	D, see ^{90}Mo	4E+4	1E+5	6E-5	2E-7	-	-
			St wall (5E+4)	-	-	-	7E-4	7E-3
		Y, see ^{90}Mo	-	1E+5	6E-5	2E-7	-	-
43	Technetium-93m[2]	D, All compounds except those given for W	7E+4	2E+5	6E-5	2E-7	1E-3	1E-2
		W, oxides, hydroxides, halides, and nitrates	-	3E+5	1E-4	4E-7	-	-
43	Technetium-93	D, see ^{93m}Tc	3E+4	7E+4	3E-5	1E-7	4E-4	4E-3
		W, see ^{93m}Tc	-	1E+5	4E-5	1E-7	-	-
43	Technetium-94m[2]	D, see ^{93m}Tc	2E+4	4E+4	2E-5	6E-8	3E-4	3E-3
		W, see ^{93m}Tc	-	6E+4	2E-5	8E-8	-	-
43	Technetium-94	D, see ^{93m}Tc	9E+3	2E+4	8E-6	3E-8	1E-4	1E-3
		W, see ^{93m}Tc	-	2E+4	1E-5	3E-8	-	-
43	Technetium-95m	D, see ^{93m}Tc	4E+3	5E+3	2E-6	8E-9	5E-5	5E-4
		W, see ^{93m}Tc	-	2E+3	8E-7	3E-9	-	-
43	Technetium-95	D, see ^{93m}Tc	1E+4	2E+4	9E-6	3E-8	1E-4	1E-3
		W, see ^{93m}Tc	-	2E+4	8E-6	3E-8	-	-
43	Technetium-96m[2]	D, see ^{93m}Tc	2E+5	3E+5	1E-4	4E-7	2E-3	2E-2
		W, see ^{93m}Tc	-	2E+5	1E-4	3E-7	-	-
43	Technetium-96	D, see ^{93m}Tc	2E+3	3E+3	1E-6	5E-9	3E-5	3E-4
		W, see ^{93m}Tc	-	2E+3	9E-7	3E-9	-	-
43	Technetium-97m	D, see ^{93m}Tc	5E+3	7E+3	3E-6	-	6E-5	6E-4
			-	St wall (7E+3)	-	1E-8	-	-
		W, see ^{93m}Tc	-	1E+3	5E-7	2E-9	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col.3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	**Radionuclide**	**Class**	**ALI (μCi)**	**ALI (μCi)**	**DAC (μCi/ml)**	**Air (μCi/ml)**	**Water (μCi/ml)**	**Concentration (μCi/ml)**
43	Technetium-97	D, see ^{93m}Tc	4E+4	5E+4	2E-5	7E-8	5E-4	5E-3
		W, see ^{93m}Tc	-	6E+3	2E-6	8E-9	-	-
43	Technetium-98	D, see ^{93m}Tc	1E+3	2E+3	7E-7	2E-9	1E-5	1E-4
		W, see ^{93m}Tc	-	3E+2	1E-7	4E-10	-	-
43	Technetium-99m	D, see ^{93m}Tc	8E+4	2E+5	6E-5	2E-7	1E-3	1E-2
		W, see ^{93m}Tc	-	2E+5	1E-4	3E-7	-	-
43	Technetium-99	D, see ^{93m}Tc	4E+3	5E+3	2E-6	-	6E-5	6E-4
			-	St wall (6E+3)	-	8E-9	-	-
		W, see ^{93m}Tc	-	7E+2	3E-7	9E-10	-	-
43	Technetium-101[2]	D, see ^{93m}Tc	9E+4	3E+5	1E-4	5E-7	-	-
			St wall (1E+5)	-	-	-	2E-3	2E-2
		W, see ^{93m}Tc	-	4E+5	2E-4	5E-7	-	-
43	Technetium-104[2]	D, see ^{93m}Tc	2E+4	7E+4	3E-5	1E-7	-	-
			St wall (3E+4)	-	-	-	4E-4	4E-3
		W, see ^{93m}Tc	-	9E+4	4E-5	1E-7	-	-
44	Ruthenium-94[2]	D, all compounds except those given for W and Y	2E+4	4E+4	2E-5	6E-8	2E-4	2E-3
		W, halides	-	6E+4	3E-5	9E-8	-	-
		Y, oxides and hydroxides	-	6E+4	2E-5	8E-8	-	-
44	Ruthenium-97	D, see ^{94}Ru	8E+3	2E+4	8E-6	3E-8	1E-4	1E-3
		W, see ^{94}Ru	-	1E+4	5E-6	2E-8	-	-
		Y, see ^{94}Ru	-	1E+4	5E-6	2E-8	-	-
44	Ruthenium-103	D, see ^{94}Ru	2E+3	2E+3	7E-7	2E-9	3E-5	3E-4
		W, see ^{94}Ru	-	1E+3	4E-7	1E-9	-	-
		Y, see ^{94}Ru	-	6E+2	3E-7	9E-10	-	-
44	Ruthenium-105	D, see ^{94}Ru	5E+3	1E+4	6E-6	2E-8	7E-5	7E-4
		W, see ^{94}Ru	-	1E+4	6E-6	2E-8	-	-
		Y, see ^{94}Ru	-	1E+4	5E-6	2E-8	-	-
44	Ruthenium-106	D, see ^{94}Ru	2E+2	9E+1	4E-8	1E-10	-	-
			LLI wall (2E+2)	-	-	-	3E-6	3E-5
		W, see ^{94}Ru	-	5E+1	2E-8	8E-11	-	-
		Y, see ^{94}Ru	-	1E+1	5E-9	2E-11	-	-
45	Rhodium-99m	D, all compounds except those given for W and Y	2E+4	6E+4	2E-5	8E-8	2E-4	2E-3
		W, halides	-	8E+4	3E-5	1E-7	-	-
		Y, oxides and hydroxides	-	7E+4	3E-5	9E-8	-	-
45	Rhodium-99	D, see ^{99m}Rh	2E+3	3E+3	1E-6	4E-9	3E-5	3E-4
		W, see ^{99m}Rh	-	2E+3	9E-7	3E-9	-	-
		Y, see ^{99m}Rh	-	2E+3	8E-7	3E-9	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col.3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
45	Rhodium-100	D, see ^{99m}Rh	2E+3	5E+3	2E-6	7E-9	2E-5	2E-4
		W, see ^{99m}Rh	-	4E+3	2E-6	6E-9	-	-
		Y, see ^{99m}Rh	-	4E+ 3	2E-6	5E-9	-	-
45	Rhodium-101m	D, see ^{99m}Rh	6E+3	1E+4	5E-6	2E-8	8E-5	8E-4
		W, see ^{99m}Rh	-	8E+3	4E-6	1E-8	-	-
		Y, see ^{99m}Rh	-	8E+3	3E-6	1E-8	-	-
45	Rhodium-101	D, see ^{99m}Rh	2E+3	5E+2	2E-7	7E-10	3E-5	3E-4
		W, see ^{99m}Rh	-	8E+2	3E-7	1E-9	-	-
		Y, see ^{99m}Rh	-	2E+2	6E-8	2E-10	-	-
45	Rhodium-102m	D, see ^{99m}Rh	1E+3	5E+2	2E-7	7E-10	-	-
			LLI wall (1E+3)	-	-	-	2E-5	2E-4
		W, see ^{99m}Rh	-	4E+2	2E-7	5E-10	-	-
		Y, see ^{99m}Rh	-	1E+2	5E-8	2E-10	-	-
45	Rhodium-102	D, see ^{99m}Rh	6E+2	9E+1	4E-8	1E-10	8E-6	8E-5
		W, see ^{99m}Rh	-	2E+2	7E-8	2E-10	-	-
		Y, see ^{99m}Rh	-	6E+1	2E-8	8E-11	-	-
45	Rhodium-103m[2]	D, see ^{99m}Rh	4E+5	1E+6	5E-4	2E-6	6E-3	6E-2
		W, see ^{99m}Rh	-	1E+6	5E-4	2E-6	-	-
		Y, see ^{99m}Rh	-	1E+6	5E-4	2E-6	-	-
45	Rhodium-105	D, see ^{99m}Rh	4E+3	1E+4	5E-6	2E-8	-	-
			LLI wall (4E+3)	-	-	-	5E-5	5E-4
		W, see ^{99m}Rh	-	6E+3	3E-6	9E-9	-	-
		Y, see ^{99m}Rh	-	6E+3	2E-6	8E-9	-	-
45	Rhodium-106m	D, see ^{99m}Rh	8E+3	3E+4	1E-5	4E-8	1E-4	1E-3
		W, see ^{99m}Rh	-	4E+4	2E-5	5E-8	-	-
		Y, see ^{99m}Rh	-	4E+4	1E-5	5E-8	-	-
45	Rhodium-107[2]	D, see ^{99m}Rh	7E+4	2E+5	1E-4	3E-7	-	-
			St wall (9E+4)	-	-	-	1E-3	1E-2
		W, see ^{99m}Rh	-	3E+5	1E-4	4E-7	-	-
		Y, see ^{99m}Rh	-	3E+5	1E-4	3E-7	-	-
46	Palladium-100	D, all compounds except those given for W and Y	1E+3	1E+3	6E-7	2E-9	2E-5	2E-4
		W, nitrates	-	1E+3	5E-7	2E-9	-	-
		Y, oxides and hydroxides	-	1E+3	6E-7	2E-9	-	-
46	Palladium-101	D, see ^{100}Pd	1E+4	3E+4	1E-5	5E-8	2E-4	2E-3
		W, see ^{100}Pd	-	3E+4	1E-5	5E-8	-	-
		Y, see ^{100}Pd	-	3E+4	1E-5	4E-8	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col.3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
46	Palladium-103	D, see ^{100}Pd	6E+3	6E+3	3E-6	9E-9	-	-
			LLI wall (7E+3)	-	-	-	1E-4	1E-3
		W, see ^{100}Pd	-	4E+3	2E-6	6E-9	-	-
		Y, see ^{100}Pd	-	4E+3	1E-6	5E-9	-	-
46	Palladium-107	D, see ^{100}Pd	3E+4	2E+4	9E-6	-	-	-
			LLI wall (4E+4)	Kidneys (2E+4)	-	3E-8	5E-4	5E-3
		W, see ^{100}Pd	-	7E+3	3E-6	1E-8	-	-
		Y, see ^{100}Pd	-	4E+2	2E-7	6E-10	-	-
46	Palladium-109	D, see ^{100}Pd	2E+3	6E+3	3E-6	9E-9	3E-5	3E-4
		W, see ^{100}Pd	-	5E+3	2E-6	8E-9	-	-
		Y, see,^{100}Pd	-	5E+3	2E-6	6E-9	-	-
47	Silver-102[2]	D, all compounds except those given for W and Y	5E+4	2E+5	8E-5	2E-7	-	-
			St wall (6E+4)	-	-	-	9E-4	9E-3
		W, nitrates and sulfides	-	2E+5	9E-5	3E-7	-	-
		Y, oxides and hydroxides	-	2E+5	8E-5	3E-7	-	-
47	Silver-103[2]	D, see ^{102}Ag	4E+4	1E+5	4E-5	1E-7	5E-4	5E-3
		W, see ^{102}Ag	-	1E+5	5E-5	2E-7	-	-
		Y, see ^{102}Ag	-	1E+5	5E-5	2E-7	-	-
47	Silver-104m[2]	D, see ^{102}Ag	3E+4	9E+4	4E-5	1E-7	4E-4	4E-3
		W, see ^{102}Ag	-	1E+5	5E-5	2E-7	-	-
		Y, see ^{102}Ag	-	1E+5	5E-5	2E-7	-	-
47	Silver-104[2]	D, see ^{102}Ag	2E+4	7E+4	3E-5	1E-7	3E-4	3E-3
		W, see ^{102}Ag	-	1E+5	6E-5	2E-7	-	-
		Y, see ^{102}Ag	-	1E+5	6E-5	2E-7	-	-
47	Silver-105	D, see ^{102}Ag	3E+3	1E+3	4E-7	1E-9	4E-5	4E-4
		W, see ^{102}Ag	-	2E+3	7E-7	2E-9	-	-
		Y, see ^{102}Ag	-	2E+3	7E-7	2E-9	-	-
47	Silver-106m	D, see ^{102}Ag	8E+2	7E+2	3E-7	1E-9	1E-5	1E-4
		W, see ^{102}Ag	-	9E+2	4E-7	1E-9	-	-
		Y, see ^{102}Ag	-	9E+2	4E-7	1E-9	-	-
47	Silver-106[2]	D, see ^{102}Ag	6E+4	2E+5	8E-5	3E-7	-	-
			St Wall (6E+4)	-	-	-	9E-4	9E-3
		W, see ^{102}Ag	-	2E+5	9E-5	3E-7	-	-
		Y, see ^{102}Ag	-	2E+5	8E-5	3E-7	-	-
47	Silver-108m	D, see ^{102}Ag	6E+2	2E+2	8E-8	3E-10	9E-6	9E-5
		W, see ^{102}Ag	-	3E+2	1E-7	4E-10	-	-
		Y, see ^{102}Ag	-	2E+1	1E-8	3E-11	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col.3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	Oral Ingestion ALI (μCi)	Inhalation ALI (μCi)	Inhalation DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
47	Silver-110m	D, see ^{102}Ag	5E+2	1E+2	5E-8	2E-10	6E-6	6E-5
		W, see ^{102}Ag	-	2E+2	8E-8	3E-10	-	-
		Y, see ^{102}Ag	-	9E+1	4E-8	1E-10	-	-
47	Silver-111	D, see ^{102}Ag	9E+2	2E+3	6E-7	-	-	-
			LLI wall (1E+3)	Liver (2E+3)	-	2E-9	2E-5	2E-4
		W, see ^{102}Ag	-	9E+2	4E-7	1E-9	-	-
		Y, see ^{102}Ag	-	9E+2	4E-7	1E-9	-	-
47	Silver-112	D, see ^{102}Ag	3E+3	8E+3	3E-6	1E-8	4E-5	4E-4
		W, see ^{102}Ag	-	1E+4	4E-6	1E-8	-	-
		Y, see ^{102}Ag	-	9E+3	4E-6	1E-8	-	-
47	Silver-115[2]	D, see ^{102}Ag	3E+4	9E+4	4E-5	1E-7	-	-
			St wall (3E+4)	-	-	-	4E-4	4E-3
		W, see ^{102}Ag	-	9E+4	4E-5	1E-7	-	-
		Y, see ^{102}Ag	-	8E+4	3E-5	1E-7	-	-
48	Cadmium-104[2]	D, all compounds except those given for W and Y	2E+4	7E+4	3E-5	9E-8	3E-4	3E-3
		W, sulfides, halides, and nitrates	-	1E+5	5E-5	2E-7	-	-
		Y, oxides and hydroxides	-	1E+5	5E-5	2E-7	-	-
48	Cadmium-107	D, see ^{104}Cd	2E+4	5E+4	2E-5	8E-8	3E-4	3E-3
		W, see ^{104}Cd	-	6E+4	2E-5	8E-8	-	-
		Y, see ^{104}Cd	-	5E+4	2E-5	7E-8	-	-
48	Cadmium-109	D, see ^{104}Cd	3E+2	4E+1	1E-8	-	-	-
			Kidneys (4E+2)	Kidneys (5E+1)	-	7E-11	6E-6	6E-5
		W, see ^{104}Cd	-	1E+2	5E-8	-	-	-
			-	Kidneys (1E+2)	-	2E-10	-	-
		Y, see ^{104}Cd	-	1E+2	5E-8	2E-10	-	-
48	Cadmium-113m	D, see ^{104}Cd	2E+1	2E+0	1E-9	-	-	-
			Kidneys (4E+1)	Kidneys (4E+0)	-	5E-12	5E-7	5E-6
		W, see ^{104}Cd	-	8E+0	4E-9	-	-	-
			-	Kidneys (1E+1)	-	2E-11	-	-
		Y, see ^{104}Cd	-	1E+1	5E-9	2E-11	-	-
48	Cadmium-113	D, see ^{104}Cd	2E+1	2E+0	9E-10	-	-	-
			Kidneys (3E+1)	Kidneys (3E+0)	-	5E-12	4E-7	4E-6
		W, see ^{104}Cd	-	8E+0	3E-9	-	-	-
			-	Kidneys (1E+1)	-	2E-11	-	-
		Y, see ^{104}Cd	-	1E+1	6E-9	2E-11	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col.3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
48	Cadmium-115m	D, see ^{104}Cd	3E+2	5E+1	2E-8	-	4E-6	4E-5
			-	Kidneys (8E+1)	-	1E-10	-	-
		W, see ^{104}Cd	-	1E+2	5E-8	2E-10	-	-
		Y, see ^{104}Cd	-	1E+2	6E-8	2E-10	-	-
48	Cadmium-115	D, see ^{104}Cd	9E+2	1E+3	6E-7	2E-9	-	-
			LLI wall (1E+3)	-	-	-	1E-5	1E-4
		W, see ^{104}Cd	-	1E+3	5E-7	2E-9	-	-
		Y, see ^{104}Cd	-	1E+3	6E-7	2E-9	-	-
48	Cadmium-117m	D, see ^{104}Cd	5E+3	1E+4	5E-6	2E-8	6E-5	6E-4
		W, see ^{104}Cd	-	2E+4	7E-6	2E-8	-	-
		Y, see ^{104}Cd	-	1E+4	6E-6	2E-8	-	-
48	Cadmium-117	D, see ^{104}Cd	5E+3	1E+4	5E-6	2E-8	6E-5	6E-4
		W, see ^{104}Cd	-	2E+4	7E-6	2E-8	-	-
		Y, see ^{104}Cd	-	1E+4	6E-6	2E-8	-	-
49	Indium-109	D, all compounds except those given for W	2E+4	4E+4	2E-5	6E-8	3E-4	3E-3
		W, oxides, hydroxides, halides, and nitrates	-	6E+4	3E-5	9E-8	-	-
49	Indium-110[2]	D, see ^{109}In	2E+4	4E+4	2E-5	6E-8	2E-4	2E-3
	(69.1 min)	W, see ^{109}In	-	6E+4	2E-5	8E-8	-	-
49	Indium-110	D, see ^{109}In	5E+3	2E+4	7E-6	2E-8	7E-5	7E-4
	(4.9 h)	W, see ^{109}In	-	2E+4	8E-6	3E-8	-	-
49	Indium-111	D, see ^{109}In	4E+3	6E+3	3E-6	9E-9	6E-5	6E-4
		W, see ^{109}In	-	6E+3	3E-6	9E-9	-	-
49	Indium-112[2]	D, see ^{109}In	2E+5	6E+5	3E-4	9E-7	2E-3	2E-2
	-	W, see ^{109}In	-	7E+5	3E-4	1E-6	-	-
49	Indium-113m[2]	D, see ^{109}In	5E+4	1E+5	6E-5	2E-7	7E-4	7E-3
	-	W, see ^{109}In	-	2E+5	8E-5	3E-7	-	-
49	Indium-114m	D, see ^{109}In	3E+2	6E+1	3E-8	9E-11	-	-
			LLI wall (4E+2)	-	-	-	5E-6	5E-5
		W, see ^{109}In	-	1E+2	4E-8	1E-10	-	-
49	Indium-115m	D, see ^{109}In	1E+4	4E+4	2E-5	6E-8	2E-4	2E-3
	-	W, see ^{109}In	-	5E+4	2E-5	7E-8	-	-
49	Indium-115	D, see ^{109}In	4E+1	1E+0	6E-10	2E-12	5E-7	5E-6
	-	W, see ^{109}In	-	5E+0	2E-9	8E-12	-	-
49	Indium-116m[2]	D, see ^{109}In	2E+4	8E+4	3E-5	1E-7	3E-4	3E-3
		W, see ^{109}In	-	1E+5	5E-5	2E-7	-	-
49	Indium-117m[2]	D, see ^{109}In	1E+4	3E+4	1E-5	5E-8	2E-4	2E-3
	-	W, see ^{109}In	-	4E+4	2E-5	6E-8	-	-
49	Indium-117[2]	D, see ^{109}In	6E+4	2E+5	7E-5	2E-7	8E-4	8E-3
		W, see ^{109}In	-	2E+5	9E-5	3E-7	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col.3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	Oral Ingestion ALI (μCi)	Inhalation ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
49	Indium-119m[2]	D, see ^{109}In	4E+4	1E+5	5E-5	2E-7	-	-
			St wall (5E+4)	-	-	-	7E-4	7E-3
		W, see ^{109}In	-	1E+5	6E-5	2E-7	-	-
50	Tin-110	D, all compounds except those given for W	4E+3	1E+4	5E-6	2E-8	5E-5	5E-4
		W, sulfides, oxides, hydroxides, halides, nitrates, and stannic phosphate	-	1E+4	5E-6	2E-8	-	-
50	Tin-111[2]	D, see ^{110}Sn	7E+4	2E+5	9E-5	3E-7	1E-3	1E-2
		W, see ^{110}Sn	-	3E+5	1E-4	4E-7	-	-
50	Tin-113	D, see ^{110}Sn	2E+3	1E+3	5E-7	2E-9	-	-
			LLI wall (2E+3)	-	-	-	3E-5	3E-4
		W, see ^{110}Sn	-	5E+2	2E-7	8E-10	-	-
50	Tin-117m	D, see ^{110}Sn	2E+3	1E+3	5E-7	-	-	-
			LLI wall (2E+3)	Bone surf (2E+3)	-	3E-9	3E-5	3E-4
		W, see ^{110}Sn	-	1E+3	6E-7	2E-9	-	-
50	Tin-119m	D, see ^{110}Sn	3E+3	2E+3	1E-6	3E-9	-	-
			LLI wall (4E+3)	-	-	-	6E-5	6E-4
		W, see ^{110}Sn	-	1E+3	4E-7	1E-9	-	-
50	Tin-121m	D, see ^{110}Sn	3E+3	9E+2	4E-7	1E-9	-	-
			LLI wall (4E+3)	-	-	-	5E-5	5E-4
		W, see ^{110}Sn	-	5E+2	2E-7	8E-10	-	-
50	Tin-121	D, see ^{110}Sn	6E+3	2E+4	6E-6	2E-8	-	-
			LLI wall (6E+3)	-	-	-	8E-5	8E-4
		W, see ^{110}Sn	-	1E+4	5E-6	2E-8	-	-
50	Tin-123m[2]	D, see ^{110}Sn	5E+4	1E+5	5E-5	2E-7	7E-4	7E-3
		W, see ^{110}Sn	-	1E+5	6E-5	2E-7	-	-
50	Tin-123	D, see ^{110}Sn	5E+2	6E+2	3E-7	9E-10	-	-
			LLI wall (6E+2)	-	-	-	9E-6	9E-5
		W, see ^{110}Sn	-	2E+2	7E-8	2E-10	-	-
50	Tin-125	D, see ^{110}Sn	4E+2	9E+2	4E-7	1E-9	-	-
			LLI wall (5E+2)	-	-	-	6E-6	6E-5
		W, see ^{110}Sn	-	4E+2	1E-7	5E-10	-	-
50	Tin-126	D, see ^{110}Sn	3E+2	6E+1	2E-8	8E-11	4E-6	4E-5
		W, see ^{110}Sn	-	7E+1	3E-8	9E-11	-	-
50	Tin-127	D, see ^{110}Sn	7E+3	2E+4	8E-6	3E-8	9E-5	9E-4
		W, see ^{110}Sn	-	2E+4	8E-6	3E-8	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col.3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
50	Tin-128[2]	D, see ^{110}Sn	9E+3	3E+4	1E-5	4E-8	1E-4	1E-3
		W, see ^{110}Sn	-	4E+4	1E-5	5E-8	-	-
51	Antimony-115[2]	D, all compounds except those given for W	8E+4	2E+5	1E-4	3E-7	1E-3	1E-2
		W, oxides, hydroxides, halides, sulfides, sulfates, and nitrates	-	3E+5	1E-4	4E-7	-	-
51	Antimony-116m[2]	D, see ^{115}Sb	2E+4	7E+4	3E-5	1E-7	3E-4	3E-3
		W, see ^{115}Sb	-	1E+5	6E-5	2E-7	-	-
51	Antimony-116[2]	D, see ^{115}Sb	7E+4	3E+5	1E-4	4E-7	-	-
			St wall (9E+4)	-	-	-	1E-3	1E-2
		W, see ^{115}Sb	-	3E+5	1E-4	5E-7	-	-
51	Antimony-117	D, see ^{115}Sb	7E+4	2E+5	9E-5	3E-7	9E-4	9E-3
		W, see ^{115}Sb	-	3E+5	1E-4	4E-7	-	-
51	Antimony-118m	D, see ^{115}Sb	6E+3	2E+4	8E-6	3E-8	7E-5	7E-4
		W, see ^{115}Sb	5E+3	2E+4	9E-6	3E-8	-	-
51	Antimony-119	D, see ^{115}Sb	2E+4	5E+4	2E-5	6E-8	2E-4	2E-3
		W, see ^{115}Sb	2E+4	3E+4	1E-5	4E-8	-	-
51	Antimony-120[2] (16 min)	D, see ^{115}Sb	1E+5	4E+5	2E-4	6E-7	-	-
			St wall (2E+5)	-	-	-	2E-3	2E-2
		W, see ^{115}Sb	-	5E+5	2E-4	7E-7	-	-
51	Antimony-120	D, see ^{115}Sb	1E+3	2E+3	9E-7	3E-9	1E-5	1E-4
	(5.76 d)	W, see ^{115}Sb	9E+2	1E+3	5E-7	2E-9	-	-
51	Antimony-122	D, see ^{115}Sb	8E+2	2E+3	1E-6	3E-9	-	-
			LLI wall (8E+2)	-	-	-	1E-5	1E-4
		W, see ^{115}Sb	7E+2	1E+3	4E-7	2E-9	-	-
51	Antimony-124m[2]	D, see ^{115}Sb	3E+5	8E+5	4E-4	1E-6	3E-3	3E-2
		W, see ^{115}Sb	2E+5	6E+5	2E-4	8E-7	-	-
51	Antimony-124	D, see ^{115}Sb	6E+2	9E+2	4E-7	1E-9	7E-6	7E-5
		W, see ^{115}Sb	5E+2	2E+2	1E-7	3E-10	-	-
51	Antimony-125	D, see ^{115}Sb	2E+3	2E+3	1E-6	3E-9	3E-5	3E-4
		W, see ^{115}Sb	-	5E+2	2E-7	7E-10	-	-
51	Antimony-126m[2]	D, see ^{115}Sb	5E+4	2E+5	8E-5	3E-7	-	-
			St wall (7E+4)	-	-	-	9E-4	9E-3
		W, see ^{115}Sb	-	2E+5	8E-5	3E-7	-	-
51	Antimony-126	D, see ^{115}Sb	6E+2	1E+3	5E-7	2E-9	7E-6	7E-5
		W, see ^{115}Sb	5E+2	5E+2	2E-7	7E-10	-	-
51	Antimony-127	D, see ^{115}Sb	8E+2	2E+3	9E-7	3E-9	-	-
			LLI wall (8E+2)	-	-	-	1E-5	1E-4
		W, see ^{115}Sb	7E+2	9E+2	4E-7	1E-9	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col.3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
51	Antimony-128[2] (10.4 min)	D, see ^{115}Sb	8E+4	4E+5	2E-4	5E-7	-	-
			St wall (1E+5)	-	-	-	1E-3	1E-2
		W, see ^{115}Sb	-	4E+5	2E-4	6E-7	-	-
51	Antimony-128	D, see ^{115}Sb	1E+3	4E+3	2E-6	6E-9	2E-5	2E-4
	(9.01 h)	W, see ^{115}Sb	-	3E+3	1E-6	5E-9	-	-
51	Antimony-129	D, see ^{115}Sb	3E+3	9E+3	4E-6	1E-8	4E-5	4E-4
		W, see ^{115}Sb	-	9E+3	4E-6	1E-8	-	-
51	Antimony-130[2]	D, see ^{115}Sb	2E+4	6E+4	3E-5	9E-8	3E-4	3E-3
		W, see ^{115}Sb	-	8E+4	3E-5	1E-7	-	-
51	Antimony-131[2]	D, see ^{115}Sb	1E+4	2E+4	1E-5	-	-	-
			Thyroid (2E+4)	Thyroid (4E+4)	-	6E-8	2E-4	2E-3
		W, see ^{115}Sb	-	2E+4	1E-5		-	-
			-	Thyroid (4E+4)	-	6E-8	-	-
52	Tellurium-116	D, all compounds except those given for W	8E+3	2E+4	9E-6	3E-8	1E-4	1E-3
		W, oxides, hydroxides, and nitrates	-	3E+4	1E-5	4E-8	-	-
52	Tellurium-121m	D, see ^{116}Te	5E+2	2E+2	8E-8	-	-	-
			Bone surf (7E+2)	Bone surf (4E+2)	-	5E-10	1E-5	1E-4
		W, see ^{116}Te	-	4E+2	2E-7	6E-10	-	-
52	Tellurium-121	D, see ^{116}Te	3E+3	4E+3	2E-6	6E-9	4E-5	4E-4
		W, see ^{116}Te	-	3E+3	1E-6	4E-9	-	-
52	Tellurium-123m	D, see ^{116}Te	6E+2	2E+2	9E-8	-	-	-
			Bone surf (1E+3)	Bone surf (5E+2)	-	8E-10	1E-5	1E-4
		W, see ^{116}Te	-	5E+2	2E-7	8E-10	-	-
52	Tellurium-123	D, see ^{116}Te	5E+2	2E+2	8E-8	-	-	-
			Bone surf (1E+3)	Bone surf (5E+2)	-	7E-10	2E-5	2E-4
		W, see ^{116}Te	-	4E+2	2E-7	-	-	-
			-	Bone surf (1E+3)	-	2E-9	-	-
52	Tellurium-125m	D, see ^{116}Te	1E+3	4E+2	2E-7	-	-	-
			Bone surf (1E+3)	Bone surf (1E+3)	-	1E-9	2E-5	2E-4
		W, see ^{116}Te	-	7E+2	3E-7	1E-9	-	-
52	Tellurium-127m	D, see ^{116}Te	6E+2	3E+2	1E-7	-	9E-6	9E-5
			-	Bone surf (4E+2)	-	6E-10	-	-
		W, see ^{116}Te	-	3E+2	1E-7	4E-10	-	-
52	Tellurium-127	D, see ^{116}Te	7E+3	2E+4	9E-6	3E-8	1E-4	1E-3
		W, see ^{116}Te	-	2E+4	7E-6	2E-8	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col.3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	**Radionuclide**	**Class**	**ALI (μCi)**	**ALI (μCi)**	**DAC (μCi/ml)**	**Air (μCi/ml)**	**Water (μCi/ml)**	**Concentration (μCi/ml)**
52	Tellurium-129m	D, see ^{116}Te	5E+2	6E+2	3E-7	9E-10	7E-6	7E-5
		W, see ^{116}Te	-	2E+2	1E-7	3E-10	-	-
52	Tellurium-129[2]	D, see ^{116}Te	3E+4	6E+4	3E-5	9E-8	4E-4	4E-3
		W, see ^{116}Te	-	7E+4	3E-5	1E-7	-	-
52	Tellurium-131m	D, see ^{116}Te	3E+2	4E+2	2E-7	-	-	-
			Thyroid (6E+2)	Thyroid (1E+3)	-	2E-9	8E-6	8E-5
		W, see ^{116}Te	-	4E+2	2E-7	-	-	-
			-	Thyroid (9E+2)	-	1E-9	-	-
52	Tellurium-131[2]	D, see ^{116}Te	3E+3	5E+3	2E-6	-	-	-
			Thyroid (6E+3)	Thyroid (1E+4)	-	2E-8	8E-5	8E-4
		W, see ^{116}Te	-	5E+3	2E-6	-	-	-
			-	Thyroid (1E+4)	-	2E-8	-	-
52	Tellurium-132	D, see ^{116}Te	2E+2	2E+2	9E-8	-	-	-
			Thyroid (7E+2)	Thyroid (8E+2)	-	1E-9	9E-6	9E-5
		W, see ^{116}Te	-	2E+2	9E-8	-	-	-
			-	Thyroid (6E+2)	-	9E-10	-	-
52	Tellurium-133m[2]	D, see ^{116}Te	3E+3	5E+3	2E-6	-	-	-
			Thyroid (6E+3)	Thyroid (1E+4)	-	2E-8	9E-5	9E-4
		W, see ^{116}Te	-	5E+3	2E-6	-	-	-
			-	Thyroid (1E+4)	-	2E-8	-	-
52	Tellurium-133[2]	D, see ^{116}Te	1E+4	2E+4	9E-6	-	-	-
			Thyroid (3E+4)	Thyroid (6E+4)	-	8E-8	4E-4	4E-3
		W, see ^{116}Te	-	2E+4	9E-6	-	-	-
			-	Thyroid (6E+4)	-	8E-8	-	-
52	Tellurium-134[2]	D, see ^{116}Te	2E+4	2E+4	1E-5	-	-	-
			Thyroid (2E+4)	Thyroid (5E+4)	-	7E-8	3E-4	3E-3
		W, see ^{116}Te	-	2E+4	1E-5	-	-	-
			-	Thyroid (5E+4)	-	7E-8	-	-
53	Iodine-120m[2]	D, all compounds	1E+4	2E+4	9E-6	3E-8	-	-
			Thyroid (1E+4)	-	-	-	2E-4	2E-3
53	Iodine-120[2]	D, all compounds	4E+3	9E+3	4E-6	-	-	-
			Thyroid (8E+3)	Thyroid (1E+4)	-	2E-8	1E-4	1E-3

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col.3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Concentration (μCi/ml)
53	Iodine-121	D, all compounds	1E+4	2E+4	8E-6	-	-	-
			Thyroid (3E+4)	Thyroid (5E+4)	-	7E-8	4E-4	4E-3
53	Iodine-123	D, all compounds	3E+3	6E+3	3E-6	-	-	-
			Thyroid (1E+4)	Thyroid (2E+4)	-	2E-8	1E-4	1E-3
53	Iodine-124	D, all compounds	5E+1	8E+1	3E-8	-	-	-
			Thyroid (2E+2)	Thyroid (3E+2)	-	4E-10	2E-6	2E-5
53	Iodine-125	D, all compounds	4E+1	6E+1	3E-8	-	-	-
			Thyroid (1E+2)	Thyroid (2E+2)	-	3E-10	2E-6	2E-5
53	Iodine-126	D, all compounds	2E+1	4E+1	1E-8	-	-	-
			Thyroid (7E+1)	Thyroid (1E+2)	-	2E-10	1E-6	1E-5
53	Iodine-128[2]	D, all compounds	4E+4	1E+5	5E-5	2E-7	-	-
			St wall (6E+4)	-	-	-	8E-4	8E-3
53	Iodine-129	D, all compounds	5E+0	9E+0	4E-9	-	-	-
			Thyroid (2E+1)	Thyroid (3E+1)	-	4E-11	2E-7	2E-6
53	Iodine-130	D, all compounds	4E+2	7E+2	3E-7	-	-	-
			Thyroid (1E+3)	Thyroid (2E+3)	-	3E-9	2E-5	2E-4
53	Iodine-131	D, all compounds	3E+1	5E+1	2E-8	-	-	-
			Thyroid (9E+1)	Thyroid (2E+2)	-	2E-10	1E-6	1E-5
53	Iodine-132m[2]	D, all compounds	4E+3	8E+3	4E-6	-	-	-
			Thyroid (1E+4)	Thyroid (2E+4)	-	3E-8	1E-4	1E-3
53	Iodine-132	D, all compounds	4E+3	8E+3	3E-6	-	-	-
			Thyroid (9E+3)	Thyroid (1E+4)	-	2E-8	1E-4	1E-3
53	Iodine-133	D, all compounds	1E+2	3E+2	1E-7	-	-	-
			Thyroid (5E+2)	Thyroid (9E+2)	-	1E-9	7E-6	7E-5
53	Iodine-134[2]	D, all compounds	2E+4	5E+4	2E-5	6E-8	-	-
			Thyroid (3E+4)	-	-	-	4E-4	4E-3
53	Iodine-135	D, all compounds	8E+2	2E+3	7E-7	-	-	-
			Thyroid (3E+3)	Thyroid (4E+3)	-	6E-9	3E-5	3E-4
54	Xenon-120[2]	Submersion[1]	-	-	1E-5	4E-8	-	-
54	Xenon-121[2]	Submersion[1]	-	-	2E-6	1E-8	-	-
54	Xenon-122	Submersion[1]	-	-	7E-5	3E-7	-	-
54	Xenon-123	Submersion[1]	-	-	6E-6	3E-8	-	-
54	Xenon-125	Submersion[1]	-	-	2E-5	7E-8	-	-
54	Xenon-127	Submersion[1]	-	-	1E-5	6E-8	-	-
54	Xenon-129m	Submersion[1]	-	-	2E-4	9E-7	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col.3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
54	Xenon-131m	Submersion[1]	-	-	4E-4	2E-6	-	-
54	Xenon-133m	Submersion[1]	-	-	1E-4	6E-7	-	-
54	Xenon-133	Submersion[1]	-	-	1E-4	5E-7	-	-
54	Xenon-135m[2]	Submersion[1]	-	-	9E-6	4E-8	-	-
54	Xenon-135	Submersion[1]	-	-	1E-5	7E-8	-	-
54	Xenon-138[2]	Submersion[1]	-	-	4E-6	2E-8	-	-
55	Cesium-125[2]	D, all compounds	5E+4	1E+5	6E-5	2E-7	-	-
			St wall (9E+4)	-	-	-	1E-3	1E-2
55	Cesium-127	D, all compounds	6E+4	9E+4	4E-5	1E-7	9E-4	9E-3
55	Cesium-129	D, all compounds	2E+4	3E+4	1E-5	5E-8	3E-4	3E-3
55	Cesium-130[2]	D, all compounds	6E+4	2E+5	8E-5	3E-7	-	-
			St wall (1E+5)	-	-	-	1E-3	1E-2
55	Cesium-131	D, all compounds	2E+4	3E+4	1E-5	4E-8	3E-4	3E-3
55	Cesium-132	D, all compounds	3E+3	4E+3	2E-6	6E-9	4E-5	4E-4
55	Cesium-134m	D, all compounds	1E+5	1E+5	6E-5	2E-7	-	-
			St wall (1E+5)	-	-	-	2E-3	2E-2
55	Cesium-134	D, all compounds	7E+1	1E+2	4E-8	2E-10	9E-7	9E-6
55	Cesium-135m[2]	D, all compounds	1E+5	2E+5	8E-5	3E-7	1E-3	1E-2
55	Cesium-135	D, all compounds	7E+2	1E+3	5E-7	2E-9	1E-5	1E-4
55	Cesium-136	D, all compounds	4E+2	7E+2	3E-7	9E-10	6E-6	6E-5
55	Cesium-137	D, all compounds	1E+2	2E+2	6E-8	2E-10	1E-6	1E-5
55	Cesium-138[2]	D, all compounds	2E+4	6E+4	2E-5	8E-8	-	-
			St wall (3E+4)	-	-	-	4E-4	4E-3
56	Barium-126[2]	D, all compounds	6E+3	2E+4	6E-6	2E-8	8E-5	8E-4
56	Barium-128	D, all compounds	5E+2	2E+3	7E-7	2E-9	7E-6	7E-5
56	Barium-131m[2]	D, all compounds	4E+5	1E+6	6E-4	2E-6	-	-
			St wall (5E+5)	-	-	-	7E-3	7E-2
56	Barium-131	D, all compounds	3E+3	8E+3	3E-6	1E-8	4E-5	4E-4
56	Barium-133m	D, all compounds	2E+3	9E+3	4E-6	1E-8	-	-
			LLI wall (3E+3)	-	-	-	4E-5	4E-4
56	Barium-133	D, all compounds	2E+3	7E+2	3E-7	9E-10	2E-5	2E-4
56	Barium-135m	D, all compounds	3E+3	1E+4	5E-6	2E-8	4E-5	4E-4
56	Barium-139[2]	D, all compounds	1E+4	3E+4	1E-5	4E-8	2E-4	2E-3
56	Barium-140	D, all compounds	5E+2	1E+3	6E-7	2E-9	-	-
			LLI wall (6E+2)	-	-	-	8E-6	8E-5
56	Barium-141[2]	D, all compounds	2E+4	7E+4	3E-5	1E-7	3E-4	3E-3
56	Barium-142[2]	D, all compounds	5E+4	1E+5	6E-5	2E-7	7E-4	7E-3
57	Lanthanum-131[2]	D, all compounds except those given for W	5E+4	1E+5	5E-5	2E-7	6E-4	6E-3
		W, oxides and hydroxides	-	2E+5	7E-5	2E-7	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col.3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	Oral Ingestion ALI (μCi)	Inhalation ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
57	Lanthanum-132	D, see ^{131}La	3E+3	1E+4	4E-6	1E-8	4E-5	4E-4
		W, see ^{131}La	-	1E+4	5E-6	2E-8	-	-
57	Lanthanum-135	D, see ^{131}La	4E+4	1E+5	4E-5	1E-7	5E-4	5E-3
		W, see ^{131}La	-	9E+4	4E-5	1E-7	-	-
57	Lanthanum-137	D, see ^{131}La	1E+4	6E+1	3E-8	-	2E-4	2E-3
			-	Liver (7E+1)	-	1E-10	-	-
		W, see ^{131}La	-	3E+2	1E-7	-	-	-
			-	Liver (3E+2)	-	4E-10	-	-
57	Lanthanum-138	D, see ^{131}La	9E+2	4E+0	1E-9	5E-12	1E-5	1E-4
		W, see ^{131}La	-	1E+1	6E-9	2E-11	-	-
57	Lanthanum-140	D, see ^{131}La	6E+2	1E+3	6E-7	2E-9	9E-6	9E-5
		W, see ^{131}La	-	1E+3	5E-7	2E-9	-	-
57	Lanthanum-141	D, see ^{131}La	4E+3	9E+3	4E-6	1E-8	5E-5	5E-4
		W, see ^{131}La	-	1E+4	5E-6	2E-8	-	-
57	Lanthanum-142[2]	D, see ^{131}La	8E+3	2E+4	9E-6	3E-8	1E-4	1E-3
		W, see ^{131}La	-	3E+4	1E-5	5E-8	-	-
57	Lanthanum-143[2]	D, see ^{131}La	4E+4	1E+5	4E-5	1E-7	-	-
			St wall (4E+4)	-	-	-	5E-4	5E-3
		W, see ^{131}La	-	9E+4	4E-5	1E-7	-	-
58	Cerium-134	W, all compounds except those given for Y	5E+2	7E+2	3E-7	1E-9	-	-
			LLI wall (6E+2)	-	-	-	8E-6	8E-5
		Y, oxides, hydroxides, and fluorides	-	7E+2	3E-7	9E-10	-	-
58	Cerium-135	W, see ^{134}Ce	2E+3	4E+3	2E-6	5E-9	2E-5	2E-4
		Y, see ^{134}Ce	-	4E+3	1E-6	5E-9	-	-
58	Cerium-137m	W, see ^{134}Ce	2E+3	4E+3	2E-6	6E-9	-	-
			LLI wall (2E+3)	-	-	-	3E-5	3E-4
		Y, see ^{134}Ce	-	4E+3	2E-6	5E-9	-	-
58	Cerium-137	W, see ^{134}Ce	5E+4	1E+5	6E-5	2E-7	7E-4	7E-3
		Y, see ^{134}Ce	-	1E+5	5E-5	2E-7	-	-
58	Cerium-139	W, see ^{134}Ce	5E+3	8E+2	3E-7	1E-9	7E-5	7E-4
		Y, see ^{134}Ce	-	7E+2	3E-7	9E-10	-	-
58	Cerium-141	W, see ^{134}Ce	2E+3	7E+2	3E-7	1E-9	-	-
			LLI wall (2E+3)	-	-	-	3E-5	3E-4
		Y, see ^{134}Ce	-	6E+2	2E-7	8E-10	-	-
58	Cerium-143	W, see ^{134}Ce	1E+3	2E+3	8E-7	3E-9	-	-
			LLI wall (1E+3)	-	-	-	2E-5	2E-4
		Y, see ^{134}Ce	-	2E+3	7E-7	2E-9	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col.3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
58	Cerium-144	W, see ^{134}Ce	2E+2	3E+1	1E-8	4E-11	-	-
			LLI wall (3E+2)	-	-	-	3E-6	3E-5
		Y, see ^{134}Ce	-	1E+1	6E-9	2E-11	-	-
59	Praseodymium-136[2]	W, all compounds except those given for Y	5E+4	2E+5	1E-4	3E-7	-	-
			St wall (7E+4)	-	-	-	1E-3	1E-2
		Y, oxides, hydroxides, carbides, and fluorides	-	2E+5	9E-5	3E-7	-	-
59	Praseodymium-137[2]	W, see ^{136}Pr	4E+4	2E+5	6E-5	2E-7	5E-4	5E-3
		Y, see ^{136}Pr	-	1E+5	6E-5	2E-7	-	-
59	Praseodymium-138m	W, see ^{136}Pr	1E+4	5E+4	2E-5	8E-8	1E-4	1E-3
		Y, see ^{136}Pr	-	4E+4	2E-5	6E-8	-	-
59	Praseodymium-139	W, see ^{136}Pr	4E+4	1E+5	5E-5	2E-7	6E-4	6E-3
		Y, see ^{136}Pr	-	1E+5	5E-5	2E-7	-	-
59	Praseodymium-142m[2]	W, see ^{136}Pr	8E+4	2E+5	7E-5	2E-7	1E-3	1E-2
		Y, see ^{136}Pr	-	1E+5	6E-5	2E-7	-	-
59	Praseodymium-142	W, see ^{136}Pr	1E+3	2E+3	9E-7	3E-9	1E-5	1E-4
		Y, see ^{136}Pr	-	2E+3	8E-7	3E-9	-	-
59	Praseodymium-143	W, see ^{136}Pr	9E+2	8E+2	3E-7	1E-9	-	-
			LLI wall (1E+3)	-	-	-	2E-5	2E-4
		Y, see ^{136}Pr	-	7E+2	3E-7	9E-10	-	-
59	Praseodymium-144[2]	W, see ^{136}Pr	3E+4	1E+5	5E-5	2E-7	-	-
			St wall (4E+4)	-	-	-	6E-4	6E-3
		Y, see ^{136}Pr	-	1E+5	5E-5	2E-7	-	-
59	Praseodymium-145	W, see ^{136}Pr	3E+3	9E+3	4E-6	1E-8	4E-5	4E-4
		Y, see ^{136}Pr	-	8E+3	3E-6	1E-8	-	-
59	Praseodymium-147[2]	W, see ^{136}Pr	5E+4	2E+5	8E-5	3E-7	-	-
			St wall (8E+4)	-	-	-	1E-3	1E-2
		Y, see ^{136}Pr	-	2E+5	8E-5	3E-7	-	-
60	Neodymium-136[2]	W, all compounds except those given for Y	1E+4	6E+4	2E-5	8E-8	2E-4	2E-3
		Y, oxides, hydroxides, carbides, and fluorides	-	5E+4	2E-5	8E-8	-	-
60	Neodymium-138	W, see ^{136}Nd	2E+3	6E+3	3E-6	9E-9	3E-5	3E-4
		Y, see ^{136}Nd	-	5E+3	2E-6	7E-9	-	-
60	Neodymium-139m	W, see ^{136}Nd	5E+3	2E+4	7E-6	2E-8	7E-5	7E-4
		Y, see ^{136}Nd	-	1E+4	6E-6	2E-8	-	-
60	Neodymium-139[2]	W, see ^{136}Nd	9E+4	3E+5	1E-4	5E-7	1E-3	1E-2
		Y, see ^{136}Nd	-	3E+5	1E-4	4E-7	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col.3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
60	Neodymium-141	W, see ^{136}Nd	2E+5	7E+5	3E-4	1E-6	2E-3	2E-2
		Y, see ^{136}Nd	-	6E+5	3E-4	9E-7	-	-
60	Neodymium-147	W, see ^{136}Nd	1E+3	9E+2	4E-7	1E-9	-	-
			LLI wall (1E+3)	-	-	-	2E-5	2E-4
		Y, see ^{136}Nd	-	8E+2	4E-7	1E-9	-	-
60	Neodymium-149[2]	W, see ^{136}Nd	1E+4	3E+4	1E-5	4E-8	1E-4	1E-3
		Y, see ^{136}Nd	-	2E+4	1E-5	3E-8	-	-
60	Neodymium-151[2]	W, see ^{136}Nd	7E+4	2E+5	8E-5	3E-7	9E-4	9E-3
		Y, see ^{136}Nd	-	2E+5	8E-5	3E-7	-	-
61	Promethium-141[2]	W, all compounds except those given for Y	5E+4	2E+5	8E-5	3E-7	-	-
			St wall (6E+4)	-	-	-	8E-4	8E-3
		Y, oxides, hydroxides, carbides, and fluorides	-	2E+5	7E-5	2E-7	-	-
61	Promethium-143	W, see ^{141}Pm	5E+3	6E+2	2E-7	8E-10	7E-5	7E-4
		Y, see ^{141}Pm	-	7E+2	3E-7	1E-9	-	-
61	Promethium-144	W, see ^{141}Pm	1E+3	1E+2	5E-8	2E-10	2E-5	2E-4
		Y, see ^{141}Pm	-	1E+2	5E-8	2E-10	-	-
61	Promethium-145	W, see ^{141}Pm	1E+4	2E+2	7E-8	-	1E-4	1E-3
			-	Bone surf (2E+2)	-	3E-10	-	-
		Y, see ^{141}Pm	-	2E+2	8E-8	3E-10	-	-
61	Promethium-146	W, see ^{141}Pm	2E+3	5E+1	2E-8	7E-11	2E-5	2E-4
		Y see ^{141}Pm	-	4E+1	2E-8	6E-11	-	-
61	Promethium-147	W see ^{141}Pm	4E+3	1E+2	5E-8	-	-	-
			LLI wall (5E+3)	Bone surf (2E+2)	-	3E-10	7E-5	7E-4
		Y, see ^{141}Pm	-	1E+2	6E-8	2E-10	-	-
61	Promethium-148m	W, see ^{141}Pm	7E+2	3E+2	1E-7	4E-10	1E-5	1E-4
		Y, see ^{141}Pm	-	3E+2	1E-7	5E-10	-	-
61	Promethium-148	W, see ^{141}Pm	4E+2	5E+2	2E-7	8E-10	-	-
			LLI wall (5E+2)	-	-	-	7E-6	7E-5
		Y, see ^{141}Pm	-	5E+2	2E-7	7E-10	-	-
0			LLI wall (1E+3)	-	-	-	2E-5	2E-4
		Y, see ^{141}Pm	-	2E+3	8E-7	2E-9	-	-
61	Promethium-150	W, see ^{141}Pm	5E+3	2E+4	8E-6	3E-8	7E-5	7E-4
		Y, see ^{141}Pm	-	2E+4	7E-6	2E-8	-	-
61	Promethium-151	W, see ^{141}Pm	2E+3	4E+3	1E-6	5E-9	2E-5	2E-4
		Y, see ^{141}Pm	-	3E+3	1E-6	4E-9	-	-
62	Samarium-141m[2]	W, all compounds	3E+4	1E+5	4E-5	1E-7	4E-4	4E-3

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col.3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
62	Samarium-141[2]	W, all compounds	5E+4	2E+5	8E-5	2E-7	-	-
			St wall (6E+4)	-	-	-	8E-4	8E-3
62	Samarium-142[2]	W, all compounds	8E+3	3E+4	1E-5	4E-8	1E-4	1E-3
62	Samarium-145	W, all compounds	6E+3	5E+2	2E-7	7E-10	8E-5	8E-4
62	Samarium-146	W, all compounds	1E+1	4E2	1E-11	-	-	-
			Bone surf (3E+1)	Bone surf (6E-2)	-	9E-14	3E-7	3E-6
62	Samarium-147	W, all compounds	2E+1	4E2	2E-11	-	-	-
			Bone surf (3E+1)	Bone surf (7E-2)	-	1E-13	4E-7	4E-6
62	Samarium-151	W, all compounds	1E+4	1E+2	4E-8	-	-	-
			LLI wall (1E+4)	Bone surf (2E+2)	-	2E-10	2E-4	2E-3
62	Samarium-153	W, all compounds	2E+3	3E+3	1E-6	4E-9	-	-
			LLI wall (2E+3)	-	-	-	3E-5	3E-4
62	Samarium-155[2]	W, all compounds	6E+4	2E+5	9E-5	3E-7	-	-
			St wall (8E+4)	-	-	-	1E-3	1E-2
62	Samarium-156	W, all compounds	5E+3	9E+3	4E-6	1E-8	7E-5	7E-4
63	Europium-145	W, all compounds	2E+3	2E+3	8E-7	3E-9	2E-5	2E-4
63	Europium-146	W, all compounds	1E+3	1E+3	5E-7	2E-9	1E-5	1E-4
63	Europium-147	W, all compounds	3E+3	2E+3	7E-7	2E-9	4E-5	4E-4
63	Europium-148	W, all compounds	1E+3	4E+2	1E-7	5E-10	1E-5	1E-4
63	Europium-149	W, all compounds	1E+4	3E+3	1E-6	4E-9	2E-4	2E-3
63	Europium-150 (12.62 h)	W, all compounds	3E+3	8E+3	4E-6	1E-8	4E-5	4E-4
63	Europium-150 (34.2 y)	W, all compounds	8E+2	2E+1	8E-9	3E-11	1E-5	1E-4
63	Europium-152m	W, all compounds	3E+3	6E+3	3E-6	9E-9	4E-5	4E-4
63	Europium-152	W, all compounds	8E+2	2E+1	1E-8	3E-11	1E-5	1E-4
63	Europium-154	W, all compounds	5E+2	2E+1	8E-9	3E-11	7E-6	7E-5
63	Europium-155	W, all compounds	4E+3	9E+1	4E-8	-	5E-5	5E-4
			-	Bone surf (1E+2)	-	2E-10	-	-
63	Europium-156	W, all compounds	6E+2	5E+2	2E-7	6E-10	8E-6	8E-5
63	Europium-157	W, all compounds	2E+3	5E+3	2E-6	7E-9	3E-5	3E-4
63	Europium-158[2]	W, all compounds	2E+4	6E+4	2E-5	8E-8	3E-4	3E-3
64	Gadolinium-145[2]	D, all compounds except those given for W	5E+4	2E+5	6E-5	2E-7	-	-
			St wall (5E+4)	-	-	-	6E-4	6E-3
		W, oxides, hydroxides, and fluorides	-	2E+5	7E-5	2E-7	-	-
64	Gadolinium-146	D, see ^{145}Gd	1E+3	1E+2	5E-8	2E-10	2E-5	2E-4
		W, see ^{145}Gd	-	3E+2	1E-7	4E-10	-	-
64	Gadolinium-147	D, see ^{145}Gd	2E+3	4E+3	2E-6	6E-9	3E-5	3E-4
		W, see ^{145}Gd	-	4E+3	1E-6	5E-9	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col.3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Concentration (μCi/ml)
64	Gadolinium-148	D, see ^{145}Gd	1E+1	8E+3	3E-12	-	-	-
			Bone surf (2E+1)	Bone surf (2E+2)	-	2E-14	3E-7	3E-6
		W, see ^{145}Gd	-	3E-2	1E-11	-	-	-
			-	Bone surf (6E-2)	-	8E-14	-	-
64	Gadolinium-149	D, see ^{145}Gd	3E+3	2E+3	9E-7	3E-9	4E-5	4E-4
		W, see ^{145}Gd	-	2E+3	1E-6	3E-9	-	-
64	Gadolinium-151	D, see ^{145}Gd	6E+3	4E+2	2E-7	-	9E-5	9E-4
			-	Bone surf (6E+2)	-	9E-10	-	-
		W, see ^{145}Gd	-	1E+3	5E-7	2E-9	-	-
64	Gadolinium-152	D, see ^{145}Gd	2E+1	1E-2	4E-12	-	-	-
			Bone surf (3E+1)	Bone surf (2E-2)	-	3E-14	4E-7	4E-6
		W, see ^{145}Gd	-	4E-2	2E-11	-		-
			-	Bone surf (8E-2)	-	1E-13	-	-
64	Gadolinium-153	D, see ^{145}Gd	5E+3	1E+2	6E-8	-	6E-5	6E-4
			-	Bone surf (2E+2)	-	3E-10	-	-
		W, see ^{145}Gd	-	6E+2	2E-7	8E-10	-	-
64	Gadolinium-159	D, see ^{145}Gd	3E+3	8E+3	3E-6	1E-8	4E-5	4E-4
		W, see ^{145}Gd	-	6E+3	2E-6	8E-9	-	-
65	Terbium-147[2]	W, all compounds	9E+3	3E+4	1E-5	5E-8	1E-4	1E-3
65	Terbium-149	W, all compounds	5E+3	7E+2	3E-7	1E-9	7E-5	7E-4
65	Terbium-150	W, all compounds	5E+3	2E+4	9E-6	3E-8	7E-5	7E-4
65	Terbium-151	W, all compounds	4E+3	9E+3	4E-6	1E-8	5E-5	5E-4
65	Terbium-153	W, all compounds	5E+3	7E+3	3E-6	1E-8	7E-5	7E-4
65	Terbium-154	W, all compounds	2E+3	4E+3	2E-6	6E-9	2E-5	2E-4
65	Terbium-155	W, all compounds	6E+3	8E+3	3E-6	1E-8	8E-5	8E-4
65	Terbium-156m (5.0 h)	W, all compounds	2E+4	3E+4	1E-5	4E-8	2E-4	2E-3
65	Terbium-156m (24.4 h)	W, all compounds	7E+3	8E+3	3E-6	1E-8	1E-4	1E-3
65	Terbium-156	W, all compounds	1E+3	1E+3	6E-7	2E-9	1E-5	1E-4
65	Terbium-157	W, all compounds	5E+4	3E+2	1E-7	-	-	-
			LLI wall (5E+4)	Bone surf (6E+2)	-	8E-10	7E-4	7E-3
65	Terbium-158	W, all compounds	1E+3	2E+1	8E-9	3E-11	2E-5	2E-4
65	Terbium-160	W, all compounds	8E+2	2E+2	9E-8	3E-10	1E-5	1E-4
65	Terbium-161	W, all compounds	2E+3	2E+3	7E-7	2E-9	-	-
			LLI wall (2E+3)	-	-	-	3E-5	3E-4
66	Dysprosium-155	W, all compounds	9E+3	3E+4	1E-5	4E-8	1E-4	1E-3
66	Dysprosium-157	W, all compounds	2E+4	6E+4	3E-5	9E-8	3E-4	3E-3
66	Dysprosium-159	W, all compounds	1E+4	2E+3	1E-6	3E-9	2E-4	2E-3
66	Dysprosium-165	W, all compounds	1E+4	5E+4	2E-5	6E-8	2E-4	2E-3

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col.3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
66	Dysprosium-166	W, all compounds	6E+2	7E+2	3E-7	1E-9	-	-
			LLI wall (8E+2)	-	-	-	1E-5	1E-4
67	Holmium-155[2]	W, all compounds	4E+4	2E+5	6E-5	2E-7	6E-4	6E-3
67	Holmium-157[2]	W, all compounds	3E+5	1E+6	6E-4	2E-6	4E-3	4E-2
67	Holmium-159[2]	W, all compounds	2E+5	1E+6	4E-4	1E-6	3E-3	3E-2
67	Holmium-161	W, all compounds	1E+5	4E+5	2E-4	6E-7	1E-3	1E-2
67	Holmium-162m[2]	W, all compounds	5E+4	3E+5	1E-4	4E-7	7E-4	7E-3
67	Holmium-162[2]	W, all compounds	5E+5	2E+6	1E-3	3E-6	-	-
			St wall (8E+5)	-	-	-	1E-2	1E-1
67	Holmium-164m[2]	W, all compounds	1E+5	3E+5	1E-4	4E-7	1E-3	1E-2
67	Holmium-164[2]	W, all compounds	2E+5	6E+5	3E-4	9E-7	-	-
			St wall (2E+5)	-	-	-	3E-3	3E-2
67	Holmium-166m	W, all compounds	6E+2	7E+0	3E-9	9E-12	9E-6	9E-5
67	Holmium-166	W, all compounds	9E+2	2E+3	7E-7	2E-9	-	-
			LLI wall (9E+2)	-	-	-	1E-5	1E-4
67	Holmium-167	W, all compounds	2E+4	6E+4	2E-5	8E-8	2E-4	2E-3
68	Erbium-161	W, all compounds	2E+4	6E+4	3E-5	9E-8	2E-4	2E-3
68	Erbium-165	W, all compounds	6E+4	2E+5	8E-5	3E-7	9E-4	9E-3
68	Erbium-169	W, all compounds	3E+3	3E+3	1E-6	4E-9	-	-
			LLI wall (4E+3)	-	-	-	5E-5	5E-4
68	Erbium-171	W, all compounds	4E+3	1E+4	4E-6	1E-8	5E-5	5E-4
68	Erbium-172	W, all compounds	1E+3	1E+3	6E-7	2E-9	-	-
			LLI wall (E+3)	-	-	-	2E-5	2E-4
69	Thulium-162[2]	W, all compounds	7E+4	3E+5	1E-4	4E-7	-	-
			St wall (7E+4)	-	-	-	1E-3	1E-2
69	Thulium-166	W, all compounds	4E+3	1E+4	6E-6	2E-8	6E-5	6E-4
69	Thulium-167	W, all compounds	2E+3	2E+3	8E-7	3E-9	-	-
			LLI wall (2E+3)	-	-	-	3E-5	3E-4
69	Thulium-170	W, all compounds	8E+2	2E+2	9E-8	3E-10	-	-
			LLI wall (1E+3)	-	-	-	1E-5	1E-4
69	Thulium-171	W, all compounds	1E+4	3E+2	1E-7	-	-	-
			LLI wall (1E+4)	Bone surf (6E+2)	-	8E-10	2E-4	2E-3
69	Thulium-172	W, all compounds	7E+2	1E+3	5E-7	2E-9	-	-
			LLI wall (8E+2)	-	-	-	1E-5	1E-4
69	Thulium-173	W, all compounds	4E+3	1E+4	5E-6	2E-8	6E-5	6E-4
69	Thulium-175[2]	W, all compounds	7E+4	3E+5	1E-4	4E-7	-	-
			St wall (9E+4)	-	-	-	1E-3	1E-2

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col.3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	Oral Ingestion ALI (μCi)	Inhalation ALI (μCi)	Inhalation DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
70	Ytterbium-162[2]	W, all compounds except those given for Y	7E+4	3E+5	1E-4	4E-7	1E-3	1E-2
		Y, oxides, hydroxides, and fluorides	-	3E+5	1E-4	4E-7	-	-
70	Ytterbium-166	W, see ^{162}Yb	1E+3	2E+3	8E-7	3E-9	2E-5	2E-4
		Y, see ^{162}Yb	-	2E+3	8E-7	3E-9	-	-
70	Ytterbium-167[2]	W, see ^{162}Yb	3E+5	8E+5	3E-4	1E-6	4E-3	4E-2
		Y, see ^{162}Yb	-	7E+5	3E-4	1E-6	-	-
70	Ytterbium-169	W, see ^{162}Yb	2E+3	8E+2	4E-7	1E-9	2E-5	2E-4
		Y, see ^{162}Yb	-	7E+2	3E-7	1E-9	-	-
70	Ytterbium-175	W, see ^{162}Yb	3E+3	4E+3	1E-6	5E-9	-	-
			LLI wall (3E+3)	-	-	-	4E-5	4E-4
		Y, see ^{162}Yb	-	3E+3	1E-6	5E-9	-	-
70	Ytterbium-177[2]	W, see ^{162}Yb	2E+4	5E+4	2E-5	7E-8	2E-4	2E-3
		Y, see ^{162}Yb	-	5E+4	2E-5	6E-8	-	-
70	Ytterbium-178[2]	W, see ^{162}Yb	1E+4	4E+4	2E-5	6E-8	2E-4	2E-3
		Y, see ^{162}Yb	-	4E+4	2E-5	5E-8	-	-
71	Lutetium-169	W, all compounds except those given for Y	3E+3	4E+3	2E-6	6E-9	3E-5	3E-4
		Y, oxides, hydroxides, and fluorides	-	4E+3	2E-6	6E-9	-	-
71	Lutetium-170	W, see ^{169}Lu	1E+3	2E+3	9E-7	3E-9	2E-5	2E-4
		Y, see ^{169}Lu	-	2E+3	8E-7	3E-9	-	-
71	Lutetium-171	W, see ^{169}Lu	2E+3	2E+3	8E-7	3E-9	3E-5	3E-4
		Y, see ^{169}Lu	-	2E+3	8E-7	3E-9	-	-
71	Lutetium-172	W, see ^{169}Lu	1E+3	1E+3	5E-7	2E-9	1E-5	1E-4
		Y, see ^{169}Lu	-	1E+3	5E-7	2E-9	-	-
71	Lutetium-173	W, see ^{169}Lu	5E+3	3E+2	1E-7	-	7E-5	7E-4
			-	Bone surf (5E+2)	-	6E-10	-	-
		Y, see ^{169}Lu	-	3E+2	1E-7	4E-10	-	-
71	Lutetium-174m	W, see ^{169}Lu	2E+3	2E+2	1E-7	-	-	-
			LLI wall (3E+3)	Bone surf (3E+2)	-	5E-10	4E-5	4E-4
		Y, see ^{169}Lu	-	2E+2	9E-8	3E-10	-	-
71	Lutetium-174	W, see ^{169}Lu	5E+3	1E+2	5E-8	-	7E-5	7E-4
			-	Bone surf (2E+2)	-	3E-10	-	-
		Y, see ^{169}Lu	-	2E+2	6E-8	2E-10	-	-
71	Lutetium-176m	W, see ^{169}Lu	8E+3	3E+4	1E-5	3E-8	1E-4	1E-3
		Y, see ^{169}Lu	-	2E+4	9E-6	3E-8	-	-
71	Lutetium-176	W, see ^{169}Lu	7E+2	5E+0	2E-9	-	1E-5	1E-4
			-	Bone surf (1E+1)	-	2E-11	-	-
		Y, see ^{169}Lu	-	8E+0	3E-9	1E-1	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col.3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	**Radionuclide**	**Class**	**ALI (μCi)**	**ALI (μCi)**	**DAC (μCi/ml)**	**Air (μCi/ml)**	**Water (μCi/ml)**	**Concentration (μCi/ml)**
71	Lutetium-177m	W, see ^{169}Lu	7E+2	1E+2	5E-8	-	1E-5	1E-4
			-	Bone surf (1E+2)	-	2E-10	-	-
		Y, see ^{169}Lu	-	8E+1	3E-8	1E-10	-	-
71	Lutetium-177	W, see ^{169}Lu	2E+3	2E+3	9E-7	3E-9	-	-
			LLI wall (3E+3)	-	-	-	4E-5	4E-4
		Y, see ^{169}Lu	-	2E+3	9E-7	3E-9	-	-
71	Lutetium-178m[2]	W, see ^{169}Lu	5E+4	2E+5	8E-5	3E-7	-	-
			St. wall (6E+4)	-	-	-	8E-4	8E-3
		Y, see ^{169}Lu	-	2E+5	7E-5	2E-7	-	-
71	Lutetium-178[2]	W, see ^{169}Lu	4E+4	1E+5	5E-5	2E-7	-	-
			St wall (4E+4)	-	-	-	6E-4	6E-3
		Y, see ^{169}Lu	-	1E+5	5E-5	2E-7	-	-
71	Lutetium-179	W, see ^{169}Lu	6E+3	2E+4	8E-6	3E-8	9E-5	9E-4
		Y, see ^{169}Lu	-	2E+4	6E-6	3E-8	-	-
72	Hafnium-170	D, all compounds except those given for W	3E+3	6E+3	2E-6	8E-9	4E-5	4E-4
		W, oxides, hydroxides, carbides, and nitrates	-	5E+3	2E-6	6E-9	-	-
72	Hafnium-172	D, see ^{170}Hf	1E+3	9E+0	4E-9	-	2E-5	2E-4
			-	Bone surf (2E+1)	-	3E-11	-	-
		W, see ^{170}Hf	-	4E+1	2E-8	-	-	-
			-	Bone surf (6E+1)	-	8E-11	-	-
72	Hafnium-173	D, see ^{170}Hf	5E+3	1E+4	5E-6	2E-8	7E-5	7E-4
		W, see ^{170}Hf	-	1E+4	5E-6	2E-8	-	-
72	Hafnium-175	D, see ^{170}Hf	3E+3	9E+2	4E-7	-	4E-5	4E-4
			-	Bone surf (1E+3)	-	1E-9	-	-
		W, see ^{170}Hf	-	1E+3	5E-7	2E-9	-	-
72	Hafnium-177m[2]	D, see ^{170}Hf	2E+4	6E+4	2E-5	8E-8	3E-4	3E-3
		W, see ^{170}Hf	-	9E+4	4E-5	1E-7	-	-
72	Hafnium-178m	D, see ^{170}Hf	3E+2	1E+0	5E-10	-	3E-6	3E-5
			-	Bone surf (2E+0)	-	3E-12	-	-
		W, see ^{170}Hf	-	5E+0	2E-9	-	-	-
			-	Bone surf (9E+0)	-	1E-11	-	-
72	Hafnium-179m	D, see ^{170}Hf	1E+3	3E+2	1E-7	-	1E-5	1E-4
			-	Bone surf (6E+2)	-	8E-10	-	-
		W, see ^{170}Hf	-	6E+2	3E-7	8E-10	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col.3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Concentration (μCi/ml)
72	Hafnium-180m	D, see ^{170}Hf	7E+3	2E+4	9E-6	3E-8	1E-4	1E-3
		W, see ^{170}Hf	-	3E+4	1E-5	4E-8	-	-
72	Hafnium-181	D, see ^{170}Hf	1E+3	2E+2	7E-8	-	2E-5	2E-4
			-	Bone surf (4E+2)	-	6E-10	-	-
		W, see ^{170}Hf	-	4E+2	2E-7	6E-10	-	-
72	Hafnium-182m[2]	D, see ^{170}Hf	4E+4	9E+4	4E-5	1E-7	5E-4	5E-3
		W, see ^{170}Hf	-	1E+5	6E-5	2E-7	-	-
72	Hafnium-182	D, see ^{170}Hf	2E+2	8E-1	3E-10	-	-	-
			Bone surf (4E+2)	Bone surf (2E+0)	-	2E-12	5E-6	5E-5
		W, see ^{170}Hf	-	3E+0	1E-9	-	-	-
			-	Bone surf (7E+0)	-	1E-11	-	-
72	Hafnium-183[2]	D, see ^{170}Hf	2E+4	5E+4	2E-5	6E-8	3E-4	3E-3
		W, see ^{170}Hf	-	6E+4	2E-5	8E-8	-	-
72	Hafnium-184	D, see ^{170}Hf	2E+3	8E+3	3E-6	1E-8	3E-5	3E-4
		W, see ^{170}Hf	-	6E+3	3E-6	9E-9	-	-
73	Tantalum-172[2]	W, all compounds except those given for Y	4E+4	1E+5	5E-5	2E-7	5E-4	5E-3
		Y, elemental Ta, oxides, hydroxides, halides, carbides, nitrates, and nitrides	-	1E+5	4E-5	1E-7	-	-
73	Tantalum-173	W, see ^{172}Ta	7E+3	2E+4	8E-6	3E-8	9E-5	9E-4
		Y, see ^{172}Ta	-	2E+4	7E-6	2E-8	-	-
73	Tantalum-174[2]	W, see ^{172}Ta	3E+4	1E+5	4E-5	1E-7	4E-4	4E-3
		Y, see ^{172}Ta	-	9E+4	4E-5	1E-7	-	-
73	Tantalum-175	W, see ^{172}Ta	6E+3	2E+4	7E-6	2E-8	8E-5	8E-4
		Y, see ^{172}Ta	-	1E+4	6E-6	2E-8	-	-
73	Tantalum-176	W, see ^{172}Ta	4E+3	1E+4	5E-6	2E-8	5E-5	5E-4
		Y, see ^{172}Ta	-	1E+4	5E-6	2E-8	-	-
73	Tantalum-177	W, see ^{172}Ta	1E+4	2E+4	8E-6	3E-8	2E-4	2E-3
		Y, see ^{172}Ta	-	2E+4	7E-6	2E-8	-	-
73	Tantalum-178	W, see ^{172}Ta	2E+4	9E+4	4E-5	1E-7	2E-4	2E-3
		Y, see ^{172}Ta	-	7E+4	3E-5	1E-7	-	-
73	Tantalum-179	W, see ^{172}Ta	2E+4	5E+3	2E-6	8E-9	3E-4	3E-3
		Y, see ^{172}Ta	-	9E+2	4E-7	1E-9	-	-
73	Tantalum-180m	W, see ^{172}Ta	2E+4	7E+4	3E-5	9E-8	3E-4	3E-3
		Y, see ^{172}Ta	-	6E+4	2E-5	8E-8	-	-
73	Tantalum-180	W, see ^{172}Ta	1E+3	4E+2	2E-7	6E-10	2E-5	2E-4
		Y, see ^{172}Ta	-	2E+1	1E-8	3E-11	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col.3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
73	Tantalum-182m[2]	W, see ^{172}Ta	2E+5	5E+5	2E-4	8E-7	-	-
			St wall (2E+5)	-	-	-	3E-3	3E-2
		Y, see ^{172}Ta	-	4E+5	2E-4	6E-7	-	-
73	Tantalum-182	W, see ^{172}Ta	8E+2	3E+2	1E-7	5E-10	1E-5	1E-4
		Y, see ^{172}Ta	-	1E+2	6E-8	2E-10	-	-
73	Tantalum-183	W, see ^{172}Ta	9E+2	1E+3	5E-7	2E-9	-	-
			LLI wall (1E+3)	-	-	-	2E-5	2E-4
		Y, see ^{172}Ta	-	1E+3	4E-7	1E-9	-	-
73	Tantalum-184	W, see ^{172}Ta	2E+3	5E+3	2E-6	8E-9	3E-5	3E-4
		Y, see ^{172}Ta	-	5E+3	2E-6	7E-9	-	-
73	Tantalum-185[2]	W, see ^{172}Ta	3E+4	7E+4	3E-5	1E-7	4E-4	4E-3
		Y, see ^{172}Ta	-	6E+4	3E-5	9E-8	-	-
73	Tantalum-186[2]	W, see ^{172}Ta	5E+4	2E+5	1E-4	3E-7	-	-
			St wall (7E+4)	-	-	-	1E-3	1E-2
		Y, see ^{172}Ta	-	2E+5	9E-5	3E-7	-	-
74	Tungsten-176	D, all compounds	1E+4	5E+4	2E-5	7E-8	1E-4	1E-3
74	Tungsten-177	D, all compounds	2E+4	9E+4	4E-5	1E-7	3E-4	3E-3
74	Tungsten-178	D, all compounds	5E+3	2E+4	8E-6	3E-8	7E-5	7E-4
74	Tungsten-179[2]	D, all compounds	5E+5	2E+6	7E-4	2E-6	7E-3	7E-2
74	Tungsten-181	D, all compounds	2E+4	3E+4	1E-5	5E-8	2E-4	2E-3
74	Tungsten-185	D, all compounds	2E+3	7E+3	3E-6	9E-9	-	-
			LLI wall (3E+3)	-	-	-	4E-5	4E-4
74	Tungsten-187	D, all compounds	2E+3	9E+3	4E-6	1E-8	3E-5	3E-4
74	Tungsten-188	D, all compounds	4E+2	1E+3	5E-7	2E-9	-	-
			LLI wall (5E+2)	-	-	-	7E-6	7E-5
75	Rhenium-177[2]	D, all compounds except those given for W	9E+4	3E+5	1E-4	4E-7	-	-
			St wall (1E+5)	-	-	-	2E-3	2E-2
		W, oxides, hydroxides, and nitrates	-	4E+5	1E-4	5E-7	-	-
75	Rhenium-178[2]	D, see ^{177}Re	7E+4	3E+5	1E-4	4E-7	-	-
			St wall (1E+5)	-	-	-	1E-3	1E-2
		W, see ^{177}Re	-	3E+5	1E-4	4E-7	-	-
75	Rhenium-181	D, see ^{177}Re	5E+3	9E+3	4E-6	1E-8	7E-5	7E-4
		W, see ^{177}Re	-	9E+3	4E-6	1E-8	-	-
75	Rhenium-182	D, see ^{177}Re	7E+3	1E+4	5E-6	2E-8	9E-5	9E-4
	(12.7 h)	W, see ^{177}Re	-	2E+4	6E-6	2E-8	-	-
75	Rhenium-182	D, see ^{177}Re	1E+3	2E+3	1E-6	3E-9	2E-5	2E-4
	(64.0 h)	W, see ^{177}Re	-	2E+3	9E-7	3E-9	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col.3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
75	Rhenium-184m	D, see ^{177}Re	2E+3	3E+3	1E-6	4E-9	3E-5	3E-4
		W, see ^{177}Re	-	4E+2	2E-7	6E-10	-	-
75	Rhenium-184	D, see ^{177}Re	2E+3	4E+3	1E-6	5E-9	3E-5	3E-4
		W, see ^{177}Re	-	1E+3	6E-7	2E-9	-	-
75	Rhenium-186m	D, see ^{177}Re	1E+3	2E+3	7E-7	-	-	-
			St wall (2E+3)	St wall (2E+3)	-	3E-9	2E-5	2E-4
		W, see ^{177}Re	-	2E+2	6E-8	2E-10	-	-
75	Rhenium-186	D, see ^{177}Re	2E+3	3E+3	1E-6	4E-9	3E-5	3E-4
		W, see ^{177}Re	-	2E+3	7E-7	2E-9	-	-
75	Rhenium-187	D, see ^{177}Re	6E+5	8E+5	4E-4	-	8E-3	8E-2
			St wall -	(9E+5)	-	1E-6	-	-
		W, see ^{177}Re	-	1E+5	4E-5	1E-7	-	-
75	Rhenium-188m[2]	D, see ^{177}Re	8E+4	1E+5	6E-5	2E-7	1E-3	1E-2
		W, see ^{177}Re	-	1E+5	6E-5	2E-7	-	-
75	Rhenium-188	D, see ^{177}Re	2E+3	3E+3	1E-6	4E-9	2E-5	2E-4
		W, see ^{177}Re	-	3E+3	1E-6	4E-9	-	-
75	Rhenium-189	D, see ^{177}Re	3E+3	5E+3	2E-6	7E-9	4E-5	4E-4
		W, see ^{177}Re	-	4E+3	2E-6	6E-9	-	-
76	Osmium-180[2]	D, all compounds except those given for W and Y	1E+5	4E+5	2E-4	5E-7	1E-3	1E-2
		W, halides and nitrates	-	5E+5	2E-4	7E-7	-	-
		Y, oxides and hydroxides	-	5E+5	2E-4	6E-7	-	-
76	Osmium-181[2]	D, see ^{180}Os	1E+4	4E+4	2E-5	6E-8	2E-4	2E-3
		W, see ^{180}Os	-	5E+4	2E-5	6E-8	-	-
		Y, see ^{180}Os	-	4E+4	2E-5	6E-8	-	-
76	Osmium-182	D, see ^{180}Os	2E+3	6E+3	2E-6	8E-9	3E-5	3E-4
		W, see ^{180}Os	-	4E+3	2E-6	6E-9	-	-
		Y, see ^{180}Os	-	4E+3	2E-6	6E-9	-	-
76	Osmium-185	D, see ^{180}Os	2E+3	5E+2	2E-7	7E-10	3E-5	3E-4
		W, see ^{180}Os	-	8E+2	3E-7	1E-9	-	-
		Y, see ^{180}Os	-	8E+2	3E-7	1E-9	-	-
76	Osmium-189m	D, see ^{180}Os	8E+4	2E+5	1E-4	3E-7	1E-3	1E-2
		W, see ^{180}Os	-	2E+5	9E-5	3E-7	-	-
		Y, see ^{180}Os	-	2E+5	7E-5	2E-7	-	-
76	Osmium-191m	D, see ^{180}Os	1E+4	3E+4	1E-5	4E-8	2E-4	2E-3
		W, see ^{180}Os	-	2E+4	8E-6	3E-8	-	-
		Y, see ^{180}Os	-	2E+4	7E-6	2E-8	-	-
76	Osmium-191	D, see ^{180}Os	2E+3	2E+3	9E-7	3E-9	-	-
			LLI wall (3E+3)	-	-	-	3E-5	3E-4
		W, see ^{180}Os	-	2E+3	7E-7	2E-9	-	-
		Y, see ^{180}Os	-	1E+3	6E-7	2E-9	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col.3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
76	Osmium-193	D, see ^{180}Os	2E+3	5E+3	2E-6	6E-9	-	-
			LLI wall (2E+3)	-	-	-	2E-5	2E-4
		W, see ^{180}Os	-	3E+3	1E-6	4E-9	-	-
		Y, see ^{180}Os	-	3E+3	1E-6	4E-9	-	-
76	Osmium-194	D, see ^{180}Os	4E+2	4E+1	2E-8	6E-11	-	-
			LLI wall (6E+2)	-	-	-	8E-6	8E-5
		W, see ^{180}Os	-	6E+1	2E-8	8E-11	-	-
		Y, see ^{180}Os	-	8E+0	3E-9	1E-11	-	-
77	Iridium-182[2]	D, all compounds except those given for W and Y	4E+4	1E+5	6E-5	2E-7	-	-
			St wall (4E+4)	-	-	-	6E-4	6E-3
		W, halides, nitrates, and metallic iridium	-	2E+5	6E-5	2E-7	-	-
		Y, oxides and hydroxides	-	1E+5	5E-5	2E-7	-	-
77	Iridium-184	D, see ^{182}Ir	8E+3	2E+4	1E-5	3E-8	1E-4	1E-3
		W, see ^{182}Ir	-	3E+4	1E-5	5E-8	-	-
		Y, see ^{182}Ir	-	3E+4	1E-5	4E-8	-	-
77	Iridium-185	D, see ^{182}Ir	5E+3	1E+4	5E-6	2E-8	7E-5	7E-4
		W, see^{182}Ir	-	1E+4	5E-6	2E-8	-	-
		Y, see ^{182}Ir	-	1E+4	4E-6	1E-8	-	-
77	Iridium-186	D, see ^{182}Ir	2E+3	8E+3	3E-6	1E-8	3E-5	3E-4
		W, see ^{182}Ir	-	6E+3	3E-6	9E-9	-	-
		Y, see ^{182}Ir	-	6E+3	2E-6	8E-9	-	-
77	Iridium-187	D, see ^{182}Ir	1E+4	3E+4	1E-5	5E-8	1E-4	1E-3
		W, see ^{182}Ir	-	3E+4	1E-5	4E-8	-	-
		Y, see ^{182}Ir	-	3E+4	1E-5	4E-8	-	-
77	Iridium-188	D, see ^{182}Ir	2E+3	5E+3	2E-6	6E-9	3E-5	3E-4
		W, see ^{182}Ir	-	4E+3	1E-6	5E-9	-	-
		Y, see ^{182}Ir	-	3E+3	1E-6	5E-9	-	-
77	Iridium-189	D, see ^{182}Ir	5E+3	5E+3	2E-6	7E-9	-	-
			LLI wall (5E+3)	-	-	-	7E-5	7E-4
		W, see ^{182}Ir	-	4E+3	2E-6	5E-9	-	-
		Y, see ^{182}Ir	-	4E+3	1E-6	5E-9	-	-
77	Iridium-190m[2]	D, see ^{182}Ir	2E+5	2E+5	8E-5	3E-7	2E-3	2E-2
		W, see ^{182}Ir	-	2E+5	9E-5	3E-7	-	-
		Y, see ^{182}Ir	-	2E+5	8E-5	3E-7	-	-
77	Iridium-190	D, see ^{182}Ir	1E+3	9E+2	4E-7	1E-9	1E-5	1E-4
		W, see ^{182}Ir	-	1E+3	4E-7	1E-9	-	-
		Y, see ^{182}Ir	-	9E+2	4E-7	1E-9	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col.3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
77	Iridium-192m	D, see ^{182}Ir	3E+3	9E+1	4E-8	1E-10	4E-5	4E-4
		W, see ^{182}Ir	-	2E+2	9E-8	3E-10	-	-
		Y, see ^{182}Ir	-	2E+1	6E-9	2E-11	-	-
77	Iridium-192	D, see ^{182}Ir	9E+2	3E+2	1E-7	4E-10	1E-5	1E-4
		W, see ^{182}Ir	-	4E+2	2E-7	6E-10	-	-
		Y, see ^{182}Ir	-	2E+2	9E-8	3E-10	-	-
77	Iridium-194m	D, see ^{182}Ir	6E+2	9E+1	4E-8	1E-10	9E-6	9E-5
		W, see ^{182}Ir	-	2E+2	7E-8	2E-10	-	-
		Y, see ^{182}Ir	-	1E+2	4E-8	1E-10	-	-
77	Iridium-194	D, see ^{182}Ir	1E+3	3E+3	1E-6	4E-9	1E-5	1E-4
		W, see ^{182}Ir	-	2E+3	9E-7	3E-9	-	-
		Y, see ^{182}Ir	-	2E+3	8E-7	3E-9	-	-
77	Iridium-195m	D, see ^{182}Ir	8E+3	2E+4	1E-5	3E-8	1E-4	1E-3
		W, see ^{182}Ir	-	3E+4	1E-5	4E-8	-	-
		Y, see ^{182}Ir	-	2E+4	9E-6	3E-8	-	-
77	Iridium-195	D, see ^{182}Ir	1E+4	4E+4	2E-5	6E-8	2E-4	2E-3
		W, see ^{182}Ir	-	5E+4	2E-5	7E-8	-	-
		Y, see ^{182}Ir	-	4E+4	2E-5	6E-8	-	-
78	Platinum-186	D, all compounds	1E+4	4E+4	2E-5	5E-8	2E-4	2E-3
78	Platinum-188	D, all compounds	2E+3	2E+3	7E-7	2E-9	2E-5	2E-4
78	Platinum-189	D, all compounds	1E+4	3E+4	1E-5	4E-8	1E-4	1E-3
78	Platinum-191	D, all compounds	4E+3	8E+3	4E-6	1E-8	5E-5	5E-4
78	Platinum-193m	D, all compounds	3E+3	6E+3	3E-6	8E-9	-	-
			LLI wall (3E+4)	-	-	-	4E-5	4E-4
78	Platinum-193	D, all compounds	4E+4	2E+4	1E-5	3E-8	-	-
			LLI wall (5E+4)	-	-	-	6E-4	6E-3
78	Platinum-195m	D, all compounds	2E+3	4E+3	2E-6	6E-9	-	-
			LLI wall (2E+3)	-	-	-	3E-5	3E-4
78	Platinum-197m[2]	D, all compounds	2E+4	4E+4	2E-5	6E-8	2E-4	2E-3
78	Platinum-197	D, all compounds	3E+3	1E+4	4E-6	1E-8	4E-5	4E-4
78	Platinum-199[2]	D, all compounds	5E+4	1E+5	6E-5	2E-7	7E-4	7E-3
78	Platinum-200	D, all compounds	1E+3	3E+3	1E-6	5E-9	2E-5	2E-4
79	Gold-193	D, all compounds except those given for W and Y	9E+3	3E+4	1E-5	4E-8	1E-4	1E-3
		W, halides and nitrates	-	2E+4	9E-6	3E-8	-	-
		Y, oxides and hydroxides	-	2E+4	8E-6	3E-8	-	-
79	Gold-194	D, see ^{193}Au	3E+3	8E+3	3E-6	1E-8	4E-5	4E-4
		W, see ^{193}Au	-	5E+3	2E-6	8E-9	-	-
		Y, see ^{193}Au	-	5E+3	2E-6	7E-9	-	-
79	Gold-195	D see ^{193}Au	5E+3	1E+4	5E-6	2E-8	7E-5	7E-4
		W see ^{193}Au	-	1E+3	6E-7	2E-9	-	-
		Y see ^{193}Au	-	4E+2	2E-7	6E-10	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col.3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
79	Gold-198m	D see ^{193}Au	1E+3	3E+3	1E-6	4E-9	1E-5	1E-4
		W see ^{193}Au	-	1E+3	5E-7	2E-9	-	-
		Y see ^{193}Au	-	1E+3	5E-7	2E-9	-	-
79	Gold-198	D see ^{193}Au	1E+3	4E+3	2E-6	5E-9	2E-5	2E-4
		W see ^{193}Au	-	2E+3	8E-7	3E-9	-	-
		Y see ^{193}Au	-	2E+3	7E-7	2E-9	-	-
79	Gold-199	D see ^{193}Au	3E+3	9E+3	4E-6	1E-8	-	-
			LLI wall (3E+3)	-	-	-	4E-5	4E-4
		W, see ^{193}Au	-	4E+3	2E-6	6E-9	-	-
		Y, see ^{193}Au	-	4E+3	2E-6	5E-9	-	-
79	Gold-200m	D, see ^{193}Au	1E+3	4E+3	1E-6	5E-9	2E-5	2E-4
		W, see ^{193}Au	-	3E+3	1E-6	4E-9	-	-
		Y, see ^{193}Au	-	2E+4	1E-6	3E-9	-	-
79	Gold-200[2]	D, see ^{193}Au	3E+4	6E+4	3E-5	9E-8	4E-4	4E-3
		W, see ^{193}Au	-	8E+4	3E-5	1E-7	-	-
		Y, see ^{193}Au	-	7E+4	3E-5	1E-7	-	-
79	Gold-201[2]	D, see ^{193}Au	7E+4	2E+5	9E-5	3E-7	-	-
			St wall (9E+4)	-	-	-	1E-3	1E-2
		W, see ^{193}Au	-	2E+5	1E-4	3E-7	-	-
		Y, see ^{193}Au	-	2E+5	9E-5	3E-7	-	-
80	Mercury-193m	Vapor	-	8E+3	4E-6	1E-8	-	-
		Organic D	4E+3	1E+4	5E-6	2E-8	6E-5	6E-4
		D, sulfates	3E+3	9E+3	4E-6	1E-8	4E-5	4E-4
		W, oxides, hydroxides, halides, nitrates, and sulfides	-	8E+3	3E-6	1E-8	-	-
80	Mercury-193	Vapor	-	3E+4	1E-5	4E-8	-	-
		Organic D	2E+4	6E+4	3E-5	9E-8	3E-4	3E-3
		D, see ^{193m}Hg	2E+4	4E+4	2E-5	6E-8	2E-4	2E-3
		W, see ^{193m}Hg	-	4E+4	2E-5	6E-8	-	-
80	Mercury-194	Vapor	-	3E+1	1E-8	4E-11	-	-
		Organic D	2E+1	3E+1	1E-8	4E-11	2E-7	2E-6
		D, see ^{193m}Hg	8E+2	4E+1	2E-8	6E-11	1E-5	1E-4
		W, see ^{193m}Hg	-	1E+2	5E-8	2E-10	-	-
80	Mercury-195m	Vapor	-	4E+3	2E-6	6E-9	-	-
		Organic D	3E+3	6E+3	3E-6	8E-9	4E-5	4E-4
		D, see ^{193m}Hg	2E+3	5E +3	2E-6	7E-9	3E-5	3E-4
		W, see ^{193m}Hg	-	4E+3	2E-6	5E-9	-	-
80	Mercury-195	Vapor	-	3E+4	1E-5	4E-8	-	-
		Organic D	2E+4	5E+4	2E-5	6E-8	2E-4	2E-3
		D, see ^{193m}Hg	1E+4	4E+ 4	1E-5	5E-8	2E-4	2E-3
		W, see ^{193m}Hg	-	3E+4	1E-5	5E-8	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col.3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Concentration (μCi/ml)
80	Mercury-197m	Vapor	-	5E+3	2E-6	7E-9	-	-
		Organic D	4E+3	9E+3	4E-6	1E-8	5E-5	5E-4
		D, see ^{193m}Hg	3E+3	7E+3	3E-6	1E-8	4E-5	4E-4
		W, see ^{193m}Hg	-	5E+3	2E-6	7E-9	-	-
80	Mercury-197	Vapor	-	8E+3	4E-6	1E-8	-	-
		Organic D	7E+3	1E+4	6E-6	2E-8	9E-5	9E-4
		D, see ^{193m}Hg	6E+3	1E+4	5E-6	2E-8	8E-5	8E-4
		W, see ^{193m}Hg	-	9E+3	4E-6	1E-8	-	-
80	Mercury-199m[2]	Vapor	-	8E+4	3E-5	1E-7	-	-
		Organic D	6E+4	2E+5	7E-5	2E-7	-	-
			St wall (1E+5)	-	-	-	1E-3	1E-2
		D, see ^{193m}Hg	6E+4	1E+5	6E-5	2E-7	8E-4	8E-3
		W, see ^{193m}Hg	-	2E+5	7E-5	2E-7	-	-
80	Mercury-203	Vapor	-	8E+2	4E-7	1E-9	-	-
		Organic D	5E+2	8E+2	3E-7	1E-9	7E-6	7E-5
		D, see ^{193m}Hg	2E+3	1E+3	5E-7	2E-9	3E-5	3E-4
		W, see ^{193m}Hg	-	1E+3	5E-7	2E-9	-	-
81	Thallium-194m[2]	D, all compounds	5E+4	2E+5	6E-5	2E-7	-	-
			St wall (7E+4)	-	-	-	1E-3	1E-2
81	Thallium-194[2]	D, all compounds	3E+5	6E+5	2E-4	8E-7	-	-
			St wall (3E+5)	-	-	-	4E-3	4E-2
81	Thallium-195[2]	D, all compounds	6E+4	1E+5	5E-5	2E-7	9E-4	9E-3
81	Thallium-197	D, all compounds	7E+4	1E+5	5E-5	2E-7	1E-3	1E-2
81	Thallium-198m[2]	D, all compounds	3E+4	5E+4	2E-5	8E-8	4E-4	4E-3
81	Thallium-198	D, all compounds	2E+4	3E+4	1E-5	5E-8	3E-4	3E-3
81	Thallium-199	D, all compounds	6E+4	8E+4	4E-5	1E-7	9E-4	9E-3
81	Thallium-200	D, all compounds	8E+3	1E+4	5E-6	2E-8	1E-4	1E-3
81	Thallium-201	D, all compounds	2E+4	2E+4	9E-6	3E-8	2E-4	2E-3
81	Thallium-202	D, all compounds	4E+3	5E+3	2E-6	7E-9	5E-5	5E-4
81	Thallium-204	D, all compounds	2E+3	2E+3	9E-7	3E-9	2E-5	2E-4
82	Lead-195m[2]	D, all compounds	6E+4	2E+5	8E-5	3E-7	8E-4	8E-3
82	Lead-198	D, all compounds	3E+4	6E+4	3E-5	9E-8	4E-4	4E-3
82	Lead-199[2]	D, all compounds	2E+4	7E+4	3E-5	1E-7	3E-4	3E-3
82	Lead-200	D, all compounds	3E+3	6E+3	3E-6	9E-9	4E-5	4E-4
82	Lead-201	D, all compounds	7E+3	2E+4	8E-6	3E-8	1E-4	1E-3
82	Lead-202m	D, all compounds	9E+3	3E+4	1E-5	4E-8	1E-4	1E-3
82	Lead-202	D, all compounds	1E+2	5E+1	2E-8	7E-11	2E-6	2E-5
82	Lead-203	D, all compounds	5E+3	9E+3	4E-6	1E-8	7E-5	7E-4
82	Lead-205	D, all compounds	4E+3	1E+3	6E-7	2E-9	5E-5	5E-4
82	Lead-209	D, all compounds	2E+4	6E+4	2E-5	8E-8	3E-4	3E-3
82	Lead-210	D, all compounds	6E1	2E1	1E-10	-	-	-
			Bone surf (1E+0)	Bone surf (4E-1)	-	6E-13	1E-8	1E-7
82	Lead-211[2]	D, all compounds	1E+4	6E+2	3E-7	9E-10	2E-4	2E+3

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col.3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
82	Lead-212	D, all compounds	8E+1	3E+1	1E-8	5E-11	-	-
			Bone surf (1E+2)	-	-	-	2E-6	2E-5
82	Lead-214[2]	D, all compounds	9E+3	8E+2	3E-7	1E-9	1E-4	1E-3
83	Bismuth-200[2]	D, nitrates	3E+4	8E+4	4E-5	1E-7	4E-4	4E-3
		W, all other compounds	-	1E+5	4E-5	1E-7	-	-
83	Bismuth-201[2]	D, see ^{200}Bi	1E+4	3E+4	1E-5	4E-8	2E-4	2E-3
		W, see ^{200}Bi	-	4E+4	2E-5	5E-8	-	-
83	Bismuth-202[2]	D, see ^{200}Bi	1E+4	4E+4	2E-5	6E-8	2E-4	2E-3
		W, see ^{200}Bi	-	8E+4	3E-5	1E-7	-	-
83	Bismuth-203	D, see ^{200}Bi	2E+3	7E+3	3E-6	9E-9	3E-5	3E-4
		W, see ^{200}Bi	-	6E+3	3E-6	9E-9	-	-
83	Bismuth-205	D, see ^{200}Bi	1E+3	3E+3	1E-6	3E-9	2E-5	2E-4
		W, see ^{200}Bi	-	1E+3	5E-7	2E-9	-	-
83	Bismuth-206	D, see ^{200}Bi	6E+2	1E+3	6E-7	2E-9	9E-6	9E-5
		W, see ^{200}Bi	-	9E+2	4E-7	1E-9	-	-
83	Bismuth-207	D, see ^{200}Bi	1E+3	2E+3	7E-7	2E-9	1E-5	1E-4
		W, see ^{200}Bi	-	4E+2	1E-7	5E-10	-	-
83	Bismuth-210m	D, see ^{200}Bi	4E+1	5E+0	2E-9	-	-	-
			Kidneys (6E+1)	Kidneys (6E+0)	-	9E-12	8E-7	8E-6
		W, see ^{200}Bi	-	7E-1	3E-10	9E-13		
83	Bismuth-210	D, see ^{200}Bi	8E+2	2E+2	1E-7	-	1E-5	1E-4
			-	Kidneys (4E+2)	-	5E-10	-	-
		W, see ^{200}Bi	-	3E+1	1E-8	4E-11	-	-
83	Bismuth-212[2]	D, see ^{200}Bi	5E+3	2E+2	1E-7	3E-10	7E-5	7E-4
		W, see ^{200}Bi	-	3E+2	1E-7	4E-10	-	-
83	Bismuth-213[2]	D, see ^{200}Bi	7E+3	3E+2	1E-7	4E-10	1E-4	1E-3
		W, see ^{200}Bi	-	4E+2	1E-7	5E-10	-	-
83	Bismuth-214[2]	D, see ^{200}Bi	2E+4	8E+2	3E-7	1E-9	-	-
			St wall (2E+4)	-	-	-	3E-4	3E-3
		W, see ^{200}Bi	-	9E-2	4E-7	1E-9	-	-
84	Polonium-203[2]	D, all compounds except those given for W	3E+4	6E+4	3E-5	9E-8	3E-4	3E-3
		W, oxides, hydroxides, and nitrates	-	9E+4	4E-5	1E-7	-	-
84	Polonium-205[2]	D, see ^{203}Po	2E+4	4E+4	2E-5	5E-8	3E-4	3E-3
		W, see ^{203}Po	-	7E+4	3E-5	1E-7	-	-
84	Polonium-207	D, see ^{203}Po	8E+3	3E+4	1E-5	3E-8	1E-4	1E-3
		W, see ^{203}Po	-	3E+4	1E-5	4E-8	-	-
84	Polonium-210	D, see ^{203}Po	3E+0	6E-1	3E-10	9E-13	4E-8	4E-7
		W, see ^{203}Po	-	6E-1	3E-10	9E-13	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col.3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Concentration (μCi/ml)
85	Astatine-207[2]	D, halides	6E+3	3E+3	1E-6	4E-9	8E-5	8E-4
		W	-	2E+3	9E-7	3E-9	-	-
85	Astatine-211	D, halides	1E+2	8E+1	3E-8	1E-10	2E-6	2E-5
		W	-	5E+1	2E-8	8E-11	-	-
86	Radon-220	With daughters removed	-	2E+4	7E-6	2E-8	-	-
		With daughters present	-	2E+1 (or 12 working level months)	9E-9	3E-11 (or 1.0 working level)	-	-
86	Radon-222	With daughters removed	-	1E+4	4E-6	1E-8	-	-
		With daughters present	-	1E+2 (or 4 working level months)	3E-8	1E-10 (or 0.33 working level)	-	-
87	Francium-222[2]	D, all compounds	2E+3	5E+2	2E-7	6E-10	3E-5	3E-4
87	Francium-223[2]	D, all compounds	6E+2	8E+2	3E-7	1E-9	8E-6	8E-5
88	Radium-223	W, all compounds	5E+0	7E-1	3E-10	9E-13	-	-
			Bone surf (9E+0)	-	-	-	1E-7	1E-6
88	Radium-224	W, all compounds	8E+0	2E+0	7E-10	2E-12	-	-
			Bone surf (2E+1)	-	-	-	2E-7	2E-6
88	Radium-225	W, all compounds	8E+0	7E-1	3E-10	9E-13	-	-
			Bone surf (2E+1)	-	-	-	2E-7	2E-6
88	Radium-226	W, all compounds	2E+0	6E-1	3E-10	9E-13	-	-
			Bone surf (5E+0)	-	-	-	6E-8	6E-7
88	Radium-227[2]	W, all compounds	2E+4	1E+4	6E-6	-	-	-
			Bone surf (2E+4)	Bone surf (2E+4)	-	3E-8	3E-4	3E-3
88	Radium-228	W, all compounds	2E+0	1E+0	5E-10	2E-12	-	-
			Bone surf (4E+0)	-	-	-	6E-8	6E-7
89	Actinium-224	D, all compounds except those given for W and Y	2E+3	3E+1	1E-8	-	-	-
			LLI wall (2E+3)	Bone surf (4E+1)	-	5E-11	3E-5	3E-4
		W, halides and nitrates	-	5E+1	2E-8	7E-11	-	-
		Y, oxides and hydroxides	-	5E+1	2E-8	6E-11	-	-
89	Actinium-225							
		D, see ^{224}Ac	5E+1	3E-1	1E-10	-	-	-
			LLI wall (5E+1)	Bone surf (5E-1)	-	7E-13	7E-7	7E-6
		W, see ^{224}Ac	-	6E-1	3E-10	9E-13	-	-
		Y, see ^{224}Ac	-	6E-1	3E-10	9E-13	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col.3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	**Radionuclide**	**Class**	**ALI (μCi)**	**ALI (μCi)**	**DAC (μCi/ml)**	**Air (μCi/ml)**	**Water (μCi/ml)**	**Concentration (μCi/ml)**
89	Actinium-226	D, see ^{224}Ac	1E+2	3E+0	1E-9	-	-	-
			LLI wall (1E+2)	Bone surf (4E+0)	-	5E-12	2E-6	2E-5
		W, see ^{224}Ac	-	5E+0	2E-9	7E-12	-	-
		Y, see ^{224}Ac	-	5E+0	2E-9	6E-12	-	-
89	Actinium-227	D, see ^{224}Ac	2E-1	4E-4	2E-13	-	-	-
			Bone surf (4E-1)	Bone surf (8E-4)	-	1E-15	5E-9	5E-8
		W, see ^{224}Ac	-	2E-3	7E-13	-	-	-
			-	Bone surf (3E-3)	-	4E-15	-	-
		Y, see ^{224}Ac	-	4E-3	2E-12	6E-15	-	-
89	Actinium-228	D, see ^{224}Ac	2E+3	9E+0	4E-9	-	3E-5	3E-4
			-	Bone surf (2E+1)	-	2E-11	-	-
		W see ^{224}Ac	-	4E+1	2E-8	-	-	-
			-	Bone surf (6E+1)	-	8E-11	-	-
		Y see ^{224}Ac	-	4E+1	2E-8	6E-11	-	-
90	Thorium-226[2]	W, all compounds except those given for Y	5E+3	2E+2	6E-8	2E-10	-	-
			St wall (5E+3)	-	-	-	7E-5	7E-4
		Y, oxides and hydroxides	-	1E+2	6E-8	2E-10	-	-
90	Thorium-227	W, see ^{226}Th	1E+2	3E-1	1E-10	5E-13	2E-6	2E-5
		Y, see ^{226}Th	-	3E-1	1E-10	5E-13	-	-
90	Thorium-228	W, see ^{226}Th	6E+0	1E-2	4E-12	-	-	-
			Bone surf (1E+1)	Bone surf (2E-2)	-	3E-14	2E-7	2E-6
		Y, see ^{226}Th	-	2E-2	7E-12	2E-14	-	-
90	Thorium-229	W, see ^{226}Th	6E-1	9E-4	4E-13	-	-	-
			Bone surf (1E+0)	Bone surf (2E-3)	-	3E-15	2E-8	2E-7
		Y, see ^{226}Th	-	2E-3	1E-12	-	-	-
			-	Bone surf (3E-3)	-	4E-15-	-	
90	Thorium-230	W, see ^{226}Th	4E+0	6E-3	3E-12	-	-	-
			Bone surf (9E+0)	Bone surf (2E-2)	-	2E-141E-7	1E-6	
		Y, see ^{226}Th	-	2E-2	6E-12	-	-	-
			-	Bone surf (2E-2)	-	3E-14-	-	
90	Thorium-231	W, see ^{228}Th	4E+3	6E+3	3E-6	9E-9	5E-5	5E-4
		Y, see ^{228}Th	-	6E+3	3E-6	9E-9-	-	

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col.3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Concentration (μCi/ml)
90	Thorium-232	W, see ^{228}Th	7E-1	1E-3	5E-13	-	-	-
			Bone surf (2E+0)	Bone surf (3E-3)	-	4E-15	3E-8	3E-7
		Y, see ^{228}Th	-	3E-3	1E-12	-	-	-
			-	Bone surf (4E-3)	-	6E-15	-	-
90	Thorium-234	W, see ^{228}Th	3E+2	2E+2	8E-8	3E-10	-	-
			LLI wall (4E+2)	-	-	-	5E-6	5E-5
		Y, see ^{228}Th	-	2E+2	6E-8	2E-10	-	-
91	Protactinium-227[2]	W, all compounds except those given for Y	4E+3	1E+2	5E-8	2E-10	5E-5	5E-4
		Y, oxides and hydroxides	-	1E+2	4E-8	1E-10	-	-
91	Protactinium-228	W, see ^{227}Pa	1E+3	1E+1	5E-9	-	2E-5	2E-4
			-	Bone surf (2E+1)	-	3E-11	-	-
		Y, see ^{227}Pa	-	1E+1	5E-9	2E-11	-	-
91	Protactinium-230	W, see ^{227}Pa	6E+2	5E+0	2E-9	7E-12	-	-
			Bone surf (9E+2)	-	-	-	1E-5	1E-4
		Y, see ^{227}Pa	-	4E+0	1E-9	5E-12	-	-
91	Protactinium-231	W, see ^{227}Pa	2E-1	2E-3	6E-13	-	-	-
			Bone surf (5E-1)	Bone surf (4E-3)	-	6E-15	6E-9	6E-8
		Y, see ^{227}Pa	-	4E-3	2E-12	-	-	-
			-	Bone surf (6E-3)	-	8E-15	-	-
91	Protactinium-232	W, see ^{227}Pa	1E+3	2E+1	9E-9	-	2E-5	2E-4
			-	Bone surf (6E+1)	-	8E-11	-	-
		Y, see ^{227}Pa	-	6E+1	2E-8	-	-	-
			-	Bone surf (7E+1)	-	1E-10	-	-
91	Protactinium-233	W, see ^{227}Pa	1E+3	7E+2	3E-7	1E-9	-	-
			LLI wall (2E+3)	-	-	-	2E-5	2E-4
		Y, see ^{227}Pa	-	6E+2	2E-7	8E-10	-	-
91	Protactinium-234	W, see ^{227}Pa	2E+3	8E+3	3E-6	1E-8	3E-5	3E-4
		Y, see ^{227}Pa	-	7E+3	3E-6	9E-9	-	-
92	Uranium-230	D, UF, UOF, UO(NO)	4E+0	4E-1	2E-10	-	-	-
			Bone surf (6E+0)	Bone surf (6E-1)	-	8E-13	8E-8	8E-7
		W, UO, UF, UCl	-	4E-1	1E-10	5E-13	-	-
		Y, UO, UO	-	3E-1	1E-10	4E-13	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col.3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
92	Uranium-231	D, see ^{230}U	5E+3	8E+3	3E-6	1E-8	-	-
			LLI wall (4E+3)	-	-	-	6E-5	6E-4
		W, see ^{230}U	-	6E+3	2E-6	8E-9	-	-
		Y, see ^{230}U	-	5E+3	2E-6	6E-9	-	-
92	Uranium-232	D, see ^{230}U	2E+0	2E-1	9E-11	-	-	-
			Bone surf (4E+0)	Bone surf (4E-1)	-	6E-13	6E-8	6E-7
		W, see ^{230}U	-	4E-1	2E-10	5E-13	-	-
		Y, see ^{230}U	-	8E-3	3E-12	1E-14	-	-
92	Uranium-233	D, see ^{230}U	1E+1	1E+0	5E-10	-	-	
			Bone surf (2E+1)	Bone surf (2E+0)	-	3E-12	3E-7	3E-6
		W, see ^{230}U	-	7E-1	3E-10	1E-12	-	-
		Y, see ^{230}U	-	4E-2	2E-11	5E-14	-	-
92	Uranium-234[3]	D, see ^{230}U	1E+1	1E+0	5E-10	-	-	-
			Bone surf (2E+1)	Bone surf (2E+0)	-	3E-12	3E-7	3E-6
		W, see ^{230}U	-	7E-1	3E-10	1E-12	-	-
		Y, see ^{230}U	-	4E-2	2E-11	5E-14	-	-
92	Uranium-235[3]	D, see ^{230}U	1E+1	1E+0	6E-10	-	-	-
			Bone surf (2E+1)	Bone surf (2E+0)	-	3E-12	3E-7	3E-6
		W, see ^{230}U	-	8E-1	3E-10	1E-12	-	-
		Y, see ^{230}U	-	4E-2	2E-11	6E-14	-	-
92	Uranium-236	D, see ^{230}U	1E+1	1E+0	5E-10	-	-	-
			Bone surf (2E+1)	Bone surf (2E+0)	-	3E-12	3E-7	3E-6
		W, see ^{230}U	-	8E-1	3E-10	1E-12	-	-
		Y, see ^{230}U	-	4E-2	2E-11	6E-14	-	-
92	Uranium-237	D, see ^{230}U	2E+3	3E+3	1E-6	4E-9	-	-
			LLI wall (2E+3)	-	-	-	3E-5	3E-4
		W, see ^{230}U	-	2E+3	7E-7	2E-9	-	-
		Y, see ^{230}U	-	2E+3	6E-7	2E-9	-	-
92	Uranium-238[3]	D, see ^{230}U	1E+1	1E+0	6E-10	-	-	-
			Bone surf (2E+1)	Bone surf (2E+0)	-	3E-12	3E-7	3E-6
		W, see ^{230}U	-	8E-1	3E-10	1E-12	-	-
		Y, see ^{230}U	-	4E-2	2E-11	6E-14	-	-
92	Uranium-239[2]	D, see ^{230}U	7E+4	2E+5	8E-5	3E-7	9E-4	9E-3
		W, see ^{230}U	-	2E+5	7E-5	2E-7	-	-
		Y, see ^{230}U	-	2E+5	6E-5	2E-7	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col.3	Col. 1	Col. 2	
Atomic No.	Radionuclide	Class	Oral Ingestion ALI (μCi)	Inhalation ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
92	Uranium-240	D, see ^{230}U	1E+3	4E+3	2E-6	5E-9	2E-5	2E-4
		W, see ^{230}U	-	3E+3	1E-6	4E-9	-	-
		Y, see ^{230}U	-	2E+3	1E-6	3E-9	-	-
92	Uranium-natural[3]	D, see ^{230}U	1E+1	1E+0	5E-10	-	-	-
			Bone surf (2E+1)	Bone surf (2E+0)	-	3E-12	3E-7	3E-6
		W, see ^{230}U	-	8E-1	3E-10	9E-13	-	-
		Y, see ^{230}U	-	5E-2	2E-11	9E-24	-	-
93	Neptunium-232[2]	W, all compounds	1E+5	2E+3	7E-7	-	2E-3	2E-2
			-	Bone surf (5E+2)	-	6E-9	-	-
93	Neptunium-233[2]	W, all compounds	8E+5	3E+6	1E-3	4E-6	1E-2	1E-1
93	Neptunium-234	W, all compounds	2E+3	3E+3	1E-6	4E-9	3E-5	3E-4
93	Neptunium-235	W, all compounds	2E+4	8E+2	3E-7	-	-	-
			LLI wall (2E+4)	Bone surf (1E+3)	-	2E-9	3E-4	3E-3
93	Neptunium-236 (1.15E+5 y)	W, all compounds	3E+0	2E-2	9E-12	-	-	-
			Bone surf (6E+0)	Bone surf (5E-2)	-	8E-14	9E-8	9E-7
93	Neptunium-236 (22.5 h)	W, all compounds	3E+3	3E+1	1E-8	-	-	-
			Bone surf (4E+3)	Bone surf (7E+1)	-	1E-10	5E-5	5E-4
93	Neptunium-237	W, all compounds	5E-1	4E-3	2E-12	-	-	-
			Bone surf (1E+0)	Bone surf (1E-2)	-	1E-14	2E-8	2E-7
93	Neptunium-238	W, all compounds	1E+3	6E+1	3E-8	-	2E-5	2E-4
			-	Bone surf (2E+2)	-	2E-10	-	-
93	Neptunium-239	W, all compounds	2E+3	2E+3	9E-7	3E-9	-	-
			LLI wall (2E+3)	-	-	-	2E-5	2E-4
93	Neptunium-240[2]	W, all compounds	2E+4	8E+4	3E-5	1E-7	3E-4	3E-3
94	Plutonium-234	W, all compounds except PuO	8E+3	2E+2	9E-8	3E-10	1E-4	1E-3
		Y, PuO	-	2E+2	8E-8	3E-10	-	-
94	Plutonium-235[2]	W, see ^{234}Pu	9E+5	3E+6	1E-3	4E-6	1E-2	1E-1
		Y, see ^{234}Pu	-	3E+6	1E-3	3E-6	-	-
94	Plutonium-236	W, see ^{234}Pu	2E+0	2E-2	8E-12	-	-	-
			Bone surf (4E+0)	Bone surf (4E-2)	-	5E-14	6E-8	6E-7
		Y, see ^{234}Pu	-	4E-2	2E-11	6E-14	-	-
94	Plutonium-237	W, see ^{234}Pu	1E+4	3E+3	1E-6	5E-9	2E-4	2E-3
		Y, see ^{234}Pu	-	3E+3	1E-6	4E-9	-	-
94	Plutonium-238	W, see ^{234}Pu	9E-1	7E-3	3E-12	-	-	-
			Bone surf (2E+0)	Bone surf (1E-2)	-	2E-14	2E-8	2E-7
		Y, see ^{234}Pu	-	2E-2	8E-12	2E-14	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col.3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	**Radionuclide**	**Class**	**ALI (μCi)**	**ALI (μCi)**	**DAC (μCi/ml)**	**Air (μCi/ml)**	**Water (μCi/ml)**	**Concentration (μCi/ml)**
94	Plutonium-239	W, see ^{234}Pu	8E-1	6E-3	3E-12	-	-	-
			Bone surf (1E+0)	Bone surf (1E-2)	-	2E-14	2E-8	2E-7
		Y, see ^{234}Pu	-	2E-2	7E-12	-	-	-
			-	Bone surf (2E-2)	-	2E-14	-	-
94	Plutonium-240	W, see ^{234}Pu	8E-1	6E-3	3E-12	-	-	-
			Bone surf (1E+0)	Bone surf (1E-2)	-	2E-14	2E-8	2E-7
		Y, see ^{234}Pu	-	2E-2	7E-12	-	-	-
			-	Bone surf (2E-2)	-	2E-14	-	-
94	Plutonium-241	W, see ^{234}Pu	4E+1	3E-1	1E-10	-	-	-
			Bone surf (7E+1)	Bone surf (6E-1)	-	8E-13	1E-6	1E-5
		Y, see ^{234}Pu	-	8E-1	3E-10	-	-	-
			-	Bone surf (1E+0)	-	1E-12	-	-
94	Plutonium-242	W, see ^{234}Pu	8E-1	7E-3	3E-12	-	-	-
			Bone surf (1E+0)	Bone surf (1E-2)	-	2E-14	2E-8	2E-7
		Y, see ^{234}Pu	-	2E-2	7E-12	-	-	-
			-	Bone surf (2E-2)	-	2E-14	-	-
94	Plutonium-243	W, see ^{234}Pu	2E+4	4E+4	2E-5	5E-8	2E-4	2E-3
		Y, see ^{234}Pu	-	4E+4	2E-5	5E-8	-	-
94	Plutonium-244	W, see ^{234}Pu	8E-1	7E-3	3E-12	-	-	-
			Bone surf (2E+0)	Bone surf (1E-2)	-	2E-14	2E-8	2E-7
		Y, see ^{234}Pu	-	2E-2	7E-12	-	-	-
			-	Bone surf (2E-2)	-	2E-14	-	-
94	Plutonium-245	W, see ^{234}Pu	2E+3	5E+3	2E-6	6E-9	3E-5	3E-4
		Y, see ^{234}Pu	-	4E+3	2E-6	6E-9	-	-
94	Plutonium-246	W, see ^{234}Pu	4E+2	3E+2	1E-7	4E-10	-	-
			LLI wall (4E+2)	-	-	-	6E-6	6E-5
		Y, see ^{234}Pu	-	3E+2	1E-7	4E-10	-	-
95	Americium-237[2]	W, all compounds	8E+4	3E+5	1E-4	4E-7	1E-3	1E-2
95	Americium-238[2]	W, all compounds	4E+4	3E+3	1E-6	-	5E-4	5E-3
			-	Bone surf (6E+3)	-	9E-9	-	-
95	Americium-239	W, all compounds	5E+3	1E+4	5E-6	2E-8	7E-5	7E-4
95	Americium-240	W, all compounds	2E+3	3E+3	1E-6	4E-9	3E-5	3E-4
95	Americium-241	W, all compounds	8E-1	6E-3	3E-12	-	-	-
			Bone surf (1E+0)	Bone surf (1E-2)	-	2E-14	2E-8	2E-7

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col.3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Concentration (μCi/ml)
95	Americium-242m	W, all compounds	8E-1	6E-3	3E-12	-	-	-
			Bone surf (1E+0)	Bone surf (1E-2)	-	2E-14	2E-8	2E-7
95	Americium-242	W, all compounds	4E+3	8E+1	4E-8	-	5E-5	5E-4
			-	Bone surf (9E+1)	-	1E-10	-	-
95	Americium-243	W, all compounds	8E-1	6E-3	3E-12	-	-	-
			Bone surf (1E+0)	Bone surf (1E-2)	-	2E-14	2E-8	2E-7
95	Americium-244m[2]	W, all compounds	6E+4	4E+3	2E-6	-	-	-
			St wall (8E+4)	Bone surf (7E+3)	-	1E-8	1E-3	1E-2
95	Americium-244	W, all compounds	3E+3	2E+2	8E-8	-	4E-5	4E-4
			-	Bone surf (3E+2)	-	4E-10	-	-
95	Americium-245	W, all compounds	3E+4	8E+4	3E-5	1E-7	4E-4	4E-3
95	Americium-246m[2]	W, all compounds	5E+4	2E+5	8E-5	3E-7	-	-
			St wall (6E+4)	-	-	-	8E-4	8E-3
95	Americium-246[2]	W, all compounds	3E+4	1E+5	4E-5	1E-7	4E-4	4E-3
96	Curium-238	W, all compounds	2E+4	1E+3	5E-7	2E-9	2E-4	2E-3
96	Curium-240	W, all compounds	6E+1	6E-1	2E-10	-	-	-
			Bone surf (8E+1)	Bone surf (6E-1)	-	9E-13	1E-6	1E-5
96	Curium-241	W, all compounds	1E+3	3E+1	1E-8	-	2E-5	2E-4
			-	Bone surf (4E+1)	-	5E-11	-	-
96	Curium-242	W, all compounds	3E+1	3E-1	1E-10	-	-	-
			Bone surf (5E+1)	Bone surf (3E-1)	-	4E-13	7E-7	7E-6
96	Curium-243	W, all compounds	1E+0	9E-3	4E-12	-	-	-
			Bone surf (2E+0)	Bone surf (2E-2)	-	2E-14	3E-8	3E-7
96	Curium-244	W, all compounds	1E+0	1E-2	5E-12	-	-	-
			Bone surf (3E+0)	Bone surf (2E-2)	-	3E-14	3E-8	3E-7
96	Curium-245	W, all compounds	7E-1	6E-3	3E-12	-	-	-
			Bone surf (1E+0)	Bone surf (1E-2)	-	2E-14	2E-8	2E-7
96	Curium-246	W, all compounds	7E-1	6E-3	3E-12	-	-	-
			Bone surf (1E+0)	Bone surf (1E-2)	-	2E-14	2E-8	2E-7
96	Curium-247	W, all compounds	8E-1	6E-3	3E-12	-	-	-
			Bone surf (1E+0)	Bone surf (1E-2)	-	2E-14	2E-8	2E-7
96	Curium-248	W, all compounds	2E-1	2E-3	7E-13	-	-	-
			Bone surf (4E-1)	Bone surf (3E-3)	-	4E-15	5E-9	5E-8

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col.3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
96	Curium-249[2]	W, all compounds	5E+4	2E+4	7E-6	-	7E-4	7E-3
			-	Bone surf (3E+4)	-	4E-8	-	-
96	Curium-250	W, all compounds	4E-2	3E-4	1E-13	-	-	-
			Bone surf (6E-2)	Bone surf (5E-4)	-	8E-16	9E-10	9E-9
97	Berkelium-245	W, all compounds	2E+3	1E+3	5E-7	2E-9	3E-5	3E-4
97	Berkelium-246	W, all compounds	3E+3	3E+3	1E-6	4E-9	4E-5	4E-4
97	Berkelium-247	W, all compounds	5E-1	4E-3	2E-12	-	-	-
			Bone surf (1E+0)	Bone surf (9E-3)	-	1E-14	2E-8	2E-7
97	Berkelium-249	W, all compounds	2E+2	2E+0	7E-10	-	-	-
			Bone surf (5E+2)	Bone surf (4E+0)	-	5E-12	6E-6	6E-5
97	Berkelium-250	W, all compounds	9E+3	3E+2	1E-7	-	1E-4	1E-3
			-	Bone surf (7E+2)	-	1E-9	-	-
98	Californium-244[2]	W, all compounds except those given for Y	3E+4	6E+2	2E-7	8E-10	-	-
			St wall (3E+4)	-	-	-	4E-4	4E-3
		Y, oxides and hydroxides	-	6E+2	2E-7	8E-10	-	-
98	Californium-246	W, see ^{244}Cf	4E+2	9E+0	4E-9	1E-11	5E-6	5E-5
		Y, see ^{244}Cf	-	9E+0	4E-9	1E-11	-	-
98	Californium-248	W, see ^{244}Cf	8E+0	6E-2	3E-11	-	-	-
			Bone surf (2E+1)	Bone surf (1E-1)	-	2E-13	2E-7	2E-6
		Y, see ^{244}Cf	-	1E-1	4E-11	1E-13	-	-
98	Californium-249	W, see ^{244}Cf	5E-1	4E-3	2E-12	-	-	-
			Bone surf (1E+0)	Bone surf (9E-3)	-	1E-14	2E-8	2E-7
		Y, see ^{244}Cf	-	1E-2	4E-12	-	-	-
			-	Bone surf (1E-2)	-	2E-14	-	-
98	Californium-250	W, see ^{244}Cf	1E+0	9E-3	4E-12	-	-	-
			Bone surf (2E+0)	Bone surf (2E-2)	-	3E-14	3E-8	3E-7
		Y, see ^{244}Cf	-	3E-2	1E-11	4E-14	-	-
98	Californium-251	W, see ^{244}Cf	5E-1	4E-3	2E-12	-	-	-
			Bone surf (1E+0)	Bone surf (9E-3)	-	1E-14	2E-8	2E-7
		Y, see ^{244}Cf	-	1E-2	4E-12		-	-
			-	Bone surf (1E-2)	-	2E-14	-	-
98	Californium-252	W, see ^{244}Cf	2E+0	2E-2	8E-12	-	-	-
			Bone surf (5E+0)	Bone surf (4E-2)	-	5E-14	7E-8	7E-7
		Y, see ^{244}Cf	-	3E-2	1E-11	5E-14	-	-

			Table I Occupational Values			Table II Effluent Concentrations		Table III Releases to Sewers
			Col. 1	Col. 2	Col.3	Col. 1	Col. 2	
			Oral Ingestion	Inhalation				Monthly Average
Atomic No.	Radionuclide	Class	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Concentration (μCi/ml)
98	Californium-253	W, see ^{244}Cf	2E+2	2E+0	8E-10	3E-12	-	-
			Bone surf (4E+2)	-	-	-	5E-6	5E-5
		Y, see ^{244}Cf	-	2E+0	7E-10	2E-12	-	-
98	Californium-254	W, see ^{244}Cf	2E+0	2E-2	9E-12	3E-14	3E-8	3E-7
		Y, see ^{244}Cf	-	2E-2	7E-12	2E-14	-	-
99	Einsteinium-250	W, all compounds	4E+4	5E+2	2E-7	-	6E-4	6E-3
			-	Bone surf (1E+3)	-	2E-9	-	-
99	Einsteinium-251	W, all compounds	7E+3	9E+2	4E-7	-	1E-4	1E-3
			-	Bone surf (1E+3)	-	2E-9	-	-
99	Einsteinium-253	W, all compounds	2E+2	1E+0	6E-10	2E-12	2E-6	2E-5
99	Einsteinium-254m	W, all compounds	3E+2	1E+1	4E-9	1E-11	-	-
			LLI wall (3E+2)	-	-	-	4E-6	4E-5
99	Einsteinium-254	W, all compounds	8E+0	7E-2	3E-11	-	-	-
			Bone surf (2E+1)	Bone surf (1E-1)	-	2E-13	2E-7	2E-6
100	Fermium-252	W, all compounds	5E+2	1E+1	5E-9	2E-11	6E-6	6E-5
100	Fermium-253	W, all compounds	1E+3	1E+1	4E-9	1E-11	1E-5	1E-4
100	Fermium-254	W, all compounds	3E+3	9E+1	4E-8	1E-10	4E-5	4E-4
100	Fermium-255	W, all compounds	5E+2	2E+1	9E-9	3E-11	7E-6	7E-5
100	Fermium-257	W, all compounds	2E+1	2E-1	7E-11	-	-	-
			Bone surf (4E+1)	Bone surf (2E-1)	-	3E-13	5E-7	5E-6
101	Mendelevium-257	W, all compounds	7E+3	8E+1	4E-8	-	1E-4	1E-3
			-	Bone surf (9E+1)	-	1E-10	-	-
101	Mendelevium-258	W, all compounds	3E+1	2E-1	1E-10	-	-	-
			Bone surf (5E+1)	Bone surf (3E-1)	-	5E-13	6E-7	6E-6
-	Any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half-life less than 2 hours	Submersion[1]	-	2E+2	1E-7	1E-9	-	-
-	Any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half-life greater than 2 hours.	. . .	-	2E-1	1E-10	1E-12	1E-8	1E-7

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col.3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
	Any single radionuclide not listed above that decays by alpha emission or spontaneous fission, or any mixture for which either the identity or the concentration of any radionuclide in the mixture is not known.	. . .	-	4E-4	2E-13	1E-15	2E-9	2E-8

FOOTNOTES:

[1] "Submersion" means that values given are for submersion in a hemispherical semi-infinite cloud of airborne material.

[2] These radionuclides have radiological half-lives of less than 2 hours. The total effective dose equivalent received during operations with these radionuclides might include a significant contribution from external exposure. The DAC values for all radionuclides, other than those designated Class "Submersion," are based upon the committed effective dose equivalent due to the intake of the radionuclide into the body and do NOT include potentially significant contributions to dose equivalent from external exposures. The licensee may substitute 1E-7 μCi/ml for the listed DAC to account for the submersion dose prospectively but shall use individual monitoring devices or other radiation-measuring instruments that measure external exposure to demonstrate compliance with the limits. (See R12-1-410)

[3] For soluble mixtures of U-238, U-234, and U-235 in air, chemical toxicity may be the limiting factor (see R12-1-408(E)). If the percent by weight (enrichment) of U-235 is not greater than 5, the concentration value for a 40-hour work week is 0.2 milligrams uranium per cubic meter of air average. For any enrichment, the product of the average concentration and time of exposure during a 40-hour work week shall not exceed8E-3 (SA) μCi-hr/ml, where SA is the specific activity of the uranium inhaled. The specific activity for natural uranium is 6.77E-7 curies per gram U. The specific activity for other mixtures of U-238, U-235, and U-234, if not known, shall be:

SA = 3.6E-7 curies/gram U U-depleted

SA = $[0.4 + 0.38 \text{ (enrichment)} + 0.0034 \text{ (enrichment)}^2]$ E-6, enrichment > 0.72

where enrichment is the percentage by weight of U-235, expressed as percent.

NOTE:

1. 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 shall be the most restrictive DAC of any radionuclide in the mixture.
2. If the identity of each radionuclide in the mixture is not known, but it is known that certain radionuclides specified in this Appendix are not present in the mixture, the inhalation ALI, DAC, and effluent and sewage concentrations for the mixture are the lowest values specified in this Appendix for any radionuclide that is not known to be absent from the mixture; or

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col.3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
	If it is known that Ac-227-D and Cm-250-W are not present		-	7E-4	3E-13	-	-	-
	If, in addition, it is known that Ac-227-W,Y, Th-229-W,Y, Th-230-W, Th-232-W,Y, Pa-231-W,Y, Np-237-W, Pu-239-W, Pu-240-W, Pu-242-W, Am-241-W, Am-242m-W, Am-243-W, Cm-245-W, Cm-246-W, Cm-247-W, Cm-248-W, Bk-247-W, Cf-249-W, and Cf-251-W are not present		-	7E-3	3E-12	-	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Col. 2 Inhalation ALI (μCi)	Col.3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
If, in addition, it is known that Sm-146-W, Sm-147-W, Gd-148-D,W, Gd-152-D,W, Th-228-W,Y, Th-230-Y, U-232-Y, U-233-Y, U-234-Y, U-235-Y, U-236-Y, U-238-Y, Np-236-W, Pu-236-W,Y, Pu-238-W,Y, Pu-239-Y, Pu-240-Y, Pu-242-Y, Pu-244-W,Y, Cm-243-W, Cm-244-W, Cf-248-W, Cf-249-Y, Cf-250-W,Y, Cf-251-Y, Cf-252-WY, and Cf-254-W,Y are not present			-	7E-2	3E-11	-	-	-
If, in addition, it is known that Pb-210-D, Bi-210m-W, Po-210-D,W, Ra-223-W, Ra-225-W, Ra-226-W, Ac-225-D,W,Y, Th-227-W,Y, U-230-D,W,Y, U-232-D,W, Pu-241-W, Cm-240-W, Cm-242-W, Cf-248-Y, Es-254-W, Fm-257-W, and Md-258-W are not present			-	7E-1	3E-10	-	-	-
If, in addition, it is known that Si-32-Y, Ti-44-Y, Fe-60-D, Sr-90-Y, Zr-93-D, Cd-113m-D, Cd-113-D, In-115-D,W, La-138-D, Lu-176-W, Hf-178m-D,W, Hf-182-D,W, Bi-210m-D, Ra-224-W, Ra-228-W, Ac-226-D,W,Y, Pa-230-W,Y, U-233-D,W, U-234-D,W, U-235-D,W, U-236-D,W, U-238-D,W, Pu-241-Y, Bk-249-W, Cf-253-W,Y, and Es-253-W are not present			-	7E+0	3E-9	-	-	-
If it is known that Ac-227-D,W,Y, Th-229-W,Y, Th-232-W,Y, Pa-231-W,Y, Cm-248-W, and Cm-250-W are not present			-	-	-	1E-14	-	-
If, in addition, it is known that Sm-146-W, Gd-148-D,W, Gd-152-D, Th-228-W,Y, Th-230-W,Y, U-232-Y, U-233-Y, U-234-Y, U-235-Y, U-236-Y, U-238-Y, U-Nat-Y, Np-236-W, Np-237-W, Pu-236-W,Y, Pu-238-W,Y, Pu-239-W,Y, Pu-240-W,Y, Pu-242-W,Y, Pu-244-W,Y, Am-241-W, Am-242m-W, Am-243-W, Cm-243-W, Cm-244-W, Cm-245-W, Cm-246-W, Cm-247-W, Bk-247-W, Cf-249-W,Y, Cf-250-W,Y, Cf-251-W,Y, Cf-252-W,Y, and Cf-254-W,Y are not present			-	-	-	1E-13	-	-
If, in addition, it is known that Sm-147-W, Gd-152-W, Pb-210-D, Bi-210m-W, Po-210-D,W, Ra-223-W, Ra-225-W, Ra-226-W, Ac-225-D,W,Y, Th-227-W,Y, U-230-D,W,Y, U-232-D,W, U-Nat-W, Pu-241-W, Cm-240-W, Cm-242-W, Cf-248-W,Y, Es-254-W, Fm-257-W, and Md-258-W are not present			-	-	-	-	1E-12	-
If, in addition it is known that Fe-60, Sr-90, Cd-113m, Cd-113, In-115, I-129, Cs-134, Sm-145, Sm-147, Gd-148, Gd-152, Hg-194 (organic), Bi-210m, Ra-223, Ra-224, Ra-225, Ac-225, Th-228, Th-230, U-233, U-234, U-235, U-236, U-238, U-Nat, Cm-242, Cf-248, Es-254, Fm-257, and Md-258 are not present			-	-	-	-	1E-6	1E-5

3. If a mixture of radionuclides consists of Uranium and its daughters in ore dust (10 μm AMAD particle distribution assumed) prior to chemical separation of the Uranium from the ore, the following values may be used for the DAC of the mixture: 6E-11 μCi of gross alpha activity from Uranium-238, Uranium-234, Thorium-230, and Radium-226 per milliliter of air; 3E-11 μCi of natural uranium per milliliter of air; or 45 micrograms of natural uranium per cubic meter of air.
4. If the identity and concentration of each radionuclide in a mixture are known, the limiting values should be derived as follows: determine, for each radionuclide in the mixture, the ratio between the concentration present in the mixture and the concentration otherwise established in Appendix B to Article 4 for the specific radionuclide when not in a mixture. The sum of such ratios for all of the radionuclides in the mixture may not exceed "1" (i.e., "unity").
   Example: If radionuclides "A," "B," and "C" are present in concentrations C_A, C_B, and C_C, and if the applicable DACs are DAC_A, DAC_B, and DAC_C, respectively then the concentrations shall be limited so that the following relationship exists:

$$\frac{C_A}{DAC_A} + \frac{C_B}{DAC_B} + \frac{C_C}{DAC_C} \leq 1$$

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Section repealed; new Section adopted effective August 10, 1994 (Supp. 94-3).

APPENDIX C. QUANTITIES[1] OF LICENSED OR REGISTERED MATERIAL REQUIRING LABELING

Radionuclide	Quantity (μCi)	Radionuclide	Quantity (μCi)
Hydrogen-3	1,000	Nickel-56	100
Beryllium-7	1,000	Nickel-57	100
Beryllium-10	1	Nickel-59	100
Carbon-11	1,000	Nickel-63	100
Carbon-14	1,000	Nickel-65	1,000
Fluorine-18	1,000	Nickel-66	10
Sodium-22	10	Copper-60	1,000
Sodium-24	100	Copper-61	1,000
Magnesium-28	100	Copper-64	1,000
Aluminum-26	10	Copper-67	1,000
Silicon-31	1,000	Zinc-62	100
Silicon-32	1	Zinc-63	1,000
Phosphorus-32	10	Zinc-65	10
Phosphorus-33	100	Zinc-69m	100
Sulfur-35	100	Zinc-69	1,000
Chlorine-36	10	Zinc-71m	1,000
Chlorine-38	1,000	Zinc-72	100
Chlorine-39	1,000	Gallium-65	1,000
Argon-39	1,000	Gallium-66	100
Argon-41	1,000	Gallium-67	1,000
Potassium-40	100	Gallium-68	1,000
Potassium-42	1,000	Gallium-70	1,000
Potassium-43	1,000	Gallium-72	100
Potassium-44	1,000	Gallium-73	1,000
Potassium-45	1,000	Germanium-66	1,000
Calcium-41	100	Germanium-67	1,000
Calcium-45	100	Germanium-68	10
Calcium-47	100	Germanium-69	1,000
Scandium-43	1,000	Germanium-71	1,000
Scandium-44m	100	Germanium-75	1,000
Scandium-44	100	Germanium-77	1,000
Scandium-46	10	Germanium-78	1,000
Scandium-47	100	Arsenic-69	1,000
Scandium-48	100	Arsenic-70	1,000
Scandium-49	1,000	Arsenic-71	100
Titanium-44	1	Arsenic-72	100
Titanium-45	1,000	Arsenic-73	100
Vanadium-47	1,000	Arsenic-74	100
Vanadium-48	100	Arsenic-76	100
Vanadium-49	1,000	Arsenic-77	100
Chromium-48	1,000	Arsenic-78	1,000
Chromium-49	1,000	Selenium-70	1,000
Chromium-51	1,000	Selenium-73m	1,000
Manganese-51	1,000	Selenium-73	100
Manganese-52m	1,000	Selenium-75	100
Manganese-52	100	Selenium-79	100
Manganese-53	1,000	Selenium-81m	1,000
Manganese-54	100	Selenium-81	1,000
Manganese-56	1,000	Selenium-83	1,000
Iron-52	100	Bromine-74m	1,000
Iron-55	100	Bromine-74	1,000
Iron-59	10	Bromine-75	1,000
Iron-60	1	Bromine-76	100
Cobalt-55	100	Bromine-77	1,000
Cobalt-56	10	Bromine-80m	1,000
Cobalt-57	100	Bromine-80	1,000
Cobalt-58m	1,000	Bromine-82	100
Cobalt-58	100	Bromine-83	1,000
Cobalt-60m	1,000	Bromine-84	1,000
Cobalt-60	1	Krypton-74	1,000
Cobalt-61	1,000	Krypton-76	1,000
Cobalt-62m	1,000	Krypton-77	1,000

*To convert μCi to kBq, multiply the μCi value by 37.

Radionuclide	Quantity (μCi)
Krypton-79	1,000
Krypton-81	1,000
Krypton-83m	1,000
Krypton-85m	1,000
Krypton-85	1,000
Krypton-87	1,000
Krypton-88	1,000
Rubidium-79	1,000
Rubidium-81m	1,000
Rubidium-81	1,000
Rubidium-82m	1,000
Rubidium-83	100
Rubidium-84	100
Rubidium-86	100
Rubidium-87	100
Rubidium-88	1,000
Rubidium-89	1,000
Strontium-80	100
Strontium-81	1,000
Strontium-83	100
Strontium-85m	1,000
Strontium-85	100
Strontium-87m	1,000
Strontium-89	10
Strontium-90	0.1
Strontium-91	100
Strontium-92	100
Yttrium-86m	1,000
Yttrium-86	100
Yttrium-87	100
Yttrium-88	10
Yttrium-90m	1,000
Yttrium-90	10
Yttrium-91m	1,000
Yttrium-91	10
Yttrium-92	100
Yttrium-93	100
Yttrium-94	1,000
Yttrium-95	1,000
Zirconium-86	100
Zirconium-88	10
Zirconium-89	100
Zirconium-93	1
Zirconium-95	10
Zirconium-97	100
Niobium-88	1,000
Niobium-89m (66 min)	1,000
Niobium-89 (122 min)	1,000
Niobium-90	100
Niobium-93m	10
Niobium-94	1
Niobium-95m	100
Niobium-95	100
Niobium-96	100
Niobium-97	1,000
Niobium-98	1,000
Molybdenum-90	100
Molybdenum-93m	100
Molybdenum-93	10
Molybdenum-99	100
Molybdenum-101	1,000

Radionuclide	Quantity (μCi)
Technetium-93m	1,000
Technetium-93	1,000
Technetium-94m	1,000
Technetium-94	1,000
Technetium-96m	1,000
Technetium-96	100
Technetium-97m	100
Technetium-97	1,000
Technetium-98	10
Technetium-99m	1,000
Technetium-99	100
Technetium-101	1,000
Technetium-104	1,000
Ruthenium-94	1,000
Ruthenium-97	1,000
Ruthenium-103	100
Ruthenium-105	1,000
Ruthenium-106	1
Rhodium-99m	1,000
Rhodium-99	100
Rhodium-100	100
Rhodium-101m	1,000
Rhodium-101	10
Rhodium-102m	10
Rhodium-102	10
Rhodium-103m	1,000
Rhodium-105	100
Rhodium-106m	1,000
Rhodium-107	1,000
Palladium-100	100
Palladium-101	1,000
Palladium-103	100
Palladium-107	10
Palladium-109	100
Silver-102	1,000
Silver-103	1,000
Silver-104m	1,000
Silver-104	1,000
Silver-105	100
Silver-106m	100
Silver-106	1,000
Silver-108m	1
Silver-110m	10
Silver-111	100
Silver-112	100
Silver-115	1,000
Cadmium-104	1,000
Cadmium-107	1,000
Cadmium-109	1
Cadmium-113m	0.1
Cadmium-113	100
Cadmium-115m	10
Cadmium-115	100
Cadmium-117m	1,000
Cadmium-117	1,000
Indium-109	1,000
Indium-110m (69.1m)	1,000
Indium-110 (4.9h)	1,000
Indium-111	100
Indium-112	1,000
Indium-113m	1,000

*To convert μCi to kBq, multiply the μCi value by 37.

Radionuclide	Quantity (μCi)
Indium-114m	10
Indium-115m	1,000
Indium-115	100
Indium-116m	1,000
Indium-117m	1,000
Indium-117	1,000
Indium-119m	1,000
Tin-110	100
Tin-111	1,000
Tin-113	100
Tin-117m	100
Tin-119m	100
Tin-121m	100
Tin-121	1,000
Tin-123m	1,000
Tin-123	10
Tin-125	10
Tin-126	10
Tin-127	1,000
Tin-128	1,000
Antimony-115	1,000
Antimony-116m	1,000
Antimony-116	1,000
Antimony-117	1,000
Antimony-118m	1,000
Antimony-119	1,000
Antimony-120 (16m)	1,000
Antimony-120 (5.76d)	100
Antimony-122	100
Antimony-124m	1,000
Antimony-124	10
Antimony-125	100
Antimony-126m	1,000
Antimony-126	100
Antimony-127	100
Antimony-128 (10.4m)	1,000
Antimony-128 (9.01h)	100
Antimony-129	100
Antimony-130	1,000
Antimony-131	1,000
Tellurium-116	1,000
Tellurium-121m	10
Tellurium-121	100
Tellurium-123m	10
Tellurium-123	100
Tellurium-125m	10
Tellurium-127m	10
Tellurium-127	1,000
Tellurium-129m	10
Tellurium-129	1,000
Tellurium-131m	10
Tellurium-131	100
Tellurium-132	10
Tellurium-133m	100
Tellurium-133	1,000
Tellurium-134	1,000
Iodine-120m	1,000
Iodine-120	100
Iodine-121	1,000
Iodine-123	100
Iodine-124	10
Iodine-125	1
Iodine-126	1
Iodine-128	1,000
Iodine-129	1
Iodine-130	10
Iodine-131	1
Iodine-132m	100
Iodine-132	100
Iodine-133	10
Iodine-134	1,000
Iodine-135	100
Xenon-120	1,000
Xenon-121	1,000
Xenon-122	1,000
Xenon-123	1,000
Xenon-125	1,000
Xenon-127	1,000
Xenon-129m	1,000
Xenon-131m	1,000
Xenon-133m	1,000
Xenon-133	1,000
Xenon-135m	1,000
Xenon-135	1,000
Xenon-138	1,000
Cesium-125	1,000
Cesium-127	1,000
Cesium-129	1,000
Cesium-130	1,000
Cesium-131	1,000
Cesium-132	100
Cesium-134m	1,000
Cesium-134	10
Cesium-135m	1,000
Cesium-135	100
Cesium-136	10
Cesium-137	10
Cesium-138	1,000
Barium-126	1,000
Barium-128	100
Barium-131m	1,000
Barium-131	100
Barium-133m	100
Barium-133	100
Barium-135m	100
Barium-139	1,000
Barium-140	100
Barium-141	1,000
Barium-142	1,000
Lanthanum-131	1,000
Lanthanum-132	100
Lanthanum-135	1,000
Lanthanum-137	10
Lanthanum-138	100
Lanthanum-140	100
Lanthanum-141	100
Lanthanum-142	1,000
Lanthanum-143	1,000
Cerium-134	100
Cerium-135	100
Cerium-137m	100
Cerium-137	1,000

*To convert μCi to kBq, multiply the μCi value by 37.

Radionuclide	Quantity (μCi)
Cerium-139	100
Cerium-141	100
Cerium-143	100
Cerium-144	1
Praseodymium-136	1,000
Praseodymium-137	1,000
Praseodymium-138m	1,000
Praseodymium-139	1,000
Praseodymium-142m	1,000
Praseodymium-142	100
Praseodymium-143	100
Praseodymium-144	1,000
Praseodymium-145	100
Praseodymium-147	1,000
Neodymium-136	1,000
Neodymium-138	100
Neodymium-139m	1,000
Neodymium-139	1,000
Neodymium-141	1,000
Neodymium-147	100
Neodymium-149	1,000
Neodymium-151	1,000
Promethium-141	1,000
Promethium-143	100
Promethium-144	10
Promethium-145	10
Promethium-146	1
Promethium-147	10
Promethium-148m	10
Promethium-148	10
Promethium-149	100
Promethium-150	1,000
Promethium-151	100
Samarium-141m	1,000
Samarium-141	1,000
Samarium-142	1,000
Samarium-145	100
Samarium-146	1
Samarium-147	100
Samarium-151	10
Samarium-153	100
Samarium-155	1,000
Samarium-156	1,000
Europium-145	100
Europium-146	100
Europium-147	100
Europium-148	10
Europium-149	100
Europium-150 (12.62h)	100
Europium-150 (34.2y)	1
Europium-152m	100
Europium-152	1
Europium-154	1
Europium-155	10
Europium-156	100
Europium-157	100
Europium-158	1,000
Gadolinium-145	1,000
Gadolinium-146	10
Gadolinium-147	100
Gadolinium-148	0.001
Gadolinium-149	100
Gadolinium-151	10
Gadolinium-152	100
Gadolinium-153	10
Gadolinium-159	100
Terbium-147	1,000
Terbium-149	100
Terbium-150	1,000
Terbium-151	100
Terbium-153	1,000
Terbium-154	100
Terbium-155	1,000
Terbium-156m (5.0h)	1,000
Terbium-156m (24.4h)	1,000
Terbium-156	100
Terbium-157	10
Terbium-158	1
Terbium-160	10
Terbium-161	100
Dysprosium-155	1,000
Dysprosium-157	1,000
Dysprosium-159	100
Dysprosium-165	1,000
Dysprosium-166	100
Holmium-155	1,000
Holmium-157	1,000
Holmium-159	1,000
Holmium-161	1,000
Holmium-162m	1,000
Holmium-162	1,000
Holmium-164m	1,000
Holmium-164	1,000
Holmium-166m	1
Holmium-166	100
Holmium-167	1,000
Erbium-161	1,000
Erbium-165	1,000
Erbium-169	100
Erbium-171	100
Erbium-172	100
Thulium-162	1,000
Thulium-166	100
Thulium-167	100
Thulium-170	10
Thulium-171	10
Thulium-172	100
Thulium-173	100
Thulium-175	1,000
Ytterbium-162	1,000
Ytterbium-166	100
Ytterbium-167	1,000
Ytterbium-169	100
Ytterbium-175	100
Ytterbium-177	1,000
Ytterbium-178	1,000
Lutetium-169	100
Lutetium-170	100
Lutetium-171	100
Lutetium-172	100
Lutetium-173	10
Lutetium-174m	10

*To convert μCi to kBq, multiply the μCi value by 37.

Radionuclide	Quantity (μCi)
Lutetium-174	10
Lutetium-176m	1,000
Lutetium-176	100
Lutetium-177m	10
Lutetium-177	100
Lutetium-178m	1,000
Lutetium-178	1,000
Lutetium-179	1,000
Hafnium-170	100
Hafnium-172	1
Hafnium-173	1,000
Hafnium-175	100
Hafnium-177m	1,000
Hafnium-178m	0.1
Hafnium-179m	10
Hafnium-180m	1,000
Hafnium-181	10
Hafnium-182m	1,000
Hafnium-182	0.1
Hafnium-183	1,000
Hafnium-184	100
Tantalum-172	1,000
Tantalum-173	1,000
Tantalum-174	1,000
Tantalum-175	1,000
Tantalum-176	100
Tantalum-177	1,000
Tantalum-178	1,000
Tantalum-179	100
Tantalum-180m	1,000
Tantalum-180	100
Tantalum-182m	1,000
Tantalum-182	10
Tantalum-183	100
Tantalum-184	100
Tantalum-185	1,000
Tantalum-186	1,000
Tungsten-176	1,000
Tungsten-177	1,000
Tungsten-178	1,000
Tungsten-179	1,000
Tungsten-181	1,000
Tungsten-185	100
Tungsten-187	100
Tungsten-188	10
Rhenium-177	1,000
Rhenium-178	1,000
Rhenium-181	1,000
Rhenium-182 (12.7h)	1,000
Rhenium-182 (64.0h)	100
Rhenium-184m	10
Rhenium-184	100
Rhenium-186m	10
Rhenium-186	100
Rhenium-187	1,000
Rhenium-188m	1,000
Rhenium-188	100
Rhenium-189	100
Osmium-180	1,000
Osmium-181	1,000
Osmium-182	100
Osmium-185	100
Osmium-189m	1,000
Osmium-191m	1,000
Osmium-191	100
Osmium-193	100
Osmium-194	1
Iridium-182	1,000
Iridium-184	1,000
Iridium-185	1,000
Iridium-186	100
Iridium-187	1,000
Iridium-188	100
Iridium-189	100
Iridium-190m	1,000
Iridium-190	100
Iridium-192m (1.4m)	10
Iridium-192 (73.8d)	1
Iridium-194m	10
Iridium-194	100
Iridium-195m	1,000
Iridium-195	1,000
Platinum-186	1,000
Platinum-188	100
Platinum-189	1,000
Platinum-191	100
Platinum-193m	100
Platinum-193	1,000
Platinum-195m	100
Platinum-197m	1,000
Platinum-197	100
Platinum-199	1,000
Platinum-200	100
Gold-193	1,000
Gold-194	100
Gold-195	10
Gold-198m	100
Gold-198	100
Gold-199	100
Gold-200m	100
Gold-200	1,000
Gold-201	1,000
Mercury-193m	100
Mercury-193	1,000
Mercury-194	1
Mercury-195m	100
Mercury-195	1,000
Mercury-197m	100
Mercury-197	1,000
Mercury-199m	1,000
Mercury-203	100
Thallium-194m	1,000
Thallium-194	1,000
Thallium-195	1,000
Thallium-197	1,000
Thallium-198m	1,000
Thallium-198	1,000
Thallium-199	1,000
Thallium-201	1,000
Thallium-200	1,000
Thallium-202	100
Thallium-204	100

*To convert μCi to kBq, multiply the μCi value by 37.

Radionuclide	Quantity (μCi)
Lead-195m	1,000
Lead-198	1,000
Lead-199	1,000
Lead-200	100
Lead-201	1,000
Lead-202m	1,000
Lead-202	10
Lead-203	1,000
Lead-205	100
Lead-209	1,000
Lead-210	0.01
Lead-211	100
Lead-212	1
Lead-214	100
Bismuth-200	1,000
Bismuth-201	1,000
Bismuth-202	1,000
Bismuth-203	100
Bismuth-205	100
Bismuth-206	100
Bismuth-207	10
Bismuth-210m	0.1
Bismuth-210	1
Bismuth-212	10
Bismuth-213	10
Bismuth-214	100
Polonium-203	1,000
Polonium-205	1,000
Polonium-207	1,000
Polonium-210	0.1
Astatine-207	100
Astatine-211	10
Radon-220	1
Radon-222	1
Francium-222	100
Francium-223	100
Radium-223	0.1
Radium-224	0.1
Radium-225	0.1
Radium-226	0.1
Radium-227	1,000
Radium-228	0.1
Actinium-224	1
Actinium-225	0.01
Actinium-226	0.1
Actinium-227	0.001
Actinium-228	1
Thorium-226	10
Thorium-227	0.01
Thorium-228	0.001
Thorium-229	0.001
Thorium-230	0.001
Thorium-231	100
Thorium-232	100
Thorium-234	10
Thorium-natural	100
Protactinium-227	10
Protactinium-228	1
Protactinium-230	0.1
Protactinium-231	0.001
Protactinium-232	1
Protactinium-233	100
Protactinium-234	100

Radionuclide	Quantity (μCi)
Uranium-230	0.01
Uranium-231	100
Uranium-232	0.001
Uranium-233	0.001
Uranium-234	0.001
Uranium-235	0.001
Uranium-236	0.001
Uranium-237	100
Uranium-238	100
Uranium-239	1,000
Uranium-240	100
Uranium-natural	100
Neptunium-232	100
Neptunium-233	1,000
Neptunium-234	100
Neptunium-235	100
Neptunium-236 (1.15E + 5)	0.001
Neptunium-236 (22.5h)	1
Neptunium-237	0.001
Neptunium-238	10
Neptunium-239	100
Neptunium-240	1,000
Plutonium-234	10
Plutonium-235	1,000
Plutonium-236	0.001
Plutonium-237	100
Plutonium-238	0.001
Plutonium-239	0.001
Plutonium-240	0.001
Plutonium-241	0.01
Plutonium-242	0.001
Plutonium-243	1,000
Plutonium-244	0.001
Plutonium-245	100
Americium-237	1,000
Americium-238	100
Americium-239	1,000
Americium-240	100
Americium-241	0.001
Americium-242m	0.001
Americium-242	10
Americium-243	0.001
Americium-244m	100
Americium-244	10
Americium-245	1,000
Americium-246m	1,000
Americium-246	1,000
Curium-238	100
Curium-240	0.1
Curium-241	1
Curium-242	0.01
Curium-243	0.001
Curium-244	0.001
Curium-245	0.001
Curium-246	0.001
Curium-247	0.001
Curium-248	0.001
Curium-249	1,000
Berkelium-245	100
Berkelium-246	100
Berkelium-247	0.001

*To convert μCi to kBq, multiply the μCi value by 37.

Radionuclide	Quantity (μCi)
Berkelium-249	0.1
Berkelium-250	10
Californium-244	100
Californium-246	1
Californium-248	0.01
Californium-249	0.001
Californium-250	0.001
Californium-251	0.001
Californium-252	0.001
Californium-253	0.1
Californium-254	0.001
Einsteinium-250	100
Einsteinium-251	100
Einsteinium-253	0.1
Einsteinium-254m	1
Einsteinium-254	0.01
Fermium-252	1
Fermium-253	1
Fermium-254	10
Fermium-255	1
Fermium-257	0.01
Mendelevium-257	10
Mendelevium-258	0.01
Any alpha-emitting radionuclide not listed above or mixtures of alpha emitters of unknown composition	0.001
Any radionuclide other than alpha-emitting radionuclides not listed above, or mixtures of beta emitters of unknown composition	0.01

* To convert μCi to kBq, multiply the μCi value by 37.

NOTE: For purposes of R12-1-428(E), R12-1-432(A), and R12-1-443(A) where there is involved a combination of radionuclides in known amounts, the limit for the combination shall be derived as follows: determine, for each radionuclide in the combination, the ratio between the quantity present in the combination and the limit otherwise established for the specific radionuclide when not in combination. The sum of such ratios for all radionuclides in the combination may not exceed "1" -- that is, unity.

[1] The quantities listed above were derived by taking 1/10 of the most restrictive ALI listed in Table I, Columns 1and 2, of Appendix B to Article 4, rounding to the nearest factor of 10, and constraining the values listed between 37 Bq and 37 MBq (0.001 and 1,000 μCi). Values of 3.7 MBq (100 μCi) have been assigned for radionuclides having a radioactive half-life in excess of E+9 years, except rhenium, 37 MBq (1,000 μCi), to take into account their low specific activity.

Historical Note

Adopted effective August 10, 1994 (Supp. 94-3).

APPENDIX D. CLASSIFICATION AND CHARACTERISTICS OF LOW-LEVEL RADIOACTIVE WASTE

I. Classification of Radioactive Waste for Land Disposal

a) Considerations. Determination of the classification of radioactive waste involves two considerations. First, consideration must be given to the concentration of long-lived radionuclides (and their shorter-lived precursors) whose potential hazard will persist long after such precautions as institutional controls, improved waste form, and deeper disposal have ceased to be effective. These precautions delay the time when long-lived radio nuclides could cause exposures. In addition, the magnitude of the potential dose is limited by the concentration and availability of the radionuclide at the time of exposure. Second, consideration must be given to the concentration of shorter-lived radionuclides for which requirements on institutional controls, waste form, and disposal methods are effective.

b) Classes of waste.

1) Class A waste is waste that is usually segregated from other waste classes at the disposal site. The physical form and characteristics of Class A waste must meet the minimum requirements set forth in Section II(a). If Class A waste also meets the stability requirements set forth in Section II(b), it is not necessary to segregate the waste for disposal.

2) Class B waste is waste that must meet more rigorous requirements on waste form to ensure stability after disposal. The physical form and characteristics of Class B waste must meet both the minimum and stability requirements set forth in Section II.

3) Class C waste is waste that not only must meet more rigorous requirements on waste form to ensure stability but also requires additional measures at the disposal facility to protect against inadvertent intrusion. The physical form and characteristics of Class C waste must meet both the minimum and stability requirements set forth in Section II.

c) Classification determined by long-lived radionuclides. If the radioactive waste contains only radionuclides listed in Table I, classification shall be determined as follows:

1) If the concentration does not exceed 0.1 times the value in Table I, the waste is Class A.

2) If the concentration exceeds 0.1 times the value in Table I but does not exceed the value in Table I, the waste is Class C.

3) If the concentration exceeds the value in Table I, the waste is not generally acceptable for land disposal.

4) For wastes containing mixtures of radionuclides listed in Table I, the total concentration shall be determined by the sum of fractions rule described in Section I(g).

TABLE I
Concentration

Radionuclide	curie/cubic meter[a]	nanocuries/gram[b]
C-14	8	
C-14 in activated metal	80	
Ni-59 in activated metal	220	
Nb-94 in activated metal	0.2	
Tc-99	3	
I-129	0.08	
Alpha-emitting transuranic radionuclides with half-life greater than five years	100	
Pu-241		3,500
Cm-242		20,000
Ra-226		100

[a]To convert the Ci/m^3 values to gigabecquerel (GBq) per cubic meter, multiply the Ci/m^3 value by 37.

[b]To convert the nCi/g values to becquerel (Bq) per gram, multiply the nCi/g value by 37.

d) Classification determined by short-lived radionuclides. If the waste does not contain any of the radionuclides listed in Table I, classification shall be determined based on the concentrations shown in Table II. However, as specified in Section I(f), if radioactive waste does not contain any nuclides listed in either Table I or II, it is Class A.
   1) If the concentration does not exceed the value in Column 1, the waste is Class A.
   2) If the concentration exceeds the value in Column 1 but does not exceed the value in Column 2, the waste is Class B.
   3) If the concentration exceeds the value in Column 2 but does not exceed the value in Column 3, the waste is Class C.
   4) If the concentration exceeds the value in Column 3, the waste is not generally acceptable for near-surface disposal.
   5) For wastes containing mixtures of the radionuclides listed in Table II, the total concentration shall be determined by the sum of fractions rule described in Section I(g).

TABLE II

Radionuclide	Concentration, curie/cubic meter*		
	Column 1	Column 2	Column 3
Total of all radionuclides with less than 5-year half-life	700	*	*
H-3	40	*	*
Co-60	700	*	*
Ni-63	3.5	70	700
Ni-63 in activated metal	35	700	7000
Sr-90	0.04	150	7000
Cs-137	1	44	4600

*AGENCY NOTE: To convert the Ci/m^3 value to gigabecquerel (GBq) per cubic meter, multiply the Ci/m^3 value by 37. There are no limits established for these radionuclides in Class B or C wastes. Practical considerations such as the effects of external radiation and internal heat generation on transportation, handling, and disposal will limit the concentrations for these wastes. These wastes shall be Class B unless the concentrations of other radionuclides in Table II determine the waste to be Class C independent of these radionuclides.

e) Classification determined by both long- and short-lived radionuclides. If the radioactive waste contains a mixture of radionuclides, some of which are listed in Table I and some of which are listed in Table II, classification shall be determined as follows:
   1) If the concentration of a radionuclide listed in Table I is less than 0.1 times the value listed in Table I, the class shall be that determined by the concentration of radionuclides listed in Table II.
   2) If the concentration of a radionuclide listed in Table I exceeds 0.1 times the value listed in Table I, but does not exceed the value in Table II, the waste shall be Class C, provided the concentration of radionuclides listed in Table II does not exceed the value shown in Column 3 of Table II.

f) Classification of wastes with radionuclides other than those listed in Tables I and II. If the waste does not contain any radionuclides listed in either Table I or II, it is Class A.

g) The sum of the fractions rule for mixtures of radionuclides. For determining classification for waste that contains a mixture of radionuclides, it is necessary to determine the sum of fractions by dividing each radionuclide's concentration by the appropriate limit and adding the resulting values. The appropriate limits shall all be taken from the same column of the same table. The sum of the fractions for the column shall be less than 1.0 if the waste class is to be determined by that column. Example: A waste contains Sr-90 in a concentration of 1.85 TBq/m^3 (50 Ci/m^3) and Cs-137 in a concentration of 814 GBq/

m^3 (22 Ci/m^3). Since the concentrations both exceed the values in Column 1, Table II, they shall be compared to Column 2 values. For Sr-90 fraction, 50/150 = 0.33, for Cs-137 fraction, 22/44 = 0.5; the sum of the fractions = 0.83. Since the sum is less than 1.0, the waste is Class B.

h) Determination of concentrations in wastes. The concentration of a radionuclide may be determined by indirect methods such as use of scaling factors which relate the inferred concentration of one radionuclide to another that is measured, or radionuclide material accountability, if there is reasonable assurance that the indirect methods can be correlated with actual measurements. The concentration of a radionuclide may be averaged over the volume of the waste, or weight of the waste if the units are expressed as becquerel (nanocurie) per gram.

II. Radioactive Waste Characteristics

a) The following are minimum requirements for all classes of waste and are intended to facilitate handling and provide protection of health and safety of personnel at the disposal site.

1) Wastes shall be packaged in conformance with the conditions of the license issued to the site operator to which the waste will be shipped. Where the conditions of the site license are more restrictive than the provisions of Article 4, the site license conditions shall govern.

2) Wastes shall not be packaged for disposal in cardboard or fiberboard boxes.

3) Liquid waste shall be packaged in sufficient absorbent material to absorb twice the volume of the liquid.

4) Solid waste containing liquid shall contain as little free-standing and non-corrosive liquid as is reasonably achievable, but in no case shall the liquid exceed 1% of the volume.

5) Waste shall not be readily capable of detonation or of explosive decomposition or reaction at normal pressures and temperatures, or of explosive reaction with water.

6) Waste shall not contain, or be capable of generating, quantities of toxic oases, vapors, or fumes harmful to persons transporting, handling, or disposing of the waste. This does not apply to radioactive gaseous waste packaged in accordance with Section II(a)(8).

7) Waste shall not be pyrophoric. Pyrophoric materials contained in wastes shall be treated, prepared, and packaged to be nonflammable *****

8) Wastes in a gaseous form shall be packaged at an absolute pressure that does not exceed 1.5 atmospheres at 20° C. Total activity shall not exceed 3.7 TBq (100 Ci) per container.

9) Wastes containing hazardous, biological, pathogenic, or infectious material shall be treated to reduce to the maximum extent practicable the potential hazard from the non-radiological materials.

b) The following requirements are intended to provide stability of the waste. Stability is intended to ensure that the waste does not degrade and affect overall stability of the site through slumping, collapse, or other failure of the disposal unit and thereby lead to water infiltration. Stability is also a factor in limiting exposure to an inadvertent intruder, since it provides a recognizable and nondispersible waste.

1) Waste shall have structural stability. A structurally stable waste form will generally maintain its physical dimensions and its form, under the expected disposal conditions such as weight of overburden and compaction equipment, the presence of moisture, and microbial activity, and internal factors such as radiation effects and chemical changes. Structural stability can be provided by the waste form itself, processing the waste to a stable form, or placing the waste in a disposal container or structure that provides stability after disposal.

2) Notwithstanding the provisions in Section II(a)(3) and (4), liquid wastes, or wastes containing liquid, shall be converted into a form that contains as little free-standing and noncorrosive liquid as is reasonably achievable, but in no case shall the liquid exceed 1% of the volume of the waste when the waste is in a disposal container designed to ensure stability, or 0.5% of the volume of the waste for waste processed to a stable form.

3) Void spaces within the waste and between the waste and its package shall be reduced to the extent practicable.

III. Labeling

Each package of waste shall be clearly labeled to identify whether it is Class A, Class B, or Class C waste, in accordance with Section I.

*****See (A)(4) of these regulations for definition of pyrophoric.

Historical Note

Adopted effective August 10, 1994 (Supp. 94-3).

APPENDIX E. QUANTITIES FOR USE WITH DECOMMISSIONING

Material	Microcurie	Material	Microcurie
Americium-241	0.01	Iodine-134	10
Antimony-122	100	Iodine-135	10
Antimony-124	10	Iridium-192	10
Antimony-125	10	Iridium-194	100
Arsenic-73	100	Iron-55	100
Arsenic-74	10	Iron-59	10
Arsenic-76	10	Krypton-85	100
Arsenic-77	100	Krypton-87	10
Barium-131	10	Lanthanum-140	10
Barium-133	10	Lutetium-177	100
Barium-140	10	Manganese-52	10
Bismuth-210	1	Manganese-54	10
Bromine-82	10	Manganese-56	10
Cadmium-109	10	Mercury-197m	100
Cadmium-115m	10	Mercury-197	100
Cadmium-115	100	Mercury-203	10
Calcium-45	10	Molybdenum-99	100
Calcium-47	10	Neodymium-147	100
Carbon-14	100	Neodymium-149	100
Cerium-141	100	Nickel-59	100
Cerium-143	100	Nickel-63	10
Cerium-144	1	Nickel-65	100
Cesium-131	1,000	Niobium-93m	10
Cesium-134m	100	Niobium-95	10
Cesium-134	1	Niobium-97	10
Cesium-135	10	Osmium-185	10
Cesium-136	10	Osmium-191m	100
Cesium-137	10	Osmium-191	100
Chlorine-36	10	Osmium-193	100
Chlorine-38	10	Palladium-103	100
Chromium-51	1,000	Palladium-109	100
Cobalt-58m	10	Phosphorus-32	10
Cobalt-58	10	Platinum-191	100
Cobalt-60	1	Platinum-193m	100
Copper-64	100	Platinum-193	100
Dysprosium-165	10	Platinum-197m	100
Dysprosium-166	100	Platinum-197	100
Erbium-169	100	Plutonium-239	0.01
Erbium-171	100	Polonium-210	0.1
Europium-152 (9.2 h)	100	Potassium-42	10
Europium-152 (13 yr)	1	Praseodymium-142	100
Europium-154	1	Praseodymium-143	100
Europium-155	10	Promethium-147	10
Fluorine-18	1,000	Promethium-149	10
Gadolinium-153	10	Radium-226	0.01
Gadolinium-159	100	Rhenium-186	100
Gallium-72	10	Rhenium-188	100
Germanium-71	100	Rhodium-103m	100
Gold-198	100	Rhodium-105	100
Gold-199	100	Rubidium-86	10
Hafnium-181	10	Rubidium-87	10
Holmium-166	100	Ruthenium-97	100
Hydrogen-3	1,000	Ruthenium-103	10
Indium-113m	100	Ruthenium-105	10
Indium-114m	10	Ruthenium-106	1
Indium-115m	100	Samarium-151	10
Indium-115	10	Samarium-153	100
Iodine-125	1	Scandium-46	10
Iodine-126	1	Scandium-47	100
Iodine-129	0.1	Scandium-48	10
Iodine-131	1	Selenium-75	10
Iodine-132	10	Silicon-31	100
Iodine-133	1	Silver-105	10

* To convert μCi to kBq, multiply the μCi value by 37.

Material	Microcurie
Silver-110m	1
Silver-111	100
Sodium-22	1
Sodium-24	10
Strontium-85	10
Strontium-89	1
Strontium-90	0.1
Strontium-91	10
Strontium-92	10
Sulfur-35	100
Tantalum-182	10
Technetium-96	10
Technetium-97m	100
Technetium-97	100
Technetium-99m	100
Technetium-99	10
Tellurium-125m	10
Tellurium-127m	10
Tellurium-127	100
Tellurium-129m	10
Tellurium-129	100
Tellurium-131m	10
Tellurium-132	10
Terbium-160	10
Thallium-200	100
Thallium-201	100
Thallium-202	100
Thallium-204	10
Thorium (natural)**	100
Thulium-170	10
Thulium-171	10
Tin-113	10
Tin-125	10
Tungsten-181	10
Tungsten-185	10
Tungsten-187	100
Uranium (natural)**	100
Uranium-233	0.01
Uranium-234	0.01
Uranium-235	0.01
Vanadium-48	10
Xenon-131m	1,000
Xenon-133	100
Xenon-135	100
Ytterbium-175	100
Yttrium-90	10
Yttrium-91	10
Yttrium-92	100
Yttrium-93	100
Zinc-65	10
Zinc-69m	100
Zinc-69	1,000
Zirconium-93	10
Zirconium-95	10
Zirconium-97	10
Any alpha emitting radionuclide not listed above or mixtures of alpha emitters of unknown composition	0.01
Any radionuclide other than alpha emitting radionuclides, not listed above or mixtures of beta emitters of unknown composition	0.1

*To convert μCi to kBq, multiply the μCi value by 37.
** Based on alpha disintegration rate of Th-232, Th-230 and their daughter products.
*** Based on alpha disintegration rate of U-238, U-234, and U-235.

NOTE: Where there is involved a combination of isotopes in known amounts, the limit for the combination should be derived as follows: Determine, for each isotope in the combination, the ratio between the quantity present in the combination and the limit otherwise established for the specific isotope when not in combination. The sum of such ratios for all the isotopes in the combination may not exceed “1” - that is, unity.

Historical Note

Adopted effective August 10, 1994 (Supp. 94-3).

ARRA-6. Repealed

Historical Note

Adopted effective February 25, 1985 (Supp. 85-1). Form repealed, new form adopted in Article 10 effective August 10, 1994 (Supp. 94-3).

ARRA-7. Repealed

Historical Note

Adopted effective February 25, 1985 (Supp. 85-1). Repealed effective August 10, 1994 (Supp. 94-3).

ARRA-8. Repealed

Historical Note

Adopted effective February 25, 1985 (Supp. 85-1). Repealed effective August 10, 1994 (Supp. 94-3).

R12-1-451. Termination of a Radioactive Material License or a Licensed Activity

A. As the final step before terminating a radioactive material use program licensed under R12-1-312, the licensee shall:
1. Certify to the Agency the disposition of all licensed material, including accumulated wastes, by submitting a complete description of a disposal plan with signed receipts from all licensed persons receiving the licensed material; and
2. Conduct a radiation survey of the premises where the licensed activities were carried out to demonstrate that the premises are suitable for release in accordance with the criteria for decommissioning in R12-1-452 and submit to the Agency a report of the results of this survey, unless the licensee demonstrates in some other manner acceptable to the Agency that the premises are suitable for release in accordance with the criteria for decommissioning in R12-1-452.

B. Before terminating a licensed program, each licensee authorized to possess radioactive material with a half-life greater than 120 days, in any unsealed form, shall forward the following records to the Agency:
1. Records of disposal of the licensed material required by R12-1-435, R12-1-436, R12-1-437, and R12-1-438; and
2. Records required by R12-1-418(D)(2)(d).

C. If a licensed activity is transferred or assigned in accordance with subsection (E), each licensee authorized to possess radioactive material with a half-life greater than 120 days, in any unsealed form, shall transfer the following records to the new licensee and the new licensee shall maintain these records until the license is terminated:
1. Records of disposal of licensed material required by R12-1-435, R12-1-436, R12-1-437, and R12-1-438; and
2. Records required by R12-1-418(D)(2)(d).

D. Before the Agency terminates a license, each licensee shall forward the records required by subsection (E) to the Agency.

E. A person licensed under R12-1-312 shall maintain required records regarding decommissioning of a facility in a location identified on the license until the Agency releases the site for unrestricted use. Before transfer or assignment of licensed activities, a licensee shall transfer all records required by this Section to the transferee. If records relating to facility decommissioning are kept for other purposes, the transferee shall refer to these records and provide their location on the transferee's application for a license. The transferee shall maintain the records until the Agency terminates the transferee's new license. The new licensee shall maintain the following decommissioning records for Agency review:
1. Records of spills or other occurrences involving the spread of contamination in and around the facility, equipment, or site. The licensee shall maintain a record of any instance when contamination remains after cleanup procedures or there is a reasonable likelihood that a contaminant has spread to an inaccessible area, as in the case of possible seepage into porous material such as concrete. These records shall include any known information that identifies any radionuclide involved and its quantity, form, and concentration.
2. As-built drawings showing modifications of structures and equipment in restricted areas where radioactive materials are used or stored, and locations of possible inaccessible contamination, such as buried pipes. If as-built drawings are referenced, the licensee need not index each relevant document individually. If drawings are not available, the licensee shall provide records with known information concerning these areas and locations, as prescribed in subsection (E)(1).
3. Except for areas that contain depleted uranium used only for shielding or as penetrators in unused munitions, a list, contained in a single document and updated every two years, of the following:
   a. Any area designated or formerly designated as a restricted area as defined under R12-1-102;
   b. Any area outside of a restricted area for which documentation is required under subsection (B)(1);
   c. Any area outside of a restricted area where wastes have been buried;
   d. Any area outside of a restricted area that contains regulated radioactive material that will require the licensee to either decontaminate the area for decommissioning under R12-1-452 or obtain disposal approval under R12-1-435; and
   e. Any restricted area where wastes have been buried.
4. Records of the cost estimate performed for the decommissioning funding plan or the amount certified by the Agency for decommissioning and the method for assuring funding, if either a funding plan or certification is used.

Historical Note
New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-452. Radiological Criteria for License Termination

A. General provisions and scope:
1. The criteria in this Section apply to the decommissioning of facilities licensed under Article 3 of this Chapter. The criteria do not apply to uranium and thorium recovery facilities already subject to 10 CFR 40, Appendix A, or to uranium solution extraction facilities.
2. The criteria in this Section do not apply to sites that:
   a. Have been decommissioned before the effective date of this Section; or
   b. Have previously submitted and received Agency approval of a license termination plan (LTP) or decommissioning plan.
3. If a site has been decommissioned and the license terminated in accordance with the criteria in this Section, the Agency shall not require additional cleanup unless, based on new information, the Agency determines that the criteria of this Section were not met and residual radioactivity at the site is a threat to public health and safety.
4. When calculating the TEDE for the average member of the critical group, a licensee shall use the peak annual dose expected within the first 1000 years after decommissioning.

B. Radiological criteria for unrestricted use. The Agency considers a site acceptable for unrestricted use if the licensee reduces residual radioactivity, distinguishable from background radiation, to a TEDE for an average member of the critical group that does not exceed 0.15 mSv (15 mrem) per year, including radiation from groundwater sources of drinking water, and the residual radioactivity is as low as reasonably achievable (ALARA). To determine the level that is ALARA, the Agency and the licensee shall take into account any detriment, such as deaths from transportation accidents, that is likely to result from decontamination and waste disposal.

C. Criteria for license termination under restrictive conditions. The Agency considers a site acceptable for license termination if the licensee meets all of the following restrictive conditions:
1. The licensee demonstrates that a reduction in residual radioactivity, necessary to comply with subsection (B), will result in net public or environmental harm or is not being made because the residual level of radioactivity is ALARA. To determine the level that is ALARA, the Agency and the licensee shall take into account any detriment, such as deaths from transportation accidents, that is likely to result from decontamination and waste disposal;
2. The licensee establishes one or more legally enforceable institutional controls that reduce residual radioactivity, distinguishable from background radiation, to a TEDE for the average member of the critical group that does not exceed (0.15 mSv) 15 mrem per year, including radiation from groundwater sources of drinking water;
3. The licensee demonstrates financial assurance that complies with R12-1-323(C), which enables an independent third party, including a governmental custodian of the site, to assume and carry out responsibilities for control and maintenance of the site;

4. The licensee submits a decommissioning plan or License Termination Plan (LTP) to the Agency, indicating the licensee's intent to decommission in accordance with R12-1-323 and specifying that the licensee intends to decommission by restricting use of the site. The licensee shall document in the LTP or decommissioning plan how comments from individuals and institutions in the community, who may be affected by the decommissioning, have been sought and addressed after analysis.
   a. If a licensee is restricting use of the site, the licensee shall seek comments from the public concerning the proposed decommissioning, regarding all of the following matters:
      i. Whether the institutional controls proposed by the licensee will reduce residual radioactivity, distinguishable from background radiation, to a TEDE for the average member of the critical group that does not exceed 0.15 mSv (15 mrem) per year; are enforceable; and do not impose an unreasonable burden on the local community or other affected parties; and
      ii. Whether the licensee has provided financial assurance that complies with R12-1-323(C), which enables an independent third party, including a governmental custodian of the site, to assume and carry out responsibilities for control and maintenance of the site;
   b. In seeking comments on the issues identified in subsection (C)(4)(a), the licensee shall provide for:
      i. Participation by representatives of a broad cross section of community interests that may be affected by the decommissioning;
      ii. An opportunity for a comprehensive discussion of the issues by all of the community representatives; and
      iii. A publicly available document that contains or access to each oral and written comment that reflects the viewpoints of community representatives on each issue and the extent of agreement or disagreement among representatives on each issue; and
5. The licensee reduces residual radioactivity, distinguishable from background radiation, at the site so that if the institutional controls are no longer in effect, the TEDE for the average member of the critical group is as low as reasonably achievable and does not exceed 1 mSv (100 mrem) per year; unless the licensee:
   a. Demonstrates that a further reduction in residual radioactivity necessary to comply with subsection (C)(5) is not technically achievable or economically feasible, or will result in net public or environmental harm;
   b. Provides for durable institutional controls; and
   c. Provides financial assurance that complies with R12-1-323(C), which enables an independent third party, including a governmental custodian of the site, to carry out periodic rechecks of the site, no less frequently than every five years; assures that each institutional control remains in place according to subsection (C)(3); and assumes and carries out responsibilities for maintenance of the institutional control.

D. Alternate criteria for license termination:
1. Based on circumstances that relate to a specific license, the Agency may terminate the license using the following alternate criteria for subsections (B) or (C)(2), if the licensee demonstrates that the TEDE from residual radioactivity, distinguishable from background radiation, for an average member of the critical group does not exceed 0.15 mSv (15 mrem) per year, and if the licensee:
   a. Ensures that public health and safety is protected by submitting an analysis of possible sources of exposure, prepared by a independent qualified expert, which indicates whether it is likely that the dose from all human-made sources combined, other than medical sources, is more than the 1 mSv/y (100 mrem/y) limit in R12-1-416;
   b. Employs to the extent practicable, restrictions on site use, according to the provisions of subsection (C) to minimize exposures at the site;
   c. Reduces doses to ALARA levels, taking into consideration any detriment, such as deaths from transportation accidents, that is likely to result from decontamination and waste disposal; and
   d. Submits a decommissioning plan or License Termination Plan (LTP) to the Agency that indicates the licensee's intent to decommission in accordance with R12-1-323, and specifies that the licensee proposes to decommission by use of alternate criteria. The licensee shall document in the decommissioning plan or LTP how comments from individuals and institutions in the community, who may be affected by the decommissioning, have been sought and addressed after analysis. In seeking comments, the licensee shall provide for:
      i. Participation by representatives of a broad cross section of community interests that may be affected by the decommissioning;
      ii. An opportunity for a comprehensive discussion of the issues by all of the community representatives; and
      iii. A publicly available document that contains or access to each oral and written comment that reflects viewpoints of community representatives on each issue and the extent of agreement and disagreement among the representatives on each issue.
2. The use of alternate criteria to terminate a license requires approval by the Agency after consideration of any comments provided by the U.S. Environmental Protection Agency and any public comments submitted under subsection (E).

E. Public notification and public participation:
1. Upon the receipt of an LTP or decommissioning plan from a licensee, or a proposal by a licensee for release of a site under subsection (C) or (D), or whenever the Agency determines that notice will serve the public interest, the Agency shall notify and solicit comments from:
   a. Local and state governments in the vicinity of the site and any Indian Nation or other indigenous people that have treaty or statutory rights that could be affected by the decommissioning; and
   b. The U.S. Environmental Protection Agency.
2. To comply with subsection(E)(1) the Agency shall publish a notice in a local newspaper, send letters to state or local organizations on its mailing list, hold a public hearing that is readily accessible to individuals in the vicinity of the site, and solicit comments from the public.

F. Minimization of contamination. After the effective date of this Section, an applicant for a license, other than a renewal, shall describe in the application how facility design and procedures for operation will facilitate eventual decommissioning and

minimize, to the extent practicable, the generation of radioactive waste and contamination of the facility and the environment.

G. The Agency considers a site acceptable for unrestricted use if the residual radioactivity, distinguishable from background radiation, is equal to or less than the values in Table 1.

Table 1. Acceptable Surface Contamination1 Levels

Radionuclide[1]	Average[2,3]	Maximum[2,4]	Removable[2,5]
U-nat, U-235, U-238, and associated decay products	5,000 dpm/100 cm^2	15,000 dpm/ 100cm^2	1,000 dpm/100 cm^2
Transuranics, Ra-226, Ra-228, Th-230, Pa-231, Ac-227, I-125, I-129	100dpm/ 100cm^2	300 dpm/ 100cm^2	20dpm/100cm^2
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1000 dpm/ 100cm^2	3000 dpm/ 100cm^2	200 dpm/ 100cm^2
Beta-gamma (Exceptions noted above)	5,000 dpm/100 cm^2	15,000 dpm/ 100cm^2	1,000 dpm/100 cm^2

[1] Where surface contamination by both alpha-and beta-gamma-emitting radionuclides exists, the limits established for alpha-and beta-gamma-emitting radionuclides apply independently.
[2] As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed on an instrument calibrated for background, efficiency, and geometric factors associated with the instrumentation, in accordance with R12-1-449.
[3] Measurements of average contamination level shall not be averaged over more than one square meter. For objects of less surface area, the average shall be derived for each object.
[4] The maximum contamination level applies to an area of not more than 100 cm^2.
[5] The amount of removable radioactive material per 100 cm^2 of surface area shall be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an instrument calibrated in accordance with R12-1-449. When removable contamination on objects of surface area A (where A is less than 100 sq. cm) is determined, the entire surface shall be wiped and the contamination level multiplied by 100/A to convert to a "per 100 sq. cm" basis.

Historical Note
New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

ARTICLE 5. SEALED SOURCE INDUSTRIAL RADIOGRAPHY

R12-1-501. Definitions

"Access panel" means any panel that is designed to be removed or opened for maintenance or service purposes, opened using tools, and used to provide access to the interior of the cabinet x-ray unit.

"Annual refresher safety training" means a review conducted or provided by the licensee for its employees on radiation safety aspects of industrial radiography. The review shall include, as applicable, the results of internal inspections, new procedures or equipment, new or revised state rules, accidents or errors that have occurred, and provide opportunities for employees to ask safety questions.

"Aperture" means any opening in the outside surface of the cabinet x-ray unit, other than a port, which remains open during generation of x-radiation.

"Associated equipment" means equipment used in conjunction with a radiographic exposure device that drives, guides, or comes in contact with the source.

"Collimator" means a radiation shield that is placed on the end of the guide tube or directly onto a radiographic exposure device to restrict the size of the radiation beam when the sealed source is positioned to make a radiographic exposure.

"Control (drive) cable" means the cable that is connected to the source assembly and used to drive the source to and from the exposure location.

"Control (drive) mechanism" means a device that enables the source assembly to be moved to and from the exposure device.

"Control tube" means a protective sheath for guiding the control cable. The control tube connects the control drive mechanism to the radiographic exposure device.

"Door" means any barrier that is designed to be movable or opened for routine operation purposes, not opened using tools, and used to provide access to the interior of the cabinet x-ray unit.

"Exposure head" means a device that places the gamma radiography sealed source in a selected working position.

"Ground fault" means an accidental electrical grounding of an electrical conductor.

"Guide tube (projection sheath)" means a flexible or rigid tube used to guide the source assembly and the attached control cable from the exposure device to the exposure head. The guide tube may also include the connections necessary for attachment to the exposure device and the exposure head.

"Hands-on experience" means accumulation of knowledge or skill in any area relevant to radiography.

"Port" means any opening in the outside surface of the cabinet x-ray unit that is designed to remain open, during generation of x-rays, for conveying material being irradiated into and out of the cabinet, or for partial insertion of an object for irradiation whose dimensions do not permit complete insertion into the cabinet x-ray unit.

"Practical examination" means a demonstration, through practical application of safety rules and principles of industrial radiography, including use of all radiography equipment and knowledge of radiography procedures.

"Radiographic operations" means all activities associated with the presence of radioactive sources in a radiographic exposure device during use of the device or transport (except when the device is being transported by a common or contract carrier). This includes performing surveys to confirm the adequacy of boundaries, setting up equipment, and conducting any activity inside restricted area boundaries.

"Source assembly" means an assembly that consists of a sealed source and a connector that attaches the source to a control cable. The source assembly may also include a stop ball used to secure the source in the shielded position.

Historical Note
Former Rule Section E.1; Former Section R12-1-501 repealed, new Section R12-1-501 adopted effective June 30, 1977 (Supp. 77-3). Former Section R12-1-501

repealed, new Section adopted effective April 2, 1990 (Supp. 90-2). Amended effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Section repealed; new Section made by final rulemaking at 9 A.A.R. 1126, effective May 9, 2003 (Supp. 03-1).

R12-1-502. License Requirements

A. The Agency shall review an application for a specific license for the use of radioactive material in industrial radiography and approve the license if an applicant meets all of the following requirements:
1. The applicant satisfies the general requirements in R12-1-309 and any special requirements contained in this Article; and
2. The applicant submits a program for training radiographers and radiographers' assistants that complies with R12-1-543, except that:
   a. After the effective date of this Section, an applicant is not required to describe its initial training and examination program for radiographers;
   b. An applicant shall affirm that an individual who is acting as an industrial radiographer is certified in radiation safety by a certifying organization, as required in R12-1-543, before permitting the individual to act as a radiographer. This affirmation substitutes for a description of the applicant's initial training and examination program for radiographers in the subjects outlined in R12-1-543(G); and
   c. An applicant shall submit procedures for verifying and documenting the certification status of each radiographer and for ensuring that the certification remains valid.

B. The applicant shall submit written operating and emergency procedures as prescribed in R12-1-522.

C. The applicant shall submit a description of a program for review of job performance of each radiographer and radiographers' assistant at intervals that do not exceed six months as prescribed in R12-1-543(E).

D. The applicant shall submit a description of the applicant's overall organizational structure as it applies to radiation safety responsibilities in industrial radiography, including specified delegation of authority and responsibility.

E. The applicant shall submit a list of the qualifications of each individual designated as an RSO under R12-1-512 and indicate which designee is responsible for ensuring that the licensee's radiation safety program is implemented in accordance with approved procedures.

F. If an applicant intends to perform leak testing on any sealed source or exposure device that contains depleted uranium (DU) shielding, the applicant shall submit a description of the procedures for performing the leak testing and the qualifications of each person authorized to perform leak testing. If the applicant intends to analyze its own wipe samples, the application shall include a description of the procedures to be followed. The description shall include the:
1. Instruments to be used,
2. Methods of performing the analysis, and
3. Relevant experience of the person who will analyze the wipe samples.

G. If the applicant intends to perform "in-house" calibrations of survey instruments, the applicant shall describe each calibration method to be used and the relevant experience of each person who will perform a calibration. A licensee shall perform all calibrations according to the procedures prescribed in R12-1-504.

H. The applicant shall identify and describe the location of all field stations and permanent radiographic installations.

I. The applicant shall identify each location where records required by this Chapter will be maintained.

Historical Note

Former Rule Section E.2; Former Section R12-1-502 repealed, new Section R12-1-502 adopted effective June 30, 1977 (Supp. 77-3). Former Section R12-1-502 repealed, new Section adopted effective April 2, 1990 (Supp. 90-2). Section repealed, new Section adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Section repealed; new Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-503. Performance Requirements for Equipment

A. A licensee shall ensure that equipment used in industrial radiographic operations meets the following minimum criteria:
1. Each radiographic exposure device, source assembly or sealed source, and all associated equipment meet the requirements in American National Standards Institute, N432-1980 Radiological Safety for the Design and Construction of Apparatus for Gamma Radiography, 1980 edition, published as NBS Handbook 136 and issued January 1981 by the American National Standards Institute, which is incorporated by reference and on file with the Agency. This incorporation by reference contains no future editions or amendments. This publication may be purchased from the American National Standards Institute, Inc., 1430 Broadway, New York, New York 10018 Telephone (212) 642-4900; or
2. An engineering safety analysis demonstrates the applicability of previously performed testing on similar individual radiography equipment components. Based on a review of the analysis, the Agency may find that previously performed testing can be substituted for testing of the component under the standards in subsection (A)(1).

B. In addition to the requirements in subsection (A), the following requirements apply to each radiographic exposure device, source changer, source assembly, and sealed source:
1. A licensee shall ensure that each radiographic exposure device has attached to it a durable, legible, and clearly visible label bearing:
   a. The chemical symbol and mass number of the radionuclide in the device;
   b. The activity of the source and the date on which this activity was last measured;
   c. The model (or product code) and serial number of the sealed source;
   d. The manufacturer's description of the sealed source; and
   e. The licensee's name, address, and telephone number.
2. A licensee shall ensure that each radiographic exposure device intended for use as a Type B transport container meets the applicable requirements of 10 CFR 71, 2003 edition, published January 1, 2003, by the Office of the Federal Register National Archives and Records Administration, Washington, D.C. 20408, which is incorporated by reference and on file with the Agency. This incorporation by reference contains no future editions or amendments.
3. A licensee shall not modify any radiographic exposure device, source changer, source assembly, or associated equipment, unless the design of the replacement compo-

nent, including source holder, source assembly, controls, or guide tubes is consistent with and does not compromise the design safety features of the system.

C. In addition to the requirements in subsections (A) and (B), the following requirements apply to each radiographic exposure device, source assembly, and associated equipment that allows the source to be moved out of the device for radiographic operations or to a source changer:

1. The license shall ensure that the coupling between the source assembly and the control cable is designed so that the source assembly does not become disconnected if it is positioned outside of the guide tube and is constructed so that an unintentional disconnect will not occur under normal and reasonably foreseeable abnormal conditions;
2. The device automatically secures the source assembly if it is retracted into the fully shielded position within the device and the securing system is released from the exposure device only by means of a deliberate operation;
3. The outlet fittings, lock box, and drive cable fittings on each radiographic exposure device are equipped with safety plugs or covers installed for storage and transportation to protect the source assembly from water, mud, sand, or other foreign matter;
4. Each sealed source or source assembly has attached to it or is engraved with a durable, legible, and visible label with the words: "DANGER--RADIOACTIVE." The licensee shall ensure that the label does not interfere with safe operation of the equipment;
5. The guide tube is able to withstand a crushing test that closely approximates the crushing forces that are likely to be encountered during use, and a kinking resistance test that closely approximates the kinking forces that are likely to be encountered during use;
6. A guide tube is used if a person moves the source out of the device;
7. An exposure head or similar device, designed to prevent the source assembly from passing out of the end of the guide tube, is attached to the outermost end of the guide tube during industrial radiography operations;
8. The guide tube exposure head connection is able to withstand the tensile test for control units specified in ANSI N432-1980, incorporated by reference in subsection (A); and
9. Source changers provide a system for ensuring that the source is not accidentally withdrawn from the changer when a person is connecting or disconnecting the drive cable to or from the source assembly.

D. A licensee shall ensure that radiographic exposure devices and associated equipment in use after January 10, 1996 comply with the requirements of this Section.

E. Notwithstanding subsection (A), a licensee with equipment used in industrial radiographic operations need not comply with Sec. 8.92(C) of the Endurance Test in American National Standards Institute N432-1980 if the prototype equipment has been tested using a torque value representative of the torque that an individual using the radiography equipment can realistically exert on the lever or crankshaft of the drive mechanism.

Historical Note

Former Rule Section E.3; Former Section R12-1-503 repealed, new Section R12-1-503 adopted effective June 30, 1977 (Supp. 77-3). Amended effective December 20, 1985 (Supp. 85-6). Former Section R12-1-503 repealed, new Section adopted effective April 2, 1990 (Supp. 90-2). Section repealed; new Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-504. Radiation Survey Instruments

A. A licensee shall maintain at least two calibrated and operable radiation survey instruments at each location where sources of radiation are present to make radiation surveys required by this Article and Article 4 of this Chapter. Instrumentation required by this Section shall be capable of measuring a range from 0.02 millisieverts (2 millirems) per hour through 0.01 sievert (1 rem) per hour.

B. A licensee shall ensure that each radiation survey instrument required under subsection (A) is calibrated:

1. At intervals that do not exceed six months, and after instrument servicing, except for battery changes;
2. For linear scale instruments, at two points located approximately one-third and two-thirds of full-scale on each scale; for logarithmic scale instruments, at mid-range of each decade, and at two points of at least one decade; and for digital instruments, at 3 points between 0.02 and 10 millisieverts (2 and 1000 millirems) per hour; and
3. So that an accuracy within plus or minus 20% of the calibration source can be demonstrated at each point checked.

C. A licensee shall maintain calibration records for each radiation survey instrument, and maintain each record for three years after it is made.

Historical Note

Former Rule Section E.4; Former Section R12-1-504 repealed, new Section R12-1-504 adopted effective June 30, 1977 (Supp. 77-3). Former Section R12-1-504 repealed, new Section R12-1-504 adopted effective December 20, 1985 (Supp. 85-6). Former Section R12-1-504 repealed, new Section adopted effective April 2, 1990 (Supp. 90-2). Amended effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-505. Leak Testing and Replacement of Sealed Sources

A. A licensee shall ensure that replacement of any sealed source fastened to or contained in a radiographic exposure device and leak testing of any sealed source is performed by a person authorized to do so by the Agency, NRC, or another Agreement State.

B. A licensee shall ensure that opening, repairing, or modifying any sealed source is performed by a person specifically authorized to do so by the Agency, NRC, or another Agreement State.

C. A licensee that uses a sealed source shall have the source tested for leakage by a qualified person at intervals that do not exceed six months. The person who performs leak testing of the source shall use a method approved by the Agency, NRC, or by another Agreement State. A wipe sample shall be taken from the nearest accessible point to the sealed source where contamination might accumulate. The wipe sample shall be analyzed for radioactive contamination. The licensee shall ensure that the analysis is capable of detecting the presence of 185 Bq (0.005 microcurie) of radioactive material on the test sample and a person specifically authorized by the Agency, NRC, or another Agreement State performs the analysis. The licensee shall maintain records of the leak tests in accordance with this Section.

D. Unless a sealed source is accompanied by a certificate from the transferor that shows that the sealed source has been leak tested within six months before the transfer, a licensee shall not use the sealed source until it is tested for leakage. A lic-

ensee is not required to test a sealed source that is in storage, but shall test each sealed source before use or transfer to another person if the interval of storage exceeds six months.

E. A licensee shall immediately withdraw equipment containing a leaking source from use and have it decontaminated and repaired or dispose of the source in accordance with this Chapter. The licensee shall file a report with the Director of the Agency within five days of any test with results that exceed the threshold in this subsection, and describe the equipment involved, the test results, and corrective action taken. If a leak test conducted under this Section reveals the presence of 185 Bq (0.005 microcurie) or more of removable radioactive material the Agency classifies the sealed source as leaking.

F. A licensee shall test for DU contamination at intervals that do not to exceed 12 months a radiographic exposure device that uses depleted uranium (DU) shielding and an "S" tube configuration. The licensee shall ensure that the analysis is capable of detecting the presence of 185 Bq (0.005 microcuries) of radioactive material on the test sample and a person specifically authorized by the Agency, NRC, or another Agreement State performs the analysis. If the testing reveals the presence of 185 Bq (0.005 microcuries) or more of removable DU contamination, the licensee shall remove the exposure device from use until an evaluation of the wear on the S-tube is completed. If the evaluation reveals that the S-tube is worn through, the licensee shall ensure that the device is not used again. The licensee is not required to test for DU contamination if the radiographic exposure device is in storage. Before using or transferring the radiographic exposure device, the licensee shall test the device for DU contamination if the interval of storage exceeds 12 months. The licensee shall maintain records of the DU leak test in accordance with subsection (G).

G. A licensee shall maintain records of leak test results for each sealed source and for each device that contains DU. The licensee shall ensure results are in Becquerels (microcuries), and retain each record for three years after it is made or until the source is removed from storage and tested, which ever is longer.

Historical Note

Former Rule Section E.5; Former Section R12-1-505 repealed, new Section R12-1-505 adopted effective June 30, 1977 (Supp. 77-3). Former Section R12-1-505 repealed, new Section R12-1-505 adopted effective December 20, 1985 (Supp. 85-6). Amended subsections (A), (F) and (G) effective May 2, 1988 (Supp. 88-2). Former Section R12-1-505 repealed, new Section adopted effective April 2, 1990 (Supp. 90-2). Amended effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Section repealed; new Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-506. Quarterly Inventory

A. A licensee shall conduct a quarterly physical inventory to account for all sealed sources and devices that contain depleted uranium.

B. A licensee shall maintain a record of the quarterly inventory required under subsection (A) for three years after it is made.

C. The record required in subsection (B) shall include the date of the inventory, name of the individual who conducted the inventory, radionuclide, number of becquerels (curies) or mass (for DU) in each device, location of sealed source and associated devices, and manufacturer, model, and serial number of each sealed source and device as applicable.

Historical Note

Former Rule Section E.6; Former Section R12-1-506 repealed, new Section R12-1-506 adopted effective June 30, 1977 (Supp. 77-3). Former Section R12-1-506 repealed, new Section R12-1-506 adopted effective December 20, 1985 (Supp. 85-6). Amended subsection (A) effective May 2, 1988 (Supp. 88-2). Former Section R12-1-506 repealed, new Section adopted effective April 2, 1990 (Supp. 90-2). Amended effective June 13, 1997 (Supp. 97-2). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-507. Utilization Logs

A. A licensee shall maintain for each sealed source a utilization log that provides all of the following information:

1. A description, including the make, model, and serial number of each radiographic exposure device, and each sealed source transport and storage container that contains a sealed source;
2. The identity and signature of the radiographer using the source; and
3. The plant or site where the source is used and dates of use, including the date each source is removed from and returned to storage.

B. A licensee shall retain the log required by subsection (A) for three years after the log is made.

Historical Note

Former Section R12-1-507 repealed effective December 20, 1985 (Supp. 85-6). New Section adopted effective April 2, 1990 (Supp. 90-2). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-508. Inspection and Maintenance of Radiographic Exposure Devices, Transport and Storage Containers, Source Changers, Survey Instruments, and Associated Equipment

A. A licensee shall perform visual and operability checks on each survey instrument, radiographic exposure device, transport and storage container, source changer, and associated equipment before use on each day the equipment is to be used to ensure that the equipment is in good working condition, the source is adequately shielded, and required labeling is present. A survey instrument operability check shall be performed using a check source or other authorized means. If an equipment problem is found, the licensee shall remove the equipment from service until it is repaired.

B. A licensee shall have written inspection and maintenance procedures to ensure that:

1. Radiographic exposure devices, source changers, transport and storage containers, survey instruments, and associated equipment that require inspection and maintenance at intervals that do not exceed three months or before first use of the equipment are functioning properly and safely. Replacement components shall meet design specifications. If an equipment problem is discovered, the licensee shall remove the equipment from service until it is repaired; and
2. Type B packages are shipped and maintained in accordance with the certificate of compliance or other approval.

C. A licensee shall maintain records of daily checks and quarterly inspections of radiographic exposure devices, transport and storage containers, source changers, survey instruments, and associated equipment, and retain each record for three years after it is made. The record shall include the date of the check or inspection, name of the inspector, equipment involved, any

problems found, and any repair or needed maintenance performed.

Historical Note
Former Section R12-1-508 repealed effective December 20, 1985 (Supp. 85-6). New Section adopted effective April 2, 1990 (Supp. 90-2). Heading amended effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-509. Surveillance
During each radiographic operation, a radiographer or the radiographer's assistant, as permitted by R12-1-510, shall maintain continuous direct visual surveillance of the operation to protect against unauthorized entry into a high radiation area, except at permanent radiographic installations where all entrances are locked and the licensee is in compliance with R12-1-539.

Historical Note
Former Section R12-1-509 repealed effective December 20, 1985 (Supp. 85-6). New Section adopted effective April 2, 1990 (Supp. 90-2). Amended effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Section repealed; new Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-510. Radiographic Operations
A. If industrial radiography is performed at a location other than a permanent radiographic installation, a licensee shall ensure that the radiographer is accompanied by at least one other radiographer or radiographer's assistant, qualified under R12-1-543. The additional radiographer or radiographer's assistant shall observe the operations and be capable of providing immediate assistance to prevent unauthorized entry. Industrial radiography is prohibited if only one qualified individual is present.
B. A licensee shall ensure that each industrial radiographic operation is conducted at a location of use authorized on the license in a permanent radiographic installation, unless another permanent location is specifically authorized by the Agency.

Historical Note
Repealed effective December 20, 1985 (Supp. 85-6). New Section adopted effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Section repealed; new Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-511. Repealed

Historical Note
Repealed effective December 20, 1985 (Supp. 85-6). New Section adopted effective June 13, 1997 (Supp. 97-2). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Section repealed by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-512. Radiation Safety Officer (RSO)
A. A licensee shall have a radiation safety officer (RSO) who is responsible for implementing procedures and regulatory requirements in the daily operation of the radiation safety program.
B. Except as provided in subsection (C), the licensee shall ensure that the RSO satisfies the following minimum requirements:
1. The training and testing requirements in R12-1-543,
2. Two thousand hours of hands-on experience as a qualified radiographer for an industrial radiographic operation, and
3. Formal training in the establishment and maintenance of a radiation safety program.

C. If the licensee uses an individual in the position of RSO who does not have the training and experience required in subsection (B), the licensee shall provide the Agency with a description of the individual's training and experience in the field of ionizing radiation and training with respect to the establishment and maintenance of a radiation safety protection program so the Agency can determine whether the individual is qualified to perform under subsection (D).
D. The specific duties and authorities of the RSO include, but are not limited to:
1. Establishing and overseeing operating, emergency, and ALARA procedures as required in Article 4 of this Chapter and reviewing them every year to ensure that the procedures in use conform to current Agency rules and license conditions;
2. Overseeing and approving all phases of the training program for radiographic personnel, ensuring that appropriate and effective radiation protection practices are taught;
3. Overseeing radiation surveys, leak tests, and associated documentation to ensure that the surveys and tests are performed in accordance with the rules and taking corrective measures if levels of radiation exceed established action limits;
4. Overseeing the personnel monitoring program to ensure that devices are calibrated and used properly by occupationally exposed personnel and ensuring that records are kept of the monitoring results and timely notifications are made as required in R12-1-444; and
5. Overseeing operations to ensure that they are conducted safely and instituting corrective actions, which may include ceasing operations if necessary.

Historical Note
Repealed effective December 20, 1985 (Supp. 85-6). New Section made by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Section repealed; new Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-513. Form of Records
A licensee shall maintain records in accordance with R12-1-405.

Historical Note
Repealed effective December 20, 1985 (Supp. 85-6). New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-514. Limits on External Radiation Levels from Storage Containers and Source Changers
The maximum rate limits for storage containers and source changers are 2 millisieverts (200 mRem/hr) at any exterior surface and 0.1 millisieverts (10 mRem/hr) at 1 meter from any exterior surface with the sealed source in the shielded position.

Historical Note
Repealed effective December 20, 1985 (Supp. 85-6). New Section made by final rulemaking at 9 A.A.R. 1126, effective May 9, 2003 (Supp. 03-1).

R12-1-515. Locking Radiographic Exposure Devices, Storage Containers, and Source Changers
A. Except at permanent radiographic installations governed by R12-1-539, a licensee shall ensure that each radiographic

exposure device has a lock or an outer container with a lock designed to prevent unauthorized or accidental removal of the sealed source from its shielded position. The licensee shall ensue that the exposure device or its container, if applicable, is locked (and if a keyed lock, with the key removed) if the device or container is not under the direct surveillance of a radiographer or a radiographer's assistant. During radiographic operations, the radiographer or radiographer's assistant shall secure the sealed source assembly in the shielded position each time the source is returned to the shielded position.

B. A licensee shall ensure that each sealed source storage container and source changer has a lock or an outer container with a lock designed to prevent unauthorized or accidental removal of the sealed source from its shielded position. The licensee shall ensure that each storage container and source changer is locked (and if a keyed lock, with the key removed) if the storage container or source changer contains a sealed source and is not under the direct surveillance of a radiographer or a radiographer's assistant.

Historical Note

Repealed effective December 20, 1985 (Supp. 85-6). New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-516. Records of Receipt and Transfer of Sealed Sources

A. A licensee shall maintain records that show each receipt and transfer of a sealed source or device that uses DU for shielding and retain each record for three years after it is made.

B. The records shall contain separate entries for each transaction, including the date, name of the individual making the record, radionuclide, number of Becquerels (curies) or mass (for DU), and manufacturer, model, and serial number of each sealed source or device, as applicable.

Historical Note

Repealed effective December 20, 1985 (Supp. 85-6). New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-517. Posting

A licensee shall post any area in which industrial radiography is performed as required by R12-1-429. Exceptions listed in R12-1-430 do not apply to industrial radiographic operations.

Historical Note

Repealed effective December 20, 1985 (Supp. 85-6). New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-518. Repealed

Historical Note

Repealed effective December 20, 1985 (Supp. 85-6).

R12-1-519. Repealed

Historical Note

Repealed effective December 20, 1985 (Supp. 85-6).

R12-1-520. Repealed

Historical Note

Repealed effective December 20, 1985 (Supp. 85-6).

R12-1-521. Repealed

Historical Note

Adopted effective April 2, 1990 (Supp. 90-2). Amended effective August 10, 1994 (Supp. 94-3). Amended effective June 13, 1997 (Supp. 97-2). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Section repealed by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-522. Operating and Emergency Procedures

A. A licensee shall ensure that the operating and emergency procedures include, at a minimum, instructions in the following, as applicable:

1. Handling and use of sealed sources or radiographic exposure devices, so that persons are not exposed to radiation that exceeds the limits in Article 4 of this Chapter;
2. Methods and occasions for conducting radiation surveys;
3. Methods for controlling access to radiographic areas;
4. Methods and occasions for locking and securing radiographic exposure devices, transport and storage containers, and sealed sources;
5. Personnel monitoring and associated equipment;
6. Transportation of sealed sources to field locations, including packing radiographic exposure devices and storage containers in vehicles, placarding vehicles, and maintaining control of the sealed sources during transportation, as required in 49 CFR 171-173, 2002 edition, published October 1, 2002, by the Office of the Federal Register, National Archives and Records Administration, Washington, D.C. 20408, which is incorporated by reference and on file with the Agency. This incorporation contains no future editions or amendments;
7. Inspection, maintenance, and operability checks of radiographic exposure devices, survey instruments, transport containers, and storage containers;
8. Actions to be taken immediately by radiography personnel if a pocket dosimeter is found to be off-scale or an alarm rate meter sounds an alarm;
9. Procedures for identifying and reporting defects and noncompliance, as required by R12-1-448 and R12-1-535;
10. Procedures for notifying the RSO and the Agency in the event of an accident;
11. Methods for minimizing exposure of persons in the event of an accident;
12. Procedures for recovering a source if the licensee is responsible for source recovery; and
13. Maintenance of records.

B. The licensee shall maintain copies of current operating and emergency procedures until the Agency terminates the license. Superseded procedures shall be maintained for three years after being superceded. Additionally, a copy of the procedures shall be maintained at field stations in accordance with R12-1-540.

Historical Note

Adopted effective April 2, 1990 (Supp. 90-2). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-523. Personnel Monitoring

A. An individual shall not act as a radiographer or a radiographer's assistant unless, at all times during radiographic operations, the individual wears, on the trunk of the body, a direct reading dosimeter, an operating alarm rate meter, and either a film badge, a TLD, or an optically stimulated luminescence (OSL) dosimeter. At permanent radiography installations where other required alarming or warning devices are in routine use, an alarm rate meter is not required.

1. A licensee shall provide pocket dosimeters that have a range from zero to 2 millisieverts (200 millirems) and ensure that the dosimeters are recharged at the start of

each shift. Electronic personnel dosimeters are permitted in place of ion-chamber pocket dosimeters.
2. The licensee shall assign a film badge, TLD, or OSL dosimeter to one individual, who shall wear the assigned equipment.
3. The licensee shall replace film badges at least monthly and replace TLDs or OSL dosimeters at least quarterly.
4. After replacement, the licensee shall ensure that each film badge or TLD is processed as soon as possible.

B. A radiographer or radiographer's assistant shall record exposures noted from direct reading dosimeters, such as pocket dosimeters or electronic personnel dosimeters, at the beginning and end of each shift.

C. A licensee shall ensure that each pocket dosimeter or electronic personnel dosimeter is checked at least yearly for correct response to radiation, and discontinue use of a dosimeter if it is not accurate within plus or minus 20% of the true radiation exposure.

D. If an individual's pocket dosimeter has an off-scale reading, or the electronic personnel dosimeter reads greater than 2 millisieverts (200 millirems), and radiation exposure cannot be ruled out as the cause, a licensee shall send the individual's film badge, TLD, or OSL dosimeter for processing within 24 hours. The licensee shall not allow the individual to work with licensed, radioactive material until the individual's radiation exposure has been determined. Using the information from the badge or dosimeter, the RSO or the RSO's designee shall calculate the affected individual's cumulative radiation exposure, as prescribed in Article 4 of this Chapter and include the results in records maintained in accordance with subsection (G).

E. If an individual's monitoring device is lost or damaged, the individual shall cease work immediately until the licensee provides a replacement film badge, TLD, or OSL dosimeter and the RSO or the RSO's designee calculates the exposure for the time period from issuance to discovery of the lost or damaged film badge, TLD, or OSL dosimeter. The licensee shall include the calculated exposure and the time period for which the film badge, TLD, or OSL dosimeter was lost or damaged in the records maintained in accordance with subsection (G).

F. For each alarm rate meter, a licensee shall ensure that:
1. At the start of a shift, the alarm functions (sounds) before using the device;
2. Each device is set to give an alarm signal at a preset dose rate of 5 mSv/hr (500 mrem/hr), with an accuracy of plus or minus 20% of the true radiation dose rate;
3. A special means is necessary to change the preset alarm function on the device; and
4. Each device is calibrated at periods that do not to exceed 12 months for correct response to radiation.

G. A licensee shall maintain the following personnel monitoring records:
1. The dosimeter reading and the yearly operability check required by subsections (B) and (C) for three years after each record is made;
2. A record of each alarm rate meter calibration for three years after the record is made;
3. Any report received from a film badge, TLD, or OSL processor until the Agency terminates the license; and
4. Any estimation of an exposure evidenced by an off-scale personnel direct-reading dosimeter or lost or damaged film badge, TLD, or OSL dosimeter until the Agency terminates the license.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Amended effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-524. Supervision of a Radiographer's Assistant
If a radiographer's assistant uses a radiographic exposure device, associated equipment, or a sealed source or conducts a radiation survey required by R12-1-533(B) to determine that the sealed source has returned to the shielded position after an exposure, the licensee shall ensure that the assistant is under the personal supervision of a radiographer. For purposes of this Section "personal supervision" means:
1. The radiographer is physically present at the site where the sealed source is being used,
2. The radiographer is available to give immediate assistance if required, and
3. The radiographer is able to observe the assistant's performance directly.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-525. Notification of Field Work
Each day radioactive material is used for industrial radiography, a licensee shall notify the Agency of any planned field radiography. The notice shall be in writing and specify the location of the field work, the name of the supervising individual at the job site, and the expected duration of the work at the job site listed in the notice. A facsimile that provides the required information is sufficient notice.

Historical Note
New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-526. Reserved

R12-1-527. Reserved

R12-1-528. Reserved

R12-1-529. Reserved

R12-1-530. Reserved

R12-1-531. Security
During each radiographic operation, the radiographer or radiographer's assistant shall maintain continuous direct visual surveillance of the operation to protect against unauthorized entry into a high radiation area, as defined in Article 1, unless:
1. The high radiation area is equipped with a control device or an alarm system as prescribed in R12-1-420(A), or
2. The high radiation area is locked to protect against unauthorized or accidental entry.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Amended effective August 10, 1994 (Supp. 94-3). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-532. Posting
Notwithstanding any provisions in R12-1-430, areas in which radiography is being performed shall be conspicuously posted as required by R12-1-429(A) and (B).

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Amended effective August 10, 1994 (Supp. 94-3).

R12-1-533. Radiation Surveys

A. A licensee shall conduct surveys with a calibrated and operable radiation survey instrument that meets the requirements of R12-1-504.

B. Using a survey instrument that complies with subsection (A), the licensee shall conduct a survey of the radiographic exposure device and the guide tube after each exposure before approaching the device or the guide tube. The survey shall be performed to determine that the sealed source is in the shielded position before the radiographer or radiographer's assistant exchanges films, repositions the exposure head, or dismantles the equipment.

C. The licensee shall conduct a survey of the radiographic exposure device with a calibrated radiation survey instrument any time the source is exchanged or the device is placed in a storage area, as defined in R12-1-102, to ensure that the sealed source is in the shielded position.

D. The licensee shall maintain a record of each exposure device survey conducted before the device is placed in storage under subsection (C), if that survey is the last one performed during the workday. Each record shall be maintained for three years after the record is made.

Historical Note

Adopted effective April 2, 1990 (Supp. 90-2). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-534. Repealed

Historical Note

Adopted effective April 2, 1990 (Supp. 90-2). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Section repealed by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-535. Notifications

A. In addition to the reporting requirements specified in Article 4, each licensee shall provide a written report to the Agency if any of the following incidents involving radiography equipment occur:
1. Unintentional disconnection of the source assembly from the control cable;
2. Inability to retract the source assembly to the fully shielded position or secure it in this position; or
3. Failure of any component (critical to safe operation of the device) to properly perform its intended function;

B. A licensee shall include the following information in any report submitted under this Section, regarding radiography equipment, or Article 4, regarding an overexposure, if the report concerns the failure of safety components of radiography equipment:
1. A description of the equipment problem;
2. Cause of the incident, if known;
3. Name of manufacturer and model number of the equipment involved in the incident;
4. Place, date, and time of the incident;
5. Actions taken to establish normal operations;
6. Corrective actions taken or planned to prevent reoccurrence; and
7. Qualifications of personnel involved in the incident.

C. Any licensee that conducts radiographic operations, or stores radioactive material at a location not listed on the license or for a period longer than 180 days during a calender year, shall notify the Agency of these activities before the 180 days has elapsed.

Historical Note

New Section made by final rulemaking at 9 A.A.R. 1126, effective May 9, 2003 (Supp. 03-1).

R12-1-536. Reserved

R12-1-537. Reserved

R12-1-538. Reserved

R12-1-539. Permanent Radiographic Installations

A. If a licensee maintains a permanent radiographic installation that does not fall within the definition of "enclosed radiography" in R12-1-102, the licensee shall ensure that each entrance, used for personnel access to the high radiation area, has either:
1. An entrance control device of the type described in R12-1-420(A)(1) that reduces the radiation level upon entry into the area, or
2. Both conspicuous visible and audible alarm signals to warn of the presence of radiation. The licensee shall ensure that the visible signal is actuated by radiation if a source is exposed and the audible signal is actuated if someone attempts to enter the installation while a source is exposed.

B. A licensee with an alarm signal shall test the alarm signal for proper operation with a radiation source each day before the installation is used for radiographic operations. The test shall include a check of both the visible and audible signals. A licensee with an entrance control device shall test the device monthly. If an entrance control device or alarm signal is operating improperly, the licensee shall immediately label the device or signal as "defective" and repair the device or signal within seven calendar days. The licensee may continue to use the facility during this seven-day period, if the licensee implements continuous surveillance requirements of R12-1-509 and uses an alarming rate meter.

C. A licensee shall maintain each record an alarm system or entrance control device test for three years after the record is made.

Historical Note

New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-540. Location of Documents and Records

A. A licensee shall maintain a copy of each record required by this Article and other applicable Articles of this Chapter at a location specified under R12-1-502(I).

B. A licensee shall maintain a copy of each record listed below at each field station and temporary job site;
1. The license that authorizes use of radioactive material;
2. A copy of Articles 4, 5, and 10 of this Chapter;
3. Utilization logs for each radiographic exposure device dispatched from that location, as required by R12-1-507;
4. Records of equipment problems identified in daily checks of equipment, as required by R12-1-508(A);
5. Records of alarm system and entrance control checks as required by R12-1-539;
6. Records of direct-reading dosimeters, such as pocket dosimeters and electronic personnel dosimeters as required by R12-1-523;
7. Operating and emergency procedures as required by R12-1-522;
8. A report on the most recent calibration of the radiation survey instruments in use at the site as required by R12-1-504;
9. A report on the most recent calibration of each alarm rate meter, and operability check of each pocket dosimeter

and electronic personnel dosimeter as required in R12-1-523;
10. Most recent survey record as required by R12-1-533;
11. The shipping papers for the transportation of radioactive material required by 10 CFR 71.5, 2003 edition, published January 1, 2003, by the Office of the Federal Register, National Archives and Records Administration, Washington, D.C. 20408, which is incorporated by reference and on file with the Agency (this incorporation contains no future editions or amendments); and
12. If operating under reciprocity in accordance with R12-1-320, a copy of the NRC or Agreement State license authorizing the use of radioactive materials.

Historical Note

New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-541. Enclosed Radiography Using X-ray Machines

A. Certified and certifiable cabinet x-ray systems, as defined in Article 1, are exempt from the requirements of Article 5, provided the following conditions are met:
1. The registrant shall make, or cause to be made, an evaluation of each certified and certifiable cabinet x-ray system, at intervals not to exceed 12 months, to determine conformance with the standards for certified and certifiable cabinet x-ray systems defined in Article 1. Records of the evaluations shall be retained for three years from the date of their creation; and
2. Physical radiation surveys shall be performed with a survey instrument appropriate for the energy range and levels of radiation to be assessed and calibrated within the preceding 12 months.

B. The registrant shall ensure that cabinet x-ray systems not exempted in subsection (A) comply with the recordkeeping requirements of this Article and the following special requirements:
1. Radiation levels measured at 5 centimeters (2 inches) from any accessible exterior surface of the enclosure shall not exceed 50 microsievert (0.5 milliroentgen) in one hour for any combination of technical factors (i.e., mA, kVp);
2. Access to the interior of the enclosure shall be possible only through interlocked doors or panels that allow production of radiation only when all interlocked doors or panels are securely closed. Opening any point of access shall result in immediate termination of radiation production, and subsequent reactivation of the x-ray tube shall only be possible at the control panel;
3. Visible warning signals that are activated only during production of radiation shall be provided at the control panel and at each point of access to the interior of the enclosure;
4. The registrant shall make, or cause to be made, evaluations of each x-ray system to determine conformance with this Article, before placing the x-ray system into use and thereafter at intervals not to exceed three months. Records of the evaluations shall be retained for two years, and
5. Physical radiation surveys to satisfy the requirements of subsection (B)(4) shall be performed only with instrumentation meeting the requirements of R12-1-504.

C. The registrant shall ensure that shielded room x-ray systems comply with the recordkeeping requirements of this Article and the following special requirements;
1. Each x-ray room shall be so shielded that every location on the exterior meets the requirements for an "unrestricted area" as specified in R12-1-416;
2. Access to the interior of a shielded x-ray room shall only be possible through doors or panels which are interlocked. Radiation production shall be possible only when all interlocked doors and panels are securely closed. Opening of any interlocked access points shall result in immediate termination of radiation production, and subsequent reactivation of the x-ray tube shall only be possible at the control panel;
3. Each access point shall be provided with two interlocks, each on a separate circuit so that failure of one interlock will not affect the performance of the other;
4. Visible warning signals activated only during production of radiation shall be provided at the control panel and at each point of access into the shielded room;
5. The registrant shall make, or cause to be made, evaluations of each shielded room x-ray system before placing the system into use and thereafter at intervals not to exceed three months to determine compliance with this Article. Records of the evaluations shall be retained for two years.
6. Radiation surveys performed to determine exposure shall be performed with instrumentation that meets the requirements of R12-1-504;
7. Electrical interlocks and warning devices shall be inspected for proper operation at the beginning of each period of use, and records of the inspections shall be prepared and retained for two years;
8. The registrant shall not permit any individual to operate an x-ray machine for shielded room radiography unless that individual has received a copy of, and instruction in, the operating procedures and has demonstrated competence in the safe use of the equipment;
9. An individual shall not occupy the interior of any shielded room x-ray system during production of radiation; and
10. The registrant shall provide personnel monitoring devices that meet the requirements of R12-1-523(C) to each shielded room x-ray machine operator, and require that each operator use the devices.
11. The registrant shall maintain records of:
    a. Quarterly inventories for mobile systems, as prescribed in R12-1-506; and
    b. Utilization of all systems, as prescribed in R12-1-507.
12. Records shall be maintained for three years from the date of the inventory or utilization.

D. The registrant shall connect an enclosed radiography machine to the electrical system in a manner that will prevent a ground fault from generating x-radiation.

Historical Note

Adopted effective April 2, 1990 (Supp. 90-2). Amended effective August 10, 1994 (Supp. 94-3). Amended effective June 13, 1997 (Supp. 97-2). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Amended by final rulemaking at 9 A.A.R. 1126, effective May 9, 2003 (Supp. 03-1).

R12-1-542. Baggage Inspection Systems

A. For x-ray systems designed to screen carry-on baggage at airlines, railroads, bus terminals, or similar facilities, a registrant shall station the operator at the control area in a position that

permits surveillance of the ports and doors during generation of x-radiation to prevent exposure to passengers and other members of the public.

B. For an exposure or preset succession of exposures of one-half second or greater duration, a registrant shall use a system that enables the operator to terminate the exposure or preset succession of exposures at any time.

C. For an exposure or preset succession of exposures of less than one-half second duration, a registrant shall use a system that allows the operator to complete the exposure in progress, but prevent additional exposures.

D. A registrant shall operate a baggage inspection system according to the manufacturer's instructions.

E. A registrant shall not disconnect or otherwise tamper with the safety systems of a baggage inspection system, except for maintenance purposes.

F. In addition to the requirements in this Section, registrants using a baggage inspection system shall meet the requirements in R12-1-541(A), (B), and (D).

Historical Note

Adopted effective April 2, 1990 (Supp. 90-2). Repealed effective August 10, 1994 (Supp. 94-3). New Section made by final rulemaking at 9 A.A.R. 1126, effective May 9, 2003 (Supp. 03-1).

Appendix A. Repealed

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Amended effective December 20, 1985 (Supp. 85-6). Repealed effective April 2, 1990 (Supp. 90-2).

R12-1-543. Training

A. A licensee shall not allow an individual to act as a radiographer until the individual has received training in the subjects in subsection (G), has participated in a minimum of two months of on-the-job training, and is certified through a radiographer certification program by a independent certifying organization in accordance with the criteria specified in Appendix A.

1. A licensee shall provide the Agency with proof of an individuals's certification and a written request that the individual be added to a license as a certified radiographer.
2. A licensee shall maintain proof of certification at the job site where a radiographer is performing field radiography.
3. A licensee that employs certified radiographers in Arizona shall ensure that:
   a. Each radiographer has obtained initial certification within the last five years, and
   b. An uncertified radiographer works only as a radiographer's assistant until certified.
4. A radiographer shall recertify every five years by:
   a. Taking an approved radiography certification examination in accordance with this subsection; or
   b. Providing written evidence that the radiographer is active in the practice of industrial radiography and has participated in continuing education during the previous five-year period.
5. If an individual cannot provide the written evidence required in subsection (4)(b), the individual shall retake the certification examination.
6. A radiographer shall provide the licensee with proof of certification in the form of a card issued by the certifying organization that contains:
   a. A picture of the certified radiographer,
   b. The radiographer's certification number,
   c. The date the certification expires, and
   d. The radiographer's signature.

B. A licensee shall not allow an individual to act as a radiographer until the individual:

1. Has received copies of and instruction in the requirements of this Article; applicable Sections of Articles 4 and 10 and R12-1-107; applicable DOT regulations in 10 CFR 71, January 1, 2003 edition, by the Office of the Federal Register, National Archives and Records Administration, Washington, D.C. 20408, which is incorporated by reference, contains no future editions or amendments, and is on file with Agency; the Agency license or licenses under which the radiographer will perform industrial radiography; and the licensee's operating and emergency procedures;
2. Has demonstrated an understanding of the licensee's license and operating and emergency procedures by successfully completing a written or oral examination that covers the relevant material;
3. Has received training in:
   a. Use of the licensee's radiographic exposure devices and sealed sources,
   b. Daily inspection of devices and associated equipment, and
   c. Use of radiation survey instruments; and
4. Has demonstrated an understanding of the use of radiographic exposure devices, sources, survey instruments, and associated equipment described in subsection (B)(3) by successfully completing a practical examination covering this material.

C. A licensee shall not allow an individual to act as a radiographer's assistant until the individual:

1. Has received copies of and instruction in the requirements of this Article; applicable Sections of Articles 4 and 10 and R12-1-107; applicable DOT regulations in 10 CFR 71, January 1, 2003 edition, by the Office of the Federal Register, National Archives and Records Administration, Washington, D.C. 20408, which is incorporated by reference, contains no future editions or amendments, and is on file with Agency; the Agency license or licenses under which the radiographer's assistant will perform industrial radiography; and the licensee's operating and emergency procedures;
2. Has developed competence to use, under the personal supervision of the radiographer, the licensee's radiographic exposure devices, sealed sources, associated equipment, and radiation survey instruments; and
3. Has demonstrated understanding of the instructions provided under subsection (C)(1) by successfully completing a written test on the subjects covered and has demonstrated competence using the hardware described in subsection (C)(2) by successfully completing a practical examination.

D. A licensee shall provide refresher safety training for each radiographer and radiographer's assistant at intervals not to exceed 12 months.

E. Unless an individual serves as both a radiographer and an RSO, the RSO or the RSO's designee shall design and implement an inspection program to examine the job performance of each radiographer and radiographer's assistant and to ensure that the Agency's rules and license requirements, and the licensee's operating and emergency procedures are followed. The inspection program shall:

1. Include observation of the performance of each radiographer and radiographer's assistant during an actual industrial radiographic operation, at intervals that do not exceed six months; and

2. If a radiographer or a radiographer's assistant has not participated in an industrial radiographic operation for more than six months, the radiographer shall demonstrate knowledge of the training requirements in subsection (B)(3) and the radiographer's assistant shall demonstrate knowledge of the training requirements of subsection (C)(2) by a practical examination before participating in a radiographic operation.

F. A licensee shall maintain records of the training required in this Section including certification documents, written and practical examinations, refresher safety training documents, and inspection documents, in accordance with subsection (I).

G. A licensee shall include the following subjects in the training required under subsection (A):
1. Fundamentals of radiation safety, including:
   a. Characteristics of gamma radiation,
   b. Units of radiation dose and quantity of radioactivity,
   c. Hazards of exposure to radiation,
   d. Levels of radiation from licensed material, and
   e. Methods of controlling radiation dose (time, distance, and shielding);
2. Radiation detection instruments, including:
   a. Use, operation, calibration, and limitations of radiation survey instruments;
   b. Survey techniques; and
   c. Use of personnel monitoring equipment;
3. Equipment topics, including:
   a. Operation and control of radiographic exposure equipment, use of remote handling equipment, and use of storage containers, using pictures or models of source assemblies (pigtails);
   b. Storage, control, and disposal of licensed material; and
   c. Inspection and maintenance of equipment;
4. The requirements of pertinent Agency rules; and
5. Case histories of accidents in radiography.

H. A licensee shall maintain records of radiographer certification in accordance with subsection (I)(1) and provide proof of certification as required in subsection (A)(1).

I. A licensee shall maintain the following records for three years after each record is made:
1. Records of training for each radiographer and each radiographer's assistant. For radiographers, the records shall include radiographer certification documents and verification of certification status. All records shall include copies of written tests, dates of oral and practical examinations, and names of individuals who conducted and took the oral and practical examinations; and
2. Records of annual refresher safety training and semi-annual inspections of job performance for each radiographer and each radiographer's assistant. The records for the annual refresher safety training shall list topics discussed during training, the date of training, and names of each instructor and attendee. For inspections of job performance, the records shall include a list of the items checked during the inspection and any non-compliance observed by the RSO.

Historical Note

New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

Appendix A. Standards for Organizations that Provide Radiography Certification

Note: For purposes of this Article an "independent certifying organization" means an organization that meets all of the criteria in this Appendix.

I. Requirements for an Organization that Provides Radiographer Certification

To qualify to provide radiographer certification an organization shall:

A. Be a society or association, with members who participate in, or have an interest in, the field of industrial radiography;

B. Not restrict membership because of race, color, religion, sex, age, national origin, or disability;

C. Have a certification program that is open to nonmembers, as well as members;

D. Be an incorporated, nationally recognized organization that is involved in setting national standards of practice within its fields of expertise;

E. Have a staff comparable to other nationally recognized organizations, a viable system for financing its operations, and a policy-and decision-making review board;

F. Have a set of written, organizational by-laws and policies that address conflicts of interest and provide a system for monitoring and enforcing the by-laws and policies;

G. Have a committee, with members who can carry out their responsibilities impartially, review and approve the certification guidelines and procedures, and advise the organization's staff in implementing the certification program;

H. Have a committee, with members who can carry out their responsibilities impartially, review complaints against certified individuals and determine sanctions;

I. Have written procedures describing all aspects of the organization's certification program;

J. Maintain records of the current status of each individual's certification and administration of the certification program;

K. Have procedures to ensure that certified individuals are provided due process with respect to administration of the certification program, including a process for becoming certified and a process for imposing sanctions against certified individuals;

L. Have procedures for proctoring examinations and qualifying proctors. The organization, through these procedures, shall ensure that an individual who proctors an examination is not employed by the same company or corporation (or a wholly-owned subsidiary of the company or corporation) that employs an examinee;

M. Exchange information about certified individuals with the Agency, other independent certifying organizations, the NRC, or Agreement States and allow periodic review of its certification program and related records; and

N. Provide a description to the Agency of its procedures for choosing examination sites and providing a favorable examination environment.

II. Requirements for a Certification Program

An independent certifying organization shall ensure that its certification program:

A. Requires an applicant for certification to:
1. Obtain training in the subjects listed in R12-1-543(G) or equivalent NRC or Agreement State regulations, and
2. Satisfactorily complete a written examination that covers these subjects;

B. Requires an applicant for certification to provide documentation demonstrating that the applicant has:
1. Received training in the subjects listed in R12-1-543(G) or equivalent NRC or Agreement State regulations;
2. Satisfactorily completed the on-the-job training required in R12-1-543(A); and
3. Received verification by an Agreement State or a NRC licensee that the applicant has demonstrated the capability of independently working as a radiographer;

C. Provides procedures that protect examination questions from disclosure;
D. Provides procedures for denying certification to an applicant and revoking, suspending, and reinstating a certificate;
E. Provides a certification period that is not less than three years or more than five years, procedures for renewing certifications and, if the procedures allow renewals without examination, a system for assessing evidence of recent full-time employment and annual refresher training; and
F. Provides a timely response to inquiries, by telephone or letter, from members of the public, about an individual's certification status.

III. Requirements for a Written Examination

An independent certifying organization shall ensure that its examination:
A. Is designed to test an individual's knowledge and understanding of the subjects listed in R12-1-543(G);
B. Is written in a multiple-choice format; and
C. Has psychometrically valid questions drawn from a question bank and based on the material in R12-1-543(G).

Historical Note
New Appendix made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

ARTICLE 6. USE OF X-RAYS IN THE HEALING ARTS

R12-1-601. Repealed

Historical Note
Former Rule Section F.1; Former Section R12-1-601 repealed, new Section R12-1-601 adopted effective June 30, 1977 (Supp. 77-3). Repealed effective August 8, 1986 (Supp. 86-4).

R12-1-602. Definitions

The following definitions apply in this Article:

"Accessible surface" means the external surface of the enclosure or housing provided by the manufacturer.

"Added filter" means the filter added to the inherent filtration.

"Aluminum equivalent" means the thickness of aluminum (type 1100 alloy) that affords equivalent attenuation, under specified conditions, as the material in question. (The nominal chemical composition of type 1100 aluminum alloy is 99.00 percent minimum aluminum, 0. 12 percent copper).

"Assembler" means any person engaged in the business of assembling, replacing, or installing one or more components into an x-ray system or subsystem.

"Attenuation block" means a block or stack, having dimensions 20 cm by 20 cm by 3.8 cm (7.9 inches by 7.9 inches by 1.5 inches) of type 1100 aluminum alloy or other materials that afford equivalent attenuation.

"Automatic exposure control" means a device that automatically controls one or more technique factors in order to obtain at a preselected location or locations a required quantity of radiation.

"Barrier" (See "Protective barrier")

"Beam axis" means a line from the source through the center of the x-ray field.

"Beam-limiting device" means a device that provides a means to restrict the dimensions of the x-ray field.

"C-arm x-ray system" means an x-ray system that has the image receptor and x-ray tube housing assembly connected by a common mechanical support system to maintain a desired spatial relationship. This system is designed to allow a change in the projection of the beam through the patient without a change in the position of the patient.

"Changeable filter" means any filter, exclusive of inherent filtration, which can be removed from the useful beam by an electronic, mechanical, or physical process.

"Cinefluorography" means fluorography that uses a movie camera to record fluorograph images on film for later playback.

"Coefficient of variation" means the ratio of the standard deviation to the mean value of a population of observations.

"Collimator" means an adjustable device, generally made of lead, that is fixed to an x-ray tube housing to intercept or collimate the useful beam and, if not made of lead, has a lead equivalency of not less than that of the tube housing assembly.

"Compression device" means a device used to bring object structures closer to the image plane of a radiograph and make a part of the human body a more uniform thickness so the optical density of the radiograph will be more uniform.

"Computed tomography" means the production of a tomogram by the acquisition and computer processing of x-ray transmission data. For purposes of these rules this term has the same meaning as "CT".

"Contact therapy system" means that the x-ray tube port is put in contact with or within 5 centimeters (2 inches) of the surface being treated.

"Control panel" means that part of the x-ray machine where switches, knobs, push-buttons, or other hardware necessary for manually setting the technique factors are located.

"Cooling curve" means the graphical relationship between heat units stored and cooling time.

"CT gantry" means the tube housing assemblies, beam-limiting devices, detectors, and the supporting structure, frame, and cover which hold or enclose these components.

"Dead-man switch" means a switch constructed so that a circuit-closing contact can be maintained only by continuous pressure on the switch by the operator.

"Diagnostic source assembly" means the tube housing assembly with a beam-limiting device attached.

"Diagnostic x-ray system" means an x-ray system designed for irradiation of any part of a human or animal body for the purpose of diagnosis or visualization.

"Direct scattered radiation" means scattered radiation that has been deviated in direction only by materials irradiated by the useful beam (See "Scattered radiation").

"Entrance exposure rate" means the roentgens per unit time at the point where the center of the useful beam enters the patient.

"Equipment" (See "X-ray equipment")

"Filter" means material placed in the useful beam to absorb undesirable radiation.

"Fluoroscopic imaging assembly" means a subsystem in which x-ray photons produce a fluoroscopic image. It includes the image receptor or receptors such as the image intensifier and spot-film device, electrical interlocks, if any, and structural material that provides a linkage between the image receptor and diagnostic source assembly.

"Fluoroscopic system" means a radiographic x-ray system used to directly visualize internal structure, the motion of internal structures, and fluids in real time, or near real-time, to aid in the treatment or diagnosis of disease, or the performance of other medical procedures.

"Focal spot" means the region of the anode target in an x-ray tube where electrons from the cathode interact to produce x-rays.

"General purpose radiographic x-ray system" means any radiographic x-ray system that, by design, is not limited to radiographic examination of a specific anatomical region.

"Gonadal shield" means a protective barrier for the testes or ovaries.

"Grid" means a device used to improve the image detail in a radiograph by reducing the intensity of x-ray scatter radiation exiting the film side of the patient

"Half-value layer (HVL)" means the thickness of a specified material that attenuates the beam of radiation to an exposure rate that is one-half of its original value. In this definition, the contribution of any scattered radiation, other than that which is present initially in the beam, is excluded.

"Healing arts radiography" means the practice of applying x-radiation to human patients for diagnostic or therapeutic purposes at the direction of a licensed practitioner. Healing arts radiography includes:

Positioning the x-ray beam with respect to the patient;

Anatomical positioning of the patient;

Selecting exposure factors; or

Initiating the exposure.

"Healing arts screening" means the application of radiation from an x-ray machine to a human for the detection or evaluation of health indications when the tests are not specifically and individually ordered by a licensed practitioner.

"Image intensifier" means an electronic device, installed in an x-ray system housing, which instantaneously converts an x-ray pattern into a corresponding light image of higher intensity.

"Image receptor" means any device, such as a fluorescent screen or radiographic film, which transforms incident x-ray photons either into a visible image or into another form which can be made into a visible image by further transformation.

"Inherent filtration" means the filtration of the useful beam by permanently installed components of the tube housing assembly.

"Kilovolts peak (kVp)" (See "Peak tube potential")

"Lead equivalent" means the thickness of lead affording the same attenuation, under specified conditions, as the material in question.

"Leakage radiation" means all radiation emanating from the tube housing except the useful beam and radiation produced when the exposure switch or timer is not activated.

"Leakage technique factors" means the technique factors associated with the diagnostic source assembly that are used in measuring leakage radiation. Included are:

For capacitor energy storage equipment, the maximum-rated peak tube potential and the maximum-rated number of exposures in an hour for operation at the maximum-rated peak tube potential with the quantity of charge per exposure being 10 millicoulombs (mAs) or the minimum obtainable from the unit, whichever is larger;

For field emission equipment rated for pulsed operation, the maximum-rated peak tube potential and maximum-rated number of x-ray pulses in an hour for operation at the maximum-rated peak tube potential; and

For all other source assemblies, the maximum-rated peak tube potential and maximum-rated continuous tube current for the maximum-rated peak tube potential.

"mA" means milliampere.

"Mammographic x-ray system" means an x-ray system that is specifically engineered to image human breasts.

"mAs" means milliampere second.

"Mobile equipment" (See "X-ray equipment")

"Peak tube potential" means the maximum value of the potential difference across the x-ray tube during an exposure.

"Phantom" means a volume of material that behaves in a manner similar to tissue with respect to the attenuation and scattering of radiation. (i.e. "Breast phantom" means an artificial test object that simulates the average composition of, and various structures in the breast.)

"Phototimer" (See automatic exposure control)

"Portable equipment" (See X-ray equipment")

"Primary protective barrier" (See "Protective barrier")

"Protective apron" means an apron made of radiation, absorbing material used to reduce radiation exposure.

"Protective barrier" means a barrier of radiation- absorbing material used to reduce radiation exposure.

"Primary protective barrier" means the material, excluding filters, placed in the useful beam.

"Secondary protective barrier" means the material which attenuates stray radiation.

"Protective glove" means a glove made of radiation- absorbing material used to reduce radiation exposure.

"Scattered radiation" means radiation that, during passage through matter, has been deviated in direction. (See "Direct scattered radiation")

"Screen" or "intensifying screen" means a device that converts the energy of the x-ray beam into visible light that interacts with the radiographic film, forming a latent image, or contains photostimulable phosphor plates that upon exposure, emit visible or nonvisible light to create an image.

"Secondary protective barrier" (See "Protective barrier")

"Shutter" (See collimator).

"Source" means the focal spot of the x-ray tube.

"Source-image receptor distance (SID)" means the distance from the source to the center of the input surface of the image receptor.

"Spot check" means an abbreviated calibration procedure which is performed to assure that a previous calibration continues to be valid. Also, a spot film may be taken to improve visualization by arresting motion and to document medical observations. Note that in some cases, a film may not be created.

"Stationary equipment" (See "X-ray equipment")

"Stray radiation" means the sum of leakage and scattered radiation.

"System"- (See x-ray system)

"Technique chart" means a tabulation of technique factors.

"Technique factors" means the following conditions of operation:

For capacitor energy storage equipment, peak tube potential in kV and quantity of charge in mAs;

For field emission equipment rated for pulsed operation, peak tube potential in kV, and number of x-ray pulses;

For CT x-ray systems designed for pulsed operation, peak tube potential in kV, scan time in seconds, and either tube current in mA, x-ray pulse width in seconds, and number of x-ray pulses per scan, or the product of tube current, x-ray pulse width, and number of x-ray pulses in mAs;

For CT x-ray systems not designed for pulsed operation, peak tube potential in kV, and either tube current in mA and scan time in seconds, or the product of tube current, exposure time in mAs, when the scan time and exposure time are equivalent; and

For all other equipment, peak tube potential in kV, and either tube current in mA and exposure time in seconds, or the product of tube current and exposure time in mAs.

"Treatment simulator" means a diagnostic x-ray system that duplicates a medical particle accelerator or other teletherapy in terms of its geometrical, mechanical, and optical qualities; the main function of which, is to display radiation treatment fields so that the target volume may be accurately included in the area of irradiation without delivering excess radiation to surrounding normal tissue.

"Tube" means x-ray tube unless otherwise specified.

"Tube housing assembly" means the tube housing with the tube installed. It includes high-voltage or filament transformers and other elements contained within the tube housing.

"Tube rating chart" means the set of curves that specify the rated limits of operation of the tube in terms of the technique factors.

"Useful beam" means the radiation emanating from the tube housing port or the radiation head and passing through the aperture of the beam-limiting device when the exposure controls are in a mode that causes the system to produce radiation.

"Visible area" means that portion of the input surface on the image receptor over which incident x-ray photons are producing a visible image.

"X-ray equipment" means an x-ray system, subsystem, or component described further by the following terms:

Mobile means x-ray equipment mounted on a permanent base with wheels or casters for moving while completely assembled.

Portable means x-ray equipment designed to be hand-carried.

Stationary means x-ray equipment installed in a fixed location.

Transportable mobile means x-ray equipment installed in a vehicle or trailer.

"X-ray system" means an assemblage of components for the controlled production of x-rays. It includes, at minimum, an x-ray high-voltage generator, an x-ray control, a tube housing assembly, a beam-limiting device, and the necessary supporting structures. Additional components that function with the system are considered integral parts of the system.

"X-ray tube" means any electron tube that is designed for the conversion of electrical energy into x-ray energy. For purposes of the rules contained in 12 A.A.C. 1, this term is synonymous with "tube".

Historical Note

Former Rule Section F.2; Former Section R12-1-602 repealed, new Section R12-1-602 adopted effective June 30, 1977 (Supp. 77-3). Amended effective August 8, 1986 (Supp. 86-4). Amended effective January 2, 1996 (Supp. 96-1). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-603. Operational Standards, Shielding, and Darkroom Requirements

A. A person shall not make, sell, lease, transfer, lend, or install x-ray equipment or the supplies used in connection with the equipment unless the supplies and equipment, when properly placed in operation and properly used, meets the requirements of 12 A.A.C. 1.

B. A registrant shall direct the operation of x-ray machines under the registrant's control and assure that all of the following provisions are met in the operation of x-ray machines:

1. The registrant shall not permit any individual to engage in the practice of "Healing Arts Radiography" using equipment under the registrant's control, unless the individual possesses a valid certificate issued by, or is exempt from, the Medical Radiologic Technology Board of Examiners.
2. The registrant shall maintain records documenting compliance with subsection (B)(1) for each individual using equipment under the registrant's control practicing "Healing Arts Radiography."
3. The registrant shall provide safety rules to each individual operating x-ray equipment under the registrant's control, including any restrictions in operating procedures necessary for the safe use of the equipment and require that the operator demonstrate familiarity with 12 A.A.C. 1.

C. Shielding

1. Each registrant shall provide each installation with primary and secondary protective barriers that are necessary to assure compliance with 12A.A.C. 1, Article 4.
2. A registrant shall ensure that attenuation provided by a protective barrier meets or exceeds the level of protection established in the National Council on Radiation Protection Report No. 49, "Structural Shielding Design and Evaluation for Medical Use of X-rays and Gamma Rays of Energies Up To 10 MeV," September 15, 1976 Edition edition, published by the National Council on Radiation Protection and Measurement, Inc., which is incorporated by reference and on file with the Agency. This incorporation by reference contains no future editions or amendments. Each registrant shall use this incorporated reference to provide sufficient shielding to prevent public exposure in excess of the limits in R12-1-416.
3. A registrant shall:
   a. Mount each lead barrier so that the barrier will not sag or cold flow because of its own weight and protect the barrier from damage;
   b. Use barriers designed so that joints between different ends of protective material do not impair the overall protection of the barriers;
   c. Use barriers designed so that joints at the floor and ceiling do not impair the overall protection of the barriers;
   d. Use windows, window frames, doors, and door frames that have the same lead equivalence required in the adjacent walls; and
   e. Cover holes in protective barriers so that overall attenuation is not impaired.
4. A registrant shall also meet the structural shielding requirements in R12-1-607(C), if the x-ray system in question is not fluoroscopic or intraoral.

D. Darkroom Requirements. A registrant shall:

1. Use a darkroom that is light-tight as determined under one of the following formulas:

a. (Base + Fog) - Base ≤ 0.03 optical density units; or
b. Using an exposed film, (Base + Fog) - Base ≤ 0.10 optical density units.
Note: Base is the optical density of unexposed film as used at the facility; (Base + Fog) is the optical density of Base unexposed film exposed in the darkroom for two minutes.

2. Use a thermometer and timer operable and appropriate to the type of film processing in the darkroom; and
3. Develop film according to the manufacturer's instructions.

Historical Note
Former Rule Section F.3; Former Section R12-1-603 repealed, new Section R12-1-603 adopted effective June 30, 1977 (Supp. 77-3). Amended effective August 8, 1986 (Supp. 86-4). Amended effective January 2, 1996 (Supp. 96-1). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-604. General Procedures

A. The registrant shall ensure the following procedural requirements are met in the operation of x-ray equipment:
1. An x-ray machine which does not meet the provisions of this Chapter shall not be operated for diagnostic or therapeutic purposes, unless specifically exempted by the Agency.
2. Except for patients who cannot be moved out of the room, only the individuals required for the radiological procedure or in training may be present in the room during radiographic exposure, and all the following requirements apply:
   a. All individuals shall be positioned such that no part of the body, including the extremities not protected by 0.5 mm lead equivalent, will be struck by the useful beam.
   b. Staff and ancillary personnel shall be protected from the direct scatter radiation by protective aprons or whole body protective barriers of not less than 0.25 mm lead equivalent.
   c. Individuals, other than the patient to be examined, who cannot be removed from the room during mobile or portable radiography shall be protected from the direct scatter radiation by whole body protective barriers of 0.25 mm lead equivalent or shall be so positioned that the nearest portion of the body is at least 2 meters (6.5 feet) from both the tube head and the nearest edge of the image receptor.
   d. If a portion of the body of any staff or ancillary personnel is potentially subjected to stray radiation that could result in that individual receiving 10% of the maximum permissible dose as defined in Article 4 of this Chapter, the registrant shall provide additional protective devices as specified by the Agency.
3. An individual shall not be exposed to the useful beam except for a healing arts purpose authorized by a licensed practitioner of the healing arts. The following acts are prohibited:
   a. Exposure of an individual without meeting the required healing art requirements and without a valid directive from a licensed practitioner;
   b. Exposure of an individual for training, demonstration, or other non-healing arts purpose;
   c. Exposure of an individual for the purpose of healing arts screening, except as authorized by the Agency after submitting to the Agency the information listed in Appendix A of this Article. If any information submitted to the Agency changes, the registrant shall immediately notify the Agency of the changes.
4. All persons who are associated with the operation of an x-ray system are subject to the occupational exposure limits specified in Article 4. Exposure of a personnel monitoring device to deceptively indicate a dose delivered to an individual is prohibited.

B. The registrant shall maintain the following records for each x-ray machine:
1. Maximum rating of technique factors.
2. Aluminum equivalent filtration of the useful beam, including any routine variation.
3. Tube rating charts and cooling curves.
4. Record of surveys, calibrations, maintenance, modifications (from the original schematics and drawings) performed on the x-ray machine or room after the effective date of these rules, along with the names of persons who performed the service.
5. A copy of all correspondence with the Agency regarding the x-ray machine facility.

Historical Note
Adopted effective June 30, 1977 (Supp. 77-3). Amended effective August 8, 1986 (Supp. 86-4). Amended effective January 2, 1996 (Supp. 96-1). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-605. X-ray Machine Standards

A. A registrant shall prevent leakage radiation from the diagnostic source assembly measured at a distance of 1 meter in any direction from the source assembly from exceeding 25.8 μC/kg (100 milliroentgens) in 1 hour when the x-ray tube is operated at its leakage technique factors. The Agency shall determine compliance by obtaining measurements averaged over an area of 100 square centimeters (15.5 square inches) with no linear dimension greater than 20 centimeters (7.9 inches).

B. The registrant shall prevent radiation emitted by a component other than the diagnostic source assembly from exceeding 516 nC/kg (2 milliroentgens) in 1 hour at 5 centimeters from any accessible surface of the component when it is operated in an assembled x-ray system under any conditions for which it was designed. The Agency shall determine compliance by obtaining measurements averaged over an area of 100 square centimeters (15.5 square inches) with no linear dimension greater than 20 centimeters (7.9 inches).

C. Beam quality.
1. The registrant shall prevent the useful beam half-value layer (HVL) for diagnostic x-ray given x-ray tube potential from falling below the values shown in Table I. If it is necessary to determine the half-value layer at an x-ray tube potential that is not listed in Table I, the registrant shall use linear interpolation or extrapolation to make the determination.

Table I

Design operating range (kilovolts peak)	*Measured potential (kilovolts peak)*	*Half-value layer (millimeters of aluminum)*
Below 51	30	0.3
	40	0.4
	50	0.5
51 to 70	51	1.2
	60	1.3
	70	1.5

Above 70	71	2.1
	80	2.3
	90	2.5
	100	2.7
	110	3.0
	120	3.2
	130	3.5
	140	3.8
	150	4.1

2. If the registrant demonstrates that the aluminum equivalent of the total filtration in the primary beam is not less than that shown in Table II, the registrant is considered to have met the criteria in subsection (C)(1).

Table II - Filtration Required vs. Operating Voltage

Operating Voltage (kVp)	*Total Filtration (inherent plus added) (millimeters aluminum equivalent)*
Below 51	0.5 millimeters
51 - 70	1.5 millimeters
Above 70	2.5 millimeters

3. The registrant shall use beryllium window tubes that have a minimum of 0.5 mm aluminum equivalent filtration permanently mounted in the useful beam.
4. For capacitor energy storage equipment, the Agency shall determine compliance with the maximum quantity of charge per exposure.
5. When determining the minimum aluminum equivalent filtration The registrant shall include the filtration contributed by all materials that are always present between the focal spot of the tube and the patient (for example, a tabletop when the tube is mounted "under the table" and inherent filtration of the tube).

D. Multiple tubes. If two or more radiographic tubes are controlled by one exposure switch, the operator shall clearly indicate which tube or tubes have been selected before initiation of the exposure, activating one light on the x-ray control panel and a second light at or near the tube housing assembly, each indicating the tube or tubes that have been selected.

E. Mechanical support of tube head. The registrant shall adjust the tube housing assembly supports so that the tube housing assembly will remain stable during an exposure, unless the tube housing movement is a designed function of the x-ray system.

F. Exposure reproducibility. The coefficient of variation shall not exceed 0.10 when all technique factors are held constant. This requirement is satisfied if the value of the average exposure (E) is greater than or equal to five times the difference between the maximum exposure (Emax) and minimum exposure (Emin) when four exposures are made at identical technique factors, [$E \geq 5(Emax - Emin)$].

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Amended subsections (A) and (B) effective August 8, 1986 (Supp. 86-4). Amended effective January 2, 1996 (Supp. 96-1). Amended effective June 13, 1997 (Supp. 97-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-606. Fluoroscopic and Fluoroscopic Treatment Simulator Systems

A. Useful beam limitation. A registrant shall:
1. Provide beam-limiting devices that restrict the entire cross section of the useful beam to less than the area of the primary barrier at any Source-to-Image Receptor Distance (SID).
2. Ensure that the x-ray field size produced by fluoroscopic systems without image intensification l does not extend beyond the visible area of the image receptor at any SID;
3. Ensure that the x-ray field size produced by fluoroscopic systems with image intensification and automatic shutter control does not exceed the diameter of the image receptor at any SID
4. Ensure that the x-ray field size produced by fluoroscopic systems with image intensification and manual shutter control does not exceed the diameter of the image receptor with the fluoroscopic imaging assembly positioned at the maximum usable distance above the table top; and
5. Ensure that the x-ray field size produced by fluoroscopic systems with image intensification and manual shutter control, where the fluoroscopic tube is above the table top, does not exceed the diameter of the image receptor with the shutters open to the fullest extent, and at the maximum SID which the fluoroscopic tube is capable of producing radiation.

B. Fluoroscopic primary protective barrier. A registrant shall
1. Provide the fluoroscopic imaging assembly with a primary protective barrier that always intercepts the entire cross section of the useful beam at any SID.
2. Ensure that the fluoroscopic tube is not capable of producing radiation unless the primary protective barrier is in a position to intercept the entire cross section of the useful beam.
3. Ensure that fluoroscopic radiation production automatically terminates if the primary protective barrier is removed from the useful beam.
4. Ensure that the fluoroscopic primary protective barrier meets the following requirements for attenuation of the useful beam:
   a. For equipment installed before November 15, 1967, the required lead equivalent of the barrier l is not less than 1.5 millimeters for fluoroscopes that produce less than 100 kVp, 1.8 millimeters for fluoroscopes that produce from 100 kVp up to 125 kVp, and 2.0 millimeters for fluoroscopes that produce 125 or more kVp. (For conventional fluoroscopes, these requirements may be assumed to have been met if the exposure rate measured at the viewing surface of the fluorescent screen does not exceed 12.9 µC/kg (50 milliroentgens) per hour with the screen in the primary beam of the fluoroscope without a patient, under normal operating conditions.) For equipment installed or reinstalled, the required lead equivalent of the barrier is 2.0 millimeters for up to 125 kVp or 2.7 millimeters for 125 or more kVp.
   b. For fluoroscopic systems that use image intensification, the exposure rate, due to transmission through the primary protective barrier, does not exceed 516 nC/kg (2 milliroentgens) per hour at 10 centimeters (4 inches) from any accessible surface of the fluoroscopic imaging assembly, beyond the plane of the image receptor for each 258µC /kg (1 roentgen) per minute of entrance exposure rate.
   c. Compliance with subsections (B)(4)(a) and (b) is determined with the image receptor positioned 35.5

centimeters (14 inches) from the panel or table top, at normal operating technical factors and with the attenuation block in the useful beam for systems with image intensification.

C. Entrance exposure rate limits. A registrant shall ensure that:
1. The exposure rate, measured at the point where the center of the useful beam enters the patient does not exceed 2.6 mC/kg (10 roentgens) per minute at any combination of tube potential and current, except during recording of fluoroscopic images or if provided with optional high- level control.
2. If provided with optional high-level control, the equipment is not operable at any combination of tube potential and current that will result in an exposure rate in excess of 2.6 mC/kg (10 roentgens) per minute at the point where the center of the useful beam enters the patient, unless the high-level control is activated, in which case an exposure rate in excess of 5.2 mC/kg (20 roentgens) per minute is prohibited.
   a. Special means of activation of high-level controls, such as additional pressure applied continuously by the operator, are required to avoid accidental use.
   b. A continuous signal audible to the fluoroscopist is required to indicate that the high-level control is being employed.
3. The Agency shall determine compliance with subsections (C)(1) and (C)(2) as follows:
   a. Remove grids and compression devices from the useful beam during the measurement;
   b If the source is below the table, measure the exposure rate 1 centimeter above the table top or cradle; and
   c. If the source is above the table, measure the exposure rate 30 centimeters (11.8 inches) above the table top with the end of the beam-limiting device or spacer positioned as closely as possible to the point of measurement;
   d. For fluoroscopy involving a mobile C-arm x-ray system, measure the exposure rate 30 centimeters (11.8 inches) from the input surface of the fluoroscopic imaging assembly;
   e. For fluoroscopy involving a C-arm x-ray system, measure the exposure rate 30 centimeters (11.8 inches) from the input surface of the fluoroscope imaging assembly, with the x-ray source positioned at any available SID, provided that the end of the beam-limiting device or spacer is not closer than 30 centimeters (11.8 inches) from the input surface of the fluoroscopic image assembly; and
   f. For a lateral-type fluoroscope, measure the exposure rate 15 centimeters (5.9 inches) from the centerline of the x-ray table and in the direction of the x-ray source with the end of the beam-limiting device or spacer positioned as closely as possible to the point of measurement. If the tabletop is movable, it shall be positioned as closely as possible to the lateral x-ray source, with the end of the beam-limiting device or spacer no closer than 15 centimeters (5.9 inches) to the centerline of the x-ray table.

D. The registrant shall ensure that the source-to-skin distance is not less than:
1. 38 centimeters (15 inches) on stationary fluoroscopes installed after January 2, 1996;
2. 35.5 centimeters (14 inches) on stationary fluoroscopes which are in operation before January 2, 1996;
3. 30 centimeters (11.8 inches) on all mobile fluoroscopes; and
4. 20 centimeters (8 inches) for image-intensified fluoroscopes used for a specific surgical application. The registrant shall follow any precautionary measures in the users operating manual.

E. Each fluoroscopic system installation is subject to all of the following requirements for the control of stray radiation. A registrant shall:
1. Provide a shielding device of at least 0.25 millimeter lead equivalent for covering the Bucky-slot during fluoroscopy;
2. Except for fluoroscopy performed using portable or mobile C-arm x-ray systems or during surgical procedures or cardiac catheterization, provide protective drapes, or hinged or sliding panels of at least 0.25 millimeters lead equivalent, between the patient and fluoroscopist to intercept scattered radiation that would otherwise reach the fluoroscopist and others near the machine, but not substitute drapes and panels for a protective apron; and
3. Ensure that protective aprons of at least 0.25 millimeter lead equivalent are worn in the fluoroscopy room by each person, except the patient, whose body is likely to be exposed to 50 µSv/hr (5 mR/hr) or more.

F. Exposure control. A registrant shall:
1. Ensure that activation of the fluoroscopic tube is controlled by a “dead-man” switch;
2. Provide a manual reset cumulative timing device, which is activated only during production of radiation in the fluoroscopic mode, to indicate elapsed time by an audible signal or terminate production of radiation;
3. Provide a device for exposure control in the “spot film” mode that terminates exposure either automatically, or after a preset time interval, preset number of pulses, preset product of current and time, or preset exposure; and
4. Ensure that the x-ray tube potential and current are continuously indicated.

G. A registrant shall provide systems used for mobile fluoroscopy with image intensification.

H. Fluoroscopic treatment simulators. Simulators are exempt from subsections (A) through (G). A registrant shall:
1. Use a beam limiting device that restricts the beam to the area of clinical interest.
2. Include and label devices for settings or physical factors, such as kVp, mA, or exposure time on the control panel;
3. Ensure that the fluoroscopic exposure switch or switches are of the “deadman” type;
4. Ensure that each person whose presence is necessary is in the simulator room during exposure and protected with a lead apron of at least 0.5 mm lead equivalent or a portable shield. Any person who places their hands in the useful x-ray beam shall wear leaded gloves; and
5. Ensure that the operator stands behind a barrier and is able to observe the patient during simulator exposures.

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Former Section R12-1-606 repealed, new Section R12-1-606 adopted effective August 8, 1986 (Supp. 86-4). Amended effective January 2, 1996 (Supp. 96-1). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-607. Additional X-ray Machine Standards, Shielding Requirements, and Procedures, Except Fluoroscopic and Dental Intraoral Radiographic Systems

A. Useful beam limitation. A registrant shall:
1. Provide a means to restrict the useful beam to the area of clinical interest for any combination of SID and image receptor size employed
2. Ensure that beam-limiting devices meet the following requirements:
   a. Devices that project a circular radiation field restrict the diameter of the useful beam, not to exceed the diagonal dimension of the image receptor by greater than 2% of the SID;
   b. Devices that project a rectangular or square radiation field restrict the useful beam to the longitudinal and transverse dimensions of the image receptor to within 2% of the SID;
   c. Beam limiting devices that do not incorporate light beams to define the projected radiation field are clearly labeled, indicating the SID and image receptor size at which each device complies with the applicable requirements of subsection (A)(2)(a) or (b);
   d. Adjustable beam-limiting devices installed after July 31, 1971, incorporate light beams to define the projected dimensions of the useful beam and provide an average illumination of not less than 100 lux (9 foot-candles) at 1 meter (3.3 feet) or at the maximum SID, whichever is less. The average illumination shall be based upon measurements made in the approximate center of each quadrant of the light field; and
   e. All beam-limiting devices installed, on general purpose fixed and mobile radiographic systems, provide stepless means of continuous adjustment of the projected radiation field size.
3. Provide a means to align the center of the radiation field to the center of the image receptor to within 2% of the SID.

B. Radiation exposure control. A registrant shall:
1. Provide a means to terminate the exposure at a preset time interval, preset product of current and time, preset number of pulses, or a preset exposure to the image receptor. The registrant shall ensure that it is not possible to make an exposure when the exposure control device is set to a "zero" or "off" position if either position is provided.
2. Ensure that the exposure switch is a "dead-man" switch, and except for those used with "spot-film" devices in fluoroscopy, is arranged so that it cannot be conveniently operated outside a shielded area.
3. Provide x-ray systems with automatic exposure control, which indicates at the control panel when this mode is selected, and a visual and audible signal, which indicates termination of the exposure.
4. Use a control panel that includes:
   a. A device (usually a milliammeter) that will give a positive indication during radiation production; and
   b. Control setting indicators or meters that indicate the appropriate technical factors: kVp, mAs mA, or exposure time, and any special mode selected for the exposure.

C. Structural shielding. A registrant shall:
1. Ensure that all wall, floor and ceiling areas struck by the useful beam have primary protective barriers. Primary protective barriers in walls shall extend from the finished floor to a minimum height of 2.13 meters (7 feet);
2. Ensure that secondary protective barriers are provided in all wall, floor, and ceiling areas that do not have primary protective barriers or where the primary protective barrier requirements are lower than the secondary barrier requirements;
3. Ensure that the operator's station is behind a protective barrier sufficient to ensure compliance with R12-1-408, R12-1-414, and R12-1-416, and the operator is able to communicate with the patient from the operator's station.
4. Provide a window of transparent material equal in attenuation to that required by the adjacent barrier, or a mirror system, that is large enough and placed so that the operator can see the patient during exposure without having to leave the protected area.

D. Operating procedures. A registrant shall:
1. Use mechanical supporting or restraining devices, if a patient must be held in position for radiography. If the patient must be held by an individual, the registrant shall ensure that the individual is protected with appropriate shielding devices, such as protective gloves and apron, and is positioned so that no part of the body of the individual holding the patient is struck by the useful beam;
2. Ensure that only individuals required for the radiographic procedure are in the radiographic room during exposure, and, except for the patient, all these individuals are equipped with protective devices;
3. Restrict the useful beam to the clinical area of interest;
4. Provide a chart in the vicinity of the diagnostic x-ray system's control panel that specifies, for all routine examinations performed with the system, the following information:
   a. Patient's anatomical size and technique factors;
   b. Type and size of the film or film screen combination;
   c. Type and focal distance of the grid, if any;
   d. X-ray source-to-image receptor distance; and
   e. Type and location of gonad shielding.
5. Provide documentation of the patient's identity, the x-ray examination performed, the date it is performed, number of projections (if applicable), and a method of identifying the individual who performed the examination, for Agency review. The registrant shall maintain the documentation for three years from the date the examination is performed.

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Former Section R12-1-607 repealed, new Section R12-1-607 adopted effective August 8, 1986 (Supp. 86-4). Amended effective January 2, 1996 (Supp. 96-1). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-608. Mobile Diagnostic Radiographic Systems, Except Dental Intraoral Radiographic Systems

A. Equipment
1. All requirements of R12-1-607(A) and (B) apply.
2. A registrant shall provide a "dead-man" switch, together with an electrical cord of sufficient length so that the operator can stand out of the useful beam and at least 1.82 meters (6 feet) from the patient during all x-ray exposures
3. A registrant shall ensure that a cone, spacer frame, or inherent provision is made so that the equipment is not operated at source-skin distances of less than 20.3 centimeters (8 inches).

B. Structural shielding. If a mobile unit is used routinely in one location, it is considered a fixed installation subject to the shielding requirements in R12-1-603(C), and R12-1-607(C).

C. Operating procedures
1. All provisions of R12-1-607(D) apply.
2. An individual who operates a mobile x-ray system shall comply with R12-1-419(B).

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Amended subsections (A) and (C) effective August 8, 1986 (Supp. 86-4). Amended effective January 2, 1996 (Supp. 96-1). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-609. Chest Photofluorographic Systems

A. Equipment
1. All provisions of R12-1-607(A) and (B) apply.
2. A collimator shall restrict the useful beam to the area of the photofluorographic screen.

B. Structural shielding. All provisions of R12-1-603(C) and R12-1-607(C) apply.

C. Operating procedures
1. All provisions of R12-1-607(D) apply.
2. All individuals except the patient being examined shall be in shielded positions during exposures.
3. Personnel monitoring shall be worn by persons operating photofluorographic systems in accordance with R12-1-419(B).

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Amended subsections (A) and (C) effective August 8, 1986 (Supp. 86-4). Amended effective January 2, 1996 (Supp. 96-1). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-610. Dental Intraoral Radiographic Systems

A. Equipment. A registrant shall:
1. Use a protective tube housing of diagnostic type.
2. Use diaphragms or cones for restricting the useful beam and to provide the same degree of protection as the housing. The diameter of the useful beam at the end of the cone or spacer frame shall not be more than 7.6 centimeters (3 inches) for intraoral radiography.
3. Ensure that a cone or spacer frame provides a source-to-skin distance of not less than 17.8 centimeters (7 inches) with apparatus operating above 50 kVp or 10 centimeters (4 inches) with apparatus operating at 50 kVp or below for intraoral radiography:
4. Provide a timer to terminate the exposure at a preset time interval, a preset product of current and time, a preset number of pulses, or a preset radiation exposure to the image receptor;
5. Ensure that it is not possible to make an exposure if the timer is set to the “zero” or “off” position;
6. Ensure that the tube head remains stationary if placed in the exposure position;
7. Ensure that the exposure initiating device is a “dead-man” switch; and
8. Use a control panel that includes:
   a. A device that will give positive indication during radiation production; and
   b. Indicators, labeled control settings, or meters, indicating the appropriate technical factors: kVp, mA, or exposure time, and any special mode selected for the exposure.

B. Structural shielding. The registrant shall:
1. Provide dental installations with primary and secondary barriers to ensure compliance with the personnel exposure requirements in Article 4 of this Chapter;
2. Install primary protective barriers between rooms or areas if dental x-ray units are used in adjacent rooms or areas;
3. Provide each installation with a protective barrier for the operator or arrange the installation so that the operator can stand at least 1.82 meters (6 feet) from the patient and well away from the useful beam;
4. Arrange the operator’s position to allow visual contact with the patient during exposure; and
5. Comply with fixed installation requirements, if a mobile unit is used routinely in one location.
   Note: In many cases structural materials of ordinary walls suffice as a protective barrier without addition of special shielding material.

C. Operating procedures
1. A dentist or other persons shall not hold patients or films during exposure. Only persons required for the radiographic procedure are allowed in the radiographic room during exposures.
2. An operator shall stand at least 1.82 meters (6 feet) from the patient or behind a protective barrier during each exposure.
3. An operator shall ensure that only the patient is in the useful beam.
4. The licensed practitioner or other person shall not hold the tube housing or the cone during the exposure.
5. A registrant shall not perform dental fluoroscopy without an image intensifier.

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Amended effective August 8, 1986 (Supp. 86-4). Amended January 2, 1996 (Supp. 96-1). Amended effective June 13, 1997 (Supp. 97-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-611. Therapeutic X-ray Systems of Less Than 1 MeV

A. Equipment requirements.
1. Leakage radiation. A registrant shall ensure that:
   a. Contact therapy systems. Leakage radiation l does not exceed 25.8 μC/kg (100 milliroentgens) per hour at 5 centimeters (2 inches) from the surface of the tube housing assembly.
   b. 0-150 kVp systems. Systems that are manufactured or installed before January 2, 1996 l have a leakage radiation that does not exceed 258 nC/kg (1 roentgen) in 1 hour at 1 meter (3.3 feet) from the source.
   c. 0-150 kVp systems. Systems that are manufactured on or after January 2, 1996, l have a leakage radiation that does not exceed 25.8 μC/kg (100 milliroentgens) in 1 hour at 1 meter from the source.
   d. Above 150 kVp. The leakage radiation does not exceed 258 nC/kg (1 roentgen) in 1 hour at 1 meter (3.3 feet) from the source except systems that operate in excess of 500 kVp may have a leakage radiation at 1 meter from the source equivalent to the exposure within 1 hour of the useful beam at 1 meter (3.3 feet) from the source multiplied by a factor of 0.001.
2. Permanent beam limiting devices. A registrant shall ensure that fixed diaphragms or cones used for limiting the useful beam provide the same or higher degree of protection as required for the tube housing assembly.
3. Removable and adjustable beam-limiting devices. A registrant shall ensure that:

a. Removable and adjustable beam-limiting devices l, for the portion of the useful beam to be blocked by these devices, transmit not more than one percent of the original x-ray beam at the maximum kilovoltage and maximum treatment filter; and
b. Adjustable beam-limiting devices installed before the effective date of this Section, for the portion of the x-ray beam to be blocked by these devices, transmit not more than 5 percent of the useful x-ray beam at maximum kilovoltage and maximum treatment filter.

4. Filter system. A registrant shall ensure that the filter system is designed so that:
   a. Filters cannot be accidentally displaced from the useful beam at any possible tube orientation;
   b. Each filter is marked regarding its material of construction and its thickness or wedge angle for wedge filters; and
   c. It is possible for the operator to determine the presence or absence of each filter and the orientation of each wedge filter in the useful beam if the operator is at the control panel, either by display at the control panel or by direct observation.
5. X-ray tube immobilization. A registrant shall ensure that the tube housing assembly is capable of being immobilized during stationary treatments.
6. Focal spot marking. A registrant shall ensure that the tube housing assembly is marked so that it is possible to determine the location of the focal spot to within 5 millimeters, and the marking is readily accessible for use during calibration procedures.
7. Therapy treatment timers. A registrant shall:
   a. Provide a timer that has a display at the treatment control panel. The timer shall be graduated in minutes and fractions of minutes. The timer shall have a preset time selector and an elapsed time indicator;
   b. Ensure that the timer is a cumulative timer that activates with the radiation, retains its reading after irradiation is interrupted or terminated, and requires the operator to reset the preset time selector after irradiation is terminated and before irradiation can be reinitiated;
   c. Ensure that the timer terminates irradiation when a preselected time has elapsed;
   d. Ensure that the timer permits accurate presetting and determination of exposure times as short as 1 second;
   e. Ensure that the timer does not permit an exposure if set at 0; and
   f. Ensure that the timer does not activate until the shutter is opened if irradiation is controlled by a shutter mechanism.
8. Control panel functions. In addition to the displays required in other provisions of this Section, a registrant shall ensure that a control panel has:
   a. An indication of whether electrical power is available at the control panel and if activation of the x-ray tube is possible;
   b. An indication of whether x-rays are being produced;
   c. A means for indicating kVp and x-ray tube current;
   d. A means for terminating an exposure at any time;
   e. A locking device that will prevent unauthorized use of the x-ray system; and
   f. For x-ray equipment installed after January 2, 1996, a positive display of specific filters in the beam.
9. Multiple tubes. If one control panel is used to energize more than one x-ray tube a registrant shall ensure that:
   a. It is possible to activate only one x-ray tube during any time interval;
   b. There is an indication at the control panel that identifies which x-ray tube is energized; and
   c. There is an indication at the tube housing assembly when that tube is energized.
10. Source-to-patient distance. A registrant shall ensure that there is a means of determining the source-to-patient distance to within 1 centimeter.
11. Shutters. Unless it is possible to bring the x-ray output to the prescribed exposure parameters within 5 seconds, a registrant shall ensure that the entire useful beam is automatically attenuated by a shutter with a lead equivalency not less than that of the tube housing assembly. In addition the registrant shall ensure that:
    a. After the unit is at operating parameters, the operator controls the shutter electrically from the control panel; and
    b. An indication of shutter position appears at the control panel.
12. Low filtration x-ray tubes. A registrant shall ensure that each x-ray system equipped with a beryllium or other low-filtration window is clearly labeled as low-filtration equipment on the tube housing assembly and at the control panel.

B. Facility design requirements. In addition to shielding necessary to meet the requirements of Article 4 of this Chapter, a registrant shall ensure that:

1. Warning lights. A treatment room to which access is possible through more than one entrance has a warning light, in a readily observable position near the outside of any access doors, which will indicate when the useful beam is "on".
2. Voice communication. Two-way oral communication is possible between the patient and the operator at the control panel; or where excessive noise levels make oral communication impractical, another effective method of communication.
3. Viewing systems. Windows, mirrors, closed-circuit television, or an equivalent system, permits continuous observation of the patient during irradiation and is located so that the operator can observe the patient from the control panel. If the primary viewing system is by electronic means (for example, television), the registrant shall have an alternate viewing system for use in the event of electronic failure.
4. Systems above 150kVp. For treatment rooms that contain an x-ray system capable of operating above 150 kVp a registrant shall ensure that:
   a. All necessary shielding, except for any beam interceptor, is provided by fixed barriers;
   b. The control panel is within a protective booth equipped with an interlocked door, or located outside the treatment rooms;
   c. All doors of the treatment room are electrically connected to the control panel so that x-ray production cannot occur unless all doors are closed; and
   d. Opening of any door to the treatment room during exposure results in automatic termination of x-ray production or reduction of radiation levels to an average of no more than 516 nC/kg (2 milliroentgens) per hour and a maximum of 2.6 μC/kg (10 milliroentgens) per hour at a distance of 1 meter (3.3 feet) from the target in any direction, and restoration

of the machine to full operation is possible only from the control panel after the termination or reduction.

C. Surveys. A registrant shall ensure that:
1. All facilities, both new and existing, or not previously surveyed, are surveyed before being put into service for the treatment of patients by, or under the direction of, a person trained and experienced in the principles of radiation protection, and perform additional surveys of a facility after any change in the facility or a facility's equipment that might cause a significant increase in radiation hazard, before being put into service for the treatment of patients.
2. The person conducting the survey reports the person's findings in writing to the individual in charge of the facility and maintains a copy of the report for inspection by the Agency.
3. The installation is operated in compliance with any limitations indicated by the protection survey required by subsection (C)(1).

D. Calibrations. A registrant shall ensure that:
1. The calibration of an x-ray system includes, but is not limited to, the following determinations:
   a. Verification that the x-ray system is operating in compliance with the design specifications;
   b. The dose rate equivalent for each combination of field size, technique factors, filter, and treatment distance used;
   c. The degree of congruence between the radiation field and the field indicated by the localizing device if a localizing device is used; and
   d. An evaluation of the uniformity of the radiation field symmetry for the field sizes used and any dependence upon source housing assembly orientation;
2. The calibration of an x-ray system is performed at intervals not to exceed 12 months and after any change or replacement of components that could cause a change in the radiation output;
3. The calibration of the radiation output of the x-ray system is performed by, or under the direction of, a person trained and experienced in performing calibrations, who is physically present at the facility during calibration;
4. Calibration of the radiation output of an x-ray system is performed with a calibrated instrument. The registrant shall ensure that calibration of the instrument is directly traceable to the National Institute of Standards and Technology (NIST) and that the instrument has been calibrated within the preceding 24 months;
5. Records of calibration performed under subsection (D)(3) are maintained for at least two years after completion of the calibration and are made available for inspection by the Agency; and
6. A copy of the most recent calibration is available for use by the operator at the control panel.

E. Spot checks. A registrant shall ensure that spot checks are performed on x-ray systems capable of operation at greater than 150 kVp. The registrant shall ensure that spot checks meet the following requirements:
1. The spot-check procedures are in writing and have been developed by a qualified person;
2. The measurements taken during the spot checks demonstrate the degree of consistency of the operating characteristics that can affect the radiation output of the x-ray system;
3. The written spot-check procedure specifies the frequency of the tests or measurements, made at intervals not to exceed monthly;
4. The spot-check procedure identifies conditions that require recalibration of the system in accordance with subsection (D)(l); and
5. Records of spot-check measurements performed as required by subsection (E)(3) are maintained, available for inspection by the Agency, for three years following the measurements.

F. Operating procedures. A registrant shall ensure that:
1. Therapeutic x-ray systems are not left unattended unless the system is secured according to subsection (A)(8)(e);
2. If a patient must be held in position for radiation therapy, mechanical supporting or restraining devices are used;
3. The tube housing assembly is not held by an individual during exposures; and
4. At 150 kVp or more the patient is the only person in the treatment room during production of radiation. At less than 150 kVp an individual may be in the room with patient, provided the individual is protected by a barrier sufficient to meet the requirements of Article 4 of this Chapter.

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Former Section R12-1-611 repealed, new Section R12-1-611 adopted effective August 8, 1986 (Supp. 86-4). Amended effective January 2, 1996 (Supp. 96-1). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-612. Computerized Tomographic Systems

A. Definitions:
1. "CT" means computerized tomography.
2. "CT conditions of operation" means all selectable parameters governing the operation of a CT including, but not limited to, nominal tomographic section thickness, and technique factors.
3. "CTDI" means computed tomography dose index, the integral of the dose profile along a line perpendicular to the tomographic plane divided by the product of the nominal tomographic thickness and the number of tomogram produced in a single scan.
4. "CTN" means CT number, the number used to represent the x-ray attenuation associated with each elemental area of the CT image.
5. "Dose profile" means the dose as a function of position along a line.
6. "Elemental area" means the smallest area within a tomogram for which the x-ray attenuation properties of a body are depicted.
7. "Multiple tomogram system" means a CT system that obtains x-ray transmissions data simultaneously during a single scan to produce more than one tomogram.
8. "Nominal tomographic section thickness" means the full width at half-maximum of the sensitivity profile taken at the center of the cross section volume over which x-ray transmission data are collected.
9. "Reference plane" means a plane that is displaced from and parallel to the tomographic plane.
10. "Scan" means the complete process of collecting x-ray transmission data for the production of a tomogram.

B. Facility: A registrant shall ensure that a CT facility has:
1. An operable two-way communication system between the patient and the operator in each CT room.

2. A viewing system that will allow the operator to continuously view the patient from the control panel during each examination. If the viewing system malfunctions the CT shall not be used until the viewing system is repaired.

C. Equipment. A registrant shall ensure that:
1. There is a means to terminate x-ray exposure automatically in the event of equipment failure by:
   a. De-energizing the x-ray source; or
   b. Shuttering the x-ray beam.
2. The equipment shall provide the operator the ability to terminate the x-ray exposure at any time during the examination, provided the scan or series of scans is greater than one-half second duration.
   a. If an operator terminates an x-ray exposure, the operator shall reset the CT conditions of operation before the initiation of another scan.
   b. A visible signal shall indicate when an x-ray exposure has been terminated because of equipment failure.
3. A means is provided to permit visual determination of the tomographic plane for a single tomogram system, or the location of a reference plane offset from a single tomograph or multiple tomogram system.
   a. If a light source is used to satisfy this requirement, it shall provide illumination of the tomographic plane or reference plane under ambient light conditions.
   b. The difference between the actual plane location and the indicated location of a tomographic plane or reference plane shall not exceed 5 millimeters.
   c. The deviation of indicated scan increment versus actual increment shall not exceed plus or minus one millimeter with any mass from 0 to 100 kilograms resting on the patient support device.
4. The control panel and gantry provides a visual indication, if x-rays are produced.
5. Emergency buttons and switches are marked by function.
6. Parameters of CT operation used during a patient examination are visible to the operator upon initiation of the scan. If an operational parameter is not adjustable by the operator, this subsection may be met by indicating on the control panel the parameter is not adjustable by the operator.
7. Radiation exposure does not exceed 100 mR in one hour at one meter in any direction from the tube port of an operating CT.
8. The angular position or positions where the maximum surface CTDI occurs is identified to allow for reproducible positioning of a CT dosimetry phantom, except in those cases where the x-ray tubes are designed to move, in which case, the maximum dose and associated tube position shall be evaluated according to manufacturer recommendations.

D. Operating Procedures. A registrant shall ensure that:
1. Operating procedures are available at the control panel, or by electronic means, regarding the operation of a CT and evaluation of a CT's operation.
2. The operating procedures contain the following information:
   a. A copy of the latest evaluation of the CT's operation, to include output for each CT procedure, performed by a qualified expert;
   b. Instructions on the use of the CT performance phantom by the qualified expert, a schedule of quality control tests with the results of the most recent quality control test, and the allowable variations for the indicated parameters;
   c. The distance in millimeters between the tomographic plane and the reference plane if a reference plane is used; and
   d. A current technique chart that contains the information required in R12-1-607(D)(4)(a) for both adult and pediatric patients, as applicable, is available at the CT operating console, and a procedure for determining whether a CT has been performed according to instructions of a physician.
3. If the evaluation of the CT's operation or quality control test identifies a parameter exceeding the tolerance established by a qualified expert, the use of a CT for patient examination is limited to those uses established in written instructions from the qualified expert.

E. Quality control tests. A registrant shall have a written quality control test procedure, developed by a qualified expert, and ensure that the quality control test procedure:
1. Incorporates the use of a CT performance phantom that indicates:
   a. Contrast scale;
   b. Nominal tomographic section thickness;
   c. Resolution capability of the system for low and high contrast objects; and
   d. The mean CTN for water or other reference materials;
2. Is followed in the evaluation of the CT's operation, that the interval between tests does not exceed two months, and that system conditions are specified by the registrant's qualified expert.
3. Includes obtaining quality control test images with the CT performance phantom using the same processing mode and CT conditions of operation that are used to perform the evaluation of the CT's operation.
4. Requires that images obtained under subsection (E)(3) be retained until a new evaluation of the CT's operation is performed.
5. Requires the quality control test procedure and records of quality control tests performed be maintained for three years for Agency inspection.

F. Evaluation of a CT's operation. A registrant shall ensure that:
1. The evaluation of a CT's operation is performed by, or under the direct supervision of, a qualified expert who is physically present at the facility during the evaluation of the CT's operation.
2. The evaluation of a CT's operation:
   a. Is performed before initial patient use and annually (within two months of the annual due date) and after any change or replacement of components that could, in the opinion of the qualified expert, cause a change in radiation output; and
   b. Shall measure the CTDI in a dosimetry phantom along the two axes specified in subsection (F)(4)(b).
3. The evaluation of a CT's x-ray system is performed with a calibrated dosimetry system that:
   a. Has been calibrated using a method that is traceable to the National Institute of Standards and Technology (NIST), and
   b. Has been calibrated within the preceding two years.
4. CT dosimetry phantoms used in determining radiation output meet the requirements specified by the CT manufacturer or a qualified expert who is responsible for maintaining proper operation and:
   a. Are constructed in a way that the parameters used to image the most commonly imaged parts of the human body are evaluated; and

b. At a minimum, provide means for placement of a dosimeter along the axis of rotation and along a line parallel to the axis of rotation 1.0 centimeter from the outer surface and within the phantom.

5. Any effects on the measured dose due to the removal of phantom material to accommodate the dosimeter are accounted for in the reported data or included in the statement of maximum deviation for the measured values.

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Former Section R12-1-612 repealed, new Section R12-1-612 adopted effective August 8, 1986 (Supp. 86-4). Amended effective January 2, 1996 (Supp. 96-1). Amended by final rulemaking at 5 A.A.R.1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-613. Veterinary Medicine Radiographic Systems

A. Equipment. A registrant shall ensure that:

1. Before January 2, 1996, the total filtration permanently in the useful beam is not less than 1.5 millimeters aluminum-equivalent for equipment operating at up to 70 kVp and 2.0 millimeters aluminum-equivalent for equipment operating in excess of 70 kVp;
2. A device is provided to terminate the exposure after a preset time or exposure;
3. Each radiographic system has a "dead-man" exposure switch with an electrical cord of sufficient length to allow the operator to stand at least 1.82 meters (six feet) away from the useful beam during x-ray exposures.

B. Procedures: A registrant shall ensure that:

1. Unless required to restrain an animal, the operator stands at least 1.82 meters (6 feet) away from the useful beam and the animal during a radiographic exposure;
2. An individual other than the operator is not in the x-ray room or area while an exposure is being made, unless the individual's assistance is required;
3. If possible, an animal is held in position during an x-ray exposure using mechanical supporting or restraining devices;
4. An individual holding an animal during an x-ray exposure is:
   a. Wearing protective gloves and an apron of not less than 0.5 millimeter lead equivalent or positioned behind a whole-body protective barrier;
   b. Wearing required personnel monitoring devices; and
   c. Positioned so that no part of the person's body, except hands and arms, will be struck by the useful beam;
5. If an individual holds or supports an animal or a film during an x-ray exposure, the name of the individual is recorded in an x-ray log that contains the animal's name, the type of x-ray procedure, the number of exposures, and the date of the procedure; and
6. As a condition of employment an individual is not required to routinely hold or support animals, or hold film during radiation exposures.

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Amended subsection (B) effective August 8, 1986 (Supp. 86-4). Amended effective January 2, 1996 (Supp. 96-1). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-614. Mammography

A. Equipment. A registrant shall ensure that:

1. Only radiation machines specifically designed for mammography examinations are used;
2. The film processor used in the registrant's facility is maintained in accordance with the film processor's and film manufacturer's recommendations;
3. Each facility has an image development system onsite unless the Agency has approved an alternate system;
4. If used with screen-film image receptors, and the contribution to filtration made by the compression device is included, the useful beam has a half-value layer between the values of: "measured kVp/100 and measured kVp/100 + 0.1 millimeters" of aluminum equivalent;
5. The combination of focal spot size, source-to-image distance and magnification produces a radiograph with a resolution of at least 12 line pairs per millimeter at an object-to-image receptor distance of 4.5 centimeters; or the standards in Table 3-3 of the American Associates of Physicists in Medicine, Report No. 29, August 1990 edition, published by the American Institute of Physics, Inc., which is incorporated by reference, on file with the Agency, and contains no future editions or amendments;
6. The compression device used with the mammographic unit, unless specifically manufactured otherwise, is parallel to the imaging plane, not varying at any spot by more than 1 centimeter;
7. The mammography x-ray system with initial power drive:
   a. Has compression paddles compatible with each size of image receptor;
   b. Is capable of compressing the breast with a force of at least 25 pounds, but not more than 47 pounds, and maintaining the compression for at least three seconds; and
   c. Is used in a manner so that the chest wall edge of the compression device is aligned just beyond the chest wall edge of the image receptor so that the chest wall edge of the compression device does not appear on the image receptor;
8. A mammography x-ray system using screen-film image receptors has:
   a. At least two different sizes of moving anti-scatter grids, including one for each size of image receptor utilized; and
   b. Automatic exposure control;
9. All mammography x-ray systems l indicate, or provide a means of determining, the mAs resulting from each exposure made with automatic exposure control;
10. The collimation provided limits the useful beam to the image receptor so that the beam does not extend beyond any edge of the image receptor at any designated source to image receptor distance by more than 2% of the source to image receptor distance;
11. The accuracy of the indicated kVp is within ±2kVp;
12. Mammography x-ray systems operating with automatic exposure control are capable of maintaining a film density within ± 0.30 optical density units over the clinical range of kVp used, for a breast having an equivalent phantom thicknesses from 2 to 6 centimeters. If the film density cannot be maintained to within ± 0.30 of the average kVp used and phantom thickness from 2 to 6 centimeters cannot be maintained by the automatic exposure control, a technique chart is used that alters kVp and density control settings as a function of breast thickness and density. If a technique chart is used, the operator shall maintain the film density at ± 0.30 optical density units.

13. At a kVp of 28, the mammography x-ray system is capable of generating at least 2.0 µC/kg/mAs (8 mR/ mAs) and at least 200 µC/kg/second (800 mR/second), measured at a point 4.5 centimeters above the surface of the patient support device when the source-to-image receptor distance is at its maximum;
14. Cassettes are not used for mammography if one or more areas of greater than 1 cm 2 of poor screen-film contact are seen when tested, using a 40 mesh screen test;
15. Mammography image quality:
    a. Meets the minimum mammography film standards for phantom performance in "Mammography Quality Control," 1992 edition, published by the American College of Radiology, which is incorporated by reference, on file with the Agency, and contains no future editions or amendments; or
    b. Is sufficient to demonstrate in the image produced the presence of at least 4 fibers, 3 speck groups, and 3 masses that include a 0.75 millimeter fiber, a 0.32 millimeter speck group, and a 0.75 millimeter mass, using a Radiation Measurements Inc. (RMI), Model 156 phantom or its equivalent;
16. The mean glandular dose for one cranio-caudal view of a 4.2 centimeter (1.8 inch) compressed breast, composed of 50 percent adipose and 50 percent glandular tissue, does not exceed 300 millirads (3 milligray); and
17. A radiologic physicist who meets the requirements in R12-1-614(C)(1)(c) evaluates the operation of a mammography x-ray system:
    a. When first installed and annually thereafter;
    b. Following any major change in equipment or replacement of parts; and
    c. When quality assurance tests indicate calibration is necessary.

B. Operating Procedures. A registrant shall ensure that:

1. Each mammography facility has a quality assurance program, and that the quality assurance program includes performance and documentation of the quality control tests in subsection (B)(2), conducted at the required time intervals, with test results that fall within the specified limits or corrective action taken if results fall outside of the specified limits. A radiologic physicist, as defined in R12-1-614(C)(1)(c), shall review the program and make any recommendations necessary for the facility to comply with this Section;
2. The quality assurance program meets the requirements contained in 21 CFR 900.12(d)(1); (e)(1); (e)(2)(i),(ii), and (iii); (e)(3); (e)(4), (e)(5)(i), (ii), (iii)(A), (iv), (v), (vi), (vii)(B) and (C), (viii), (ix), (x), and (xi); (e)(8)(ii); (e)(9)(ii); and (e)(10), 2001 edition, published April 1, 2001, which is incorporated by reference, on file with the Agency, and contains no future editions or amendments; or meets the following requirements:
    a. Daily sensitometric and densitometric evaluation of the image processing system demonstrates that Base + Fog < +0.03 optical density of operating level, Mid Density +/-0.15 optical density of operating level, and Density Difference +/-0.15 optical density of operating level;
    b. Weekly phantom image quality evaluations demonstrate the visualization of at least four fibers, three speck groups, and three masses with a background of >1.20 optical density of operating level, not varying by +/-0.20 optical density of operating level;
    c. Monthly technique chart evaluations demonstrate updates for all equipment changes and that all examinations are being performed according to a physicist's density control recommendation;
    d. Quarterly fixer retention evaluations demonstrate an acceptable limit of </= 5.0 micrograms per square centimeter;
    e. Quarterly repeat analysis demonstrates an acceptable limit of < 2% increase in repeats;
    f. Semiannual darkroom fog evaluations meet the limit of </= 0.05 optical density of fog, using the 2 minute exposed film method;
    g. Semiannual screen film contact evaluations meet the limit of < 1.0 centimeter squared area of poor contact, using a 40 mesh screen on all clinically-used screens;
    h. Semiannual compression force evaluations meet the limit of >/= 25 pounds (111 Newtons) and < 47 pounds (209 Newtons); and
    i. Annually and whenever indicated for installation, major repairs, parts replacement, or as deemed necessary by a qualified expert when quality control test results indicate a survey is necessary; the survey shall include the following tests: automatic exposure control performance and thickness response; kVp accuracy and reproducibility; system resolution; breast entrance air kerma and automatic exposure control reproducibility; average glandular dose; x-ray field, light field and image receptor alignment; compression paddle alignment; uniformity of screen speed; system artifacts; radiation output; decompression; and beam quality and half value layer.

C. Personnel.

1. Each registrant shall require personnel who perform mammography, which includes the production and interpretation of mammograms and related quality assurance activities, to meet the following requirements:
    a. An interpreting physician shall meet the requirements of 21 CFR 900.12(a)(1)(i) and (ii)(A) and (B), 2001 edition, published April 1, 2001, which is incorporated by reference, on file with the Agency, and contains no future editions or amendments; or:
        i. Be licensed under A.R.S. Title 32, Chapters 13 or 17;
        ii. Have initially completed 40 hours of medical education credits in mammography;
        iii. Be certified by the American Board of Radiology or the American Osteopathic Board of Radiology or be approved by the Arizona Board of Medical Examiners or the Arizona Board of Osteopathic Examiners as qualified to read and interpret mammogram images;
        iv. Have interpreted or reviewed an average of 300 mammograms per year during the preceding two years or have completed a radiology residency that included mammogram image interpretation; and
        v. Have completed 15 hours of continuing medical education credits in mammography during the preceding three years.
    b. A mammography technologist shall meet the requirements of 21 CFR 900.12(a)(2)(i)(B), (ii), and (iii), 2001 edition, published April 1, 2001, which is incorporated by reference, on file with the Agency, and contains no future editions or amendments; or:
        i. Possess a valid mammographic technologist certificate issued by the Medical Radiologic Technology Board of Examiners, as required in

A.R.S. § 32-2841, or be pursuing mammography certification by training under the direct supervision of a technologist who possesses a valid mammographic certificate, and

ii. Have completed 15 hours of continuing medical education credits in mammography during the preceding three years.

c. A radiologic physicist shall meet the requirements in 21 CFR 900.12(a)(3)(i) and (iii), and 21 CFR 900.12(a)(4), 2001 edition, published April 1, 2001, which is incorporated by reference and on file with the Agency, and contains no future editions or amendments; or

i. Be certified by the American Board of Radiology, American Board of Medical Physics, or the American Board of Health Physics;

ii. Possess documentation of state approval;

iii. Hold a master's degree or higher in a physical science;

iv. Have, upon initial employment as a radiologic physicist, experience conducting, at least one mammography facility survey and evaluating at least 10 mammography units;

v. Have, after completing the experience requirements in subsection (C)(1)(c)(iv), continuing experience surveying two mammography facilities and evaluating six mammography units during the preceding two years; and

2. Each registrant shall maintain records documenting the requirements in subsection (C)(1) for three years from the date the requirement is met and make the records available for Agency inspection.

D. Mammography films and reports. A registrant shall:

1. Maintain films and reports for a minimum of five years. In those cases where no subsequent mammography procedures are performed, the registrant shall maintain films and associated reports for 10 years. If the mammography facility is closed, the registrant shall make arrangements for storage of the films and associated reports for five years after the closure; and
2. Make films and reports available for comparison upon request for temporary or permanent transfer to other mammography facilities.

Historical Note

Adopted effective January 2, 1996 (Supp. 96-1). Amended effective June 13, 1997 (Supp. 97-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-615. Repealed

Historical Note

Adopted effective January 2, 1996 (Supp. 96-1). Section repealed by final rulemaking at 9 A.A.C. 4302, effective November 14, 2003 (Supp. 03-3).

Appendix A. Information Submitted to the Agency According to R12-1-604(A)(3)(c)

A. Name and address of the applicant and, if applicable, the name and address of any person within this state that is authorized to act on behalf of the applicant;

B. Disease or conditions to be diagnosed using the proposed x-ray examination;

C. A detailed description of each x-ray examination that will be used in the diagnosis;

D. A description of the population to be examined in the screening program, using characteristics such as age, sex, physical condition, and other descriptive information;

E. An evaluation of any known alternative diagnostic modalities not involving ionizing radiation that could achieve the same diagnosis as a screening program and why these modalities have not been chosen;

F. An evaluation by a qualified expert of the x-ray equipment used in the screening program, which demonstrates that the x-ray equipment satisfies the requirements of this Article.

G. A description of the quality control program;

H. A copy of the technique chart for the planned x-ray examination;

I. The qualifications of each individual who will be operating the x-ray equipment;

J. The qualifications of the individual who will be supervising each operator of the x-ray equipment;

K. The name and address of the individual who will interpret each radiographic image;

L. A description of the planned procedures for advising a screened individual and the screened individual's physician of the screening procedure results, and the need for further medical care, and

M. A description of the procedures for retention or disposition of the radiographic images and other records pertaining to the x-ray examination.

Historical Note

Adopted effective January 2, 1996 (Supp. 96-1). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

Appendix B. Repealed

Historical Note

Adopted effective January 2, 1996 (Supp. 96-1).

ARTICLE 7. MEDICAL USES OF RADIOACTIVE MATERIAL

R12-1-701. Scope

This Article establishes requirements for the use of radionuclides in the healing arts and for issuance of licenses authorizing the medical use of radionuclides. These requirements provide for the protection of the public health and safety, and are in addition to, and not in substitution for, other requirements in this Chapter.

Historical Note

Former Rule Section G.1. Former Section R12-1-701 repealed, new Section R12-1-701 adopted effective June 30, 1977 (Supp. 77-3). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-702. Definitions

"Authorized user" means a physician licensed in Arizona to practice medicine and who is identified as:

An authorized user on an Agency, Nuclear Regulatory Commission (NRC), or Agreement State license that authorizes the specified medical use; or

A user in a medical use broad scope program, licensed by the Agency, NRC or Agreement State to select its own authorized users in accordance with the training standards contained in this Article.

"Brachytherapy" means a method of radiation therapy in which a sealed source or group of sealed sources is utilized to deliver beta or gamma radiation at a distance of up to a few centimeters, by surface, intracavitary, intraluminal, or interstitial application.

"High dose rate afterloading brachytherapy" means the treating of human disease using the radiation from a radioactive sealed source containing more than 1 curie of radioactive material. The radioactive material is introduced into a patient's body using a device that allows the therapist to indirectly handle the radiation source during the treatment. For purposes of the requirements in this Article "pulse dose rate afterloading brachytherapy" is included in this definition.

"Medical institution" means an organization in which several medical disciplines are practiced.

"Medical use" means the intentional internal or external administration of radioactive material, or the radiation from it, to an individual under the supervision of an authorized user.

"Misadministration" means:

The administration of a radiopharmaceutical or the radiation from a sealed source, administered for therapy purposes and involving:

The wrong radiopharmaceutical or sealed source; or
The wrong patient; or
The wrong route of administration; or
A dose to an individual that differs from the prescribed dose by 20%; or

The administration of a diagnostic dose of a radiopharmaceutical involving:

The wrong patient; or
The wrong radiopharmaceutical; or
The wrong route of administration; and
A dose to an individual that exceeds 5 rems effective dose equivalent or 50 rems dose equivalent to any individual organ; or

A therapeutic radiation dose from a sealed source such that errors in the source calibration, time of exposure, and treatment geometry result in a calculated total treatment dose differing from the final, prescribed total treatment dose by more than 10 percent.

"Radiopharmaceutical" means any drug that exhibits spontaneous disintegration of unstable nuclei with the emission of nuclear particles or photons and includes any nonradioactive reagent kit or nuclide generator that is intended to be used in the preparation of any such substance.

"Remote afterloading brachytherapy device" means a device used in radiation therapy that allows the authorized user to insert, from a remote location, a radiation source into an applicator that has been previously inserted in an individual requiring treatment.

"Stereotactic radiosurgery" means the use of external radiation in conjunction with a stereotactic guidance device to very precisely deliver a dose.

"Teletherapy" means therapeutic irradiation in which the sealed source of radiation is at a distance from the body.

"Written directive" means an order in writing for a specific individual, or a diagnostic standing procedure for a group of patients written by an authorized user and on file with the licensee. The order or standing procedure shall be dated and signed by an authorized user prior to the administration of a radiopharmaceutical or radiation.

Historical Note

Former Rule Section G.2; Former Section R12-1-702 repealed, new Section R12-1-702 adopted effective June 30, 1977 (Supp. 77-3). Former Section R121-702 renumbered and amended as Section R12-1-703, new Section R12-1-702 adopted effective December 20, 1985 (Supp. 85-6). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-703. License for Medical Use of Radioactive Material

A. In addition to the requirements in R12-1-309, the Agency shall issue a specific license for medical use of radioactive material if:

1. The applicant has appointed a radiation safety committee, meeting the requirements in R12-1-706, that will oversee the use of licensed material throughout the medical institution and review the medical institution's radiation safety program;
2. The applicant possesses facilities for the clinical care of patients;
3. Any physician designated on the application as an authorized user has substantial training and experience in the handling and administration of radioactive material and, where applicable, the clinical management of radioactive patients; and
4. If the application is for a license to use unspecified quantities or multiple types of radioactive material, the applicant's staff has substantial experience in the use of a variety of radioactive materials for a variety of medical purposes.

B. Specific licenses to individual physicians for medical use of radioactive material:

1. The Agency shall approve an application by an individual physician or group of physicians for a specific license governing the medical use of radioactive material if:
   a. The applicant satisfies the general requirements in R12-1-309;
   b. The application is for use in the applicant's practice at an office outside of a medical institution;
   c. The applicant has substantial experience in the handling and administration of radionuclides, and where applicable, the clinical management of radioactive patients.
2. The Agency shall not approve an application by an individual physician or group of physicians for a specific license to receive, possess, or use radioactive material on the premises of a medical institution unless:
   a. The use of radioactive material is limited to:
      i. The administration of radiopharmaceuticals for diagnostic or therapeutic purposes;
      ii. The performance of diagnostic studies on patients to whom a radiopharmaceutical has been administered;
      iii. The performance of in vitro diagnostic studies; or
      iv. The calibration and quality control checks of radioactive assay instrumentation, radiation safety instrumentation, or diagnostic instrumentation;
   b. The physician brings the radioactive material and removes the radioactive material upon departure; and
   c. The medical institution does not hold a radioactive materials license under subsection (A).

C. Specific licenses for certain groups of medical uses of radioactive material

1. Subject to the provisions of subsections (C)(2), (3), and (4), the Agency shall approve an application for a specific license under subsection (A) or (B), for any medical use or uses of radioactive material specified in one or more of Groups I to V, inclusive, in Exhibit A of this Article for all of the materials within the group or groups in the application if:

a. The applicant satisfies the requirements of subsections (A), (B), and (D);
b. Each authorized user listed on the application meets the qualifications in R12-1-704;
c. All other personnel who will be involved in the preparation and use of the radioactive material are qualified for their activities involving radioactive material in accordance with the statutes and rules of the Medical Radiologic Technology Board of Examiners (MRTBE);
d. The applicant's radiation detection and measuring instrumentation is adequate for conducting the procedures involved in the uses included in the group or groups;
e. The applicant's radiation safety operating procedures are adequate for handling and disposal of the radioactive material involved in the uses included in the group or groups.

2. Any licensee or registrant who is authorized to use radioactive material according to one or more groups in subsection (C)(1), and Exhibit A of this Article is subject to the following conditions:
a. For Groups I, II, IV, and V, a licensee or registrant shall not receive, possess, or use radioactive material as a radiopharmaceutical unless manufactured in the form to be administered to a patient, labeled, packaged, and distributed according to a specific license issued by the Agency under R12-1-311(J), a specific license issued by the U.S. Nuclear Regulatory Commission under 10 CFR 32.72, 2003 edition, published January 1, 2003, by the Office of the Federal Register, National Archives and Records Administration, Washington, D.C. 20408, incorporated by reference and on file with the Agency (This incorporation by reference contains no future editions or amendments), or a specific license issued by an Agreement State or a Licensing State under equivalent rules.
b. For Group III, a licensee or registrant shall not receive, possess, or use generators or reagent kits that contain radioactive material to prepare radiopharmaceuticals containing radioactive material, except:
i. Reagent kits that do not contain radioactive material, approved by the Agency, the U.S. Nuclear Regulatory Commission, or an Agreement State or Licensing State for use by persons licensed under subsection (C) and Exhibit A of this Article or equivalent regulations; or
ii. Generators or reagent kits that contain radioactive material which are manufactured, labeled, packaged, and distributed according to a specific license issued by the Agency under R12-1-311(K).
c. For Group III, any licensee who uses generators or reagent kits shall:
i. Elute the generator according to instructions furnished by the manufacturer or located on the generator label, leaflet, or brochure which accompanies the generator or reagent kit;
ii. Before administration to patients, or distribution to authorized recipients for administration to patients, cause each elution or extraction of technetium-99m from a molybdenum-99/technetium-99m generator to be tested to determine either the total molybdenum-99 activity or the concentration of molybdenum-99, according to written procedures and by personnel who have been specifically trained to perform the test;
iii. Prohibit the administration or distribution for administration of technetium-99m that, at the expiration date and time shown on the container label, contains more than 5.6 kBq (0.15 microcuries) of molybdenum-99 per 37 MBq (1 millicurie) of technetium-99m. The licensee shall determine an action level for molybdenum-99/technetium-99m at elution so that the above concentration is not exceeded by radiopharmaceutical expiration. For example, the maximum concentration is 2.6 kBq (0.07 microcurie) per 37 MBq (1 millicurie) at elution for a dose that expires six hours later. The licensee shall ensure that the limits above are not exceeded for any single patient dose by checking the expiration time on the container label. The results of each test performed to detect and quantify molybdenum-99 contamination and records of training given to personnel performing these tests shall be maintained for three years for Agency inspection; and
d. For Groups I, II, and III, any licensee using radioactive material for clinical procedures other than those specified in the product labeling or package insert shall do so according to an authorized user's directive. Any deviation from the product labeling shall be recorded. Records shall be maintained for Agency review for three years from the date of the administration of the radiopharmaceutical.

3. Any licensee who is licensed according to subsection (C)(1), for one or more of the medical use groups in Exhibit A also is authorized to use radioactive material under the general license in R12-1-306(F) for the specified in vitro uses without filing Form ARRA-9 as required by R12-1-306(F)(2); provided, that the licensee is subject to the other provisions of R12-1-306(F).
4. Any licensee who is licensed according to this Section is authorized to receive, possess, and use calibration and reference radioactive sealed sources in accordance with R12-1-711.

D. In addition to the requirements in R12-1-309, the Agency shall issue a specific license for medical use of sealed sources only if the applicant's proposed authorized users have the qualifications listed in R12-1-704.

Historical Note

Former Rule Section G.3; Former Section R12-1-703 repealed, new Section R12-1-703 adopted effective June 30, 1977 (Supp. 77-3). Former Section R12-1-703 renumbered and amended as Section R12-1-704, former Section R12-1-702 renumbered and amended as Section R12-1-703 effective December 20, 1985 (Supp. 85-6). Section repealed and new Section adopted by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 9 A.A.R. 1126, effective May 9, 2003 (Supp. 03-1). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-704. Supervision

A. For purposes of this rule "supervision" means the exercise of control over or direction of the use of radioactive material in the practice of medicine by an authorized user named on a

radioactive material license. Supervision does not require a supervising physician's constant physical presence if the supervising physician can be easily contacted by radio, telephone, or telecommunication.

B. A physician may use radioactive material if he or she is licensed by the Arizona Board of Medical Examiners or Board of Osteopathic Examiners in Medicine and Surgery and is listed as an authorized user on a radioactive material license issued by the Agency, NRC, or Agreement State, authorizing the use of radioactive material for medical purposes.

C. A physician who has the training and experience listed in 10 CFR 35, 2003 edition, published January 1, 2003, by the Office of the Federal Register, National Archives and Records Administration, Washington, D.C. 20408, which is incorporated by reference and on file with the Agency, or a physician under the supervision of a physician who has the qualifications listed above, may use radioactive material for medical purposes. This incorporation by reference contains no future editions or amendments.

D. An authorized user, approved to prescribe radiopharmaceuticals for therapy purposes on a radioactive materials license, shall be physically present when a radiopharmaceutical is administered to a human being for therapeutic purposes.

E. A limited-service nuclear pharmacy permittee shall dispense radiopharmaceuticals only to a physician listed as an authorized user on a valid radioactive material license issued by the Agency, an Agreement State, or the NRC.

F. Only a physician listed on a valid radioactive material license is authorized to:

1. Supervise the use of radioactive material in the practice of medicine, and
2. Sign a preceptor statement verifying the training and experience of a physician who wants to be listed as an authorized user.

Historical Note

Repealed effective June 30, 1977 (Supp. 77-3). Former Section R12-1-703 renumbered and amended as Section R12-1-704 effective December 20, 1985 (Supp. 85-6). Section repealed and new Section adopted by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 9 A.A.R. 1126, effective May 9, 2003 (Supp. 03-1). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-705. Radiation Safety Officer

A licensee shall appoint a Radiation Safety Officer who is responsible for implementing the radiation safety program. The licensee, through the Radiation Safety Officer, shall ensure that radiation safety activities are being performed according to this Chapter and Agency approved procedures.

Historical Note

New Section adopted by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-706. Radiation Safety Committee

A. A licensee subject to this Article shall have a Radiation Safety Committee if:

1. The licensee is authorized in a radioactive material license to use radioactive material under Group IV or V in Exhibit A for two or more medical purposes; or
2. The licensee is authorized in a radioactive material license to use sealed sources for two or more therapy modalities regulated under R12-1-714, R12-1-716, R12-1-717, and R12-1-718.

B. A medical institution Radiation Safety Committee shall meet the following requirements:

1. Administrative requirements:
   a. Committee membership shall consist of at least three individuals and shall include an authorized user of each type of use permitted by the license, the Radiation Safety Officer, a representative of the nursing service, and a representative of management who is neither an authorized user nor a Radiation Safety Officer. Other members may be included as the licensee deems appropriate.
   b. The Committee shall meet at least once each calendar quarter, unless otherwise specified by license condition.
   c. To establish a quorum and to conduct business, half of the Committee's membership shall be present, including the Radiation Safety Officer and the management representative.
   d. The minutes of each Radiation Safety Committee meeting shall include:
      i. The date of the meeting;
      ii. Members present;
      iii. Members absent;
      iv. A summary of deliberations and discussions;
      v. Recommended actions and the numerical results of all ballots; and
      vi. A reference to the review required in R12-1-407.
   e. The Committee shall provide each member with a copy of the meeting minutes, and retain one copy for three years.
2. Oversight; the Committee shall:
   a. Review the radiation protection program for all sources of radiation as required in R12-1-407;
   b. Establish a table of investigational levels for occupational dose that, when exceeded, will initiate investigations and considerations of action by the Radiation Safety Officer; and
   c. Establish the safety objectives of the quality management program required by R12-1-707.

Historical Note

New Section adopted by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-707. Quality Management Program

Each licensee, using radioactive material or the radiation from radioactive material for therapeutic purposes, shall establish and maintain a written quality management program so that radioactive material or radiation from it will be administered in accordance with a written directive from an authorized user listed on a valid radioactive material license. The quality management program shall include written policies and procedures to meet the specific patient safety objectives established by the Radiation Safety Committee or Radiation Safety Officer for licensees not required to have a Radiation Safety Committee.

Historical Note

New Section adopted by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 9 A.A.R. 1126, effective May 9, 2003 (Supp. 03-1).

R12-1-708. Misadministration Reports and Records

A. Reports of therapy misadministrations.

1. When a administration involves any therapy procedure, the licensee shall notify the Agency by telephone. The licensee shall also notify the referring physician of the affected patient and the patient or a responsible relative or guardian, unless the referring physician personally informs the licensee either that he or she will inform the patient, or that in his or her medical judgment, telling the patient or the patient's responsible relative or guardian would be harmful to one or the other, respectively. These notifications shall be made within 24 hours after the licensee discovers the misadministration. If the referring physician or the patient's responsible relative or guardian cannot be reached within 24 hours, the licensee shall notify them as soon as practicable. The licensee shall not delay medical care for the patient because of notification problems.
2. Within 15 days after the initial therapy misadministration report to the Agency, the licensee shall report, in writing, to the Agency and to the referring physician and furnish a copy of the report to the patient or the patient's responsible relative or guardian, depending on who was previously notified by the licensee under subsection (A)(1). The written report shall include the licensee's name, the referring physician's name, a brief description of the event, the effect on the patient, the action taken to prevent recurrence, whether the licensee informed the patient or the patient's responsible relative or guardian, and if not, why not. The report shall not include the patient's name or other information that could lead to identification of the patient.

B. When a misadministration involves a diagnostic procedure, the licensee shall notify, in writing, the referring physician and the Agency. A licensee's report of a diagnostic misadministration is due within 10 days after the end of the calendar quarter (defined by March, June, September and December) in which the misadministration occurs. The written report shall include the licensee's name, the referring physician's name, a description of the event, the effect on the patient, and the action taken to prevent recurrence. The report shall not include the patient's name or other information that could lead to identification of the patient.

C. Each licensee shall maintain, for Agency inspection, records of all misadministrations of radiopharmaceuticals or radiation from teletherapy or brachytherapy sources. These records shall contain the names of all individuals involved in the event, including the physician, allied health personnel, the patient, and the patient's referring physician; the patient's social security number or other identification number if one has been assigned; a brief description of the event; the effect on the patient; and the action taken to prevent recurrence. These records shall be preserved until the Agency authorizes disposal.

Historical Note
New Section adopted by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-709. Reserved

Historical Note
New Section adopted by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-710. Visiting Authorized User

A. A licensee may permit any visiting authorized user to use licensed material for a medical purpose under the terms of the licensee's license for 60 days each year if:

1. The visiting authorized user has the prior written permission of the licensee's management and Radiation Safety Committee, if applicable;
2. The licensee has a copy of an Agency, Agreement State, Licensing State, or NRC license that identifies the visiting authorized user by name as a person authorized to use licensed material for medical purposes; and
3. Only those procedures for which the visiting authorized user is specifically authorized by an Agency, Agreement State, Licensing State, or NRC license are performed by that individual, and

B. A licensee need not apply for a license amendment in order to permit a visiting authorized user to use licensed material as described in subsection (A).

C. A licensee shall retain a copy of the license specified in subsection (A)(2) for three years from the date of the last visit.

Historical Note
New Section adopted by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-711. Calibration and Reference Sources

Any person authorized by R12-1-703 for medical use of radioactive material may receive, possess, and use the following radioactive material for check, calibration, and reference purposes:

1. Sealed sources manufactured and distributed by persons specifically licensed under 12 A.A.C. 1, Article 3 or equivalent provisions of the NRC, Agreement State, or Licensing State and that do not exceed 1.1 GBq (30 millicuries) each;
2. Any radioactive material listed in Group I, Group II, or Group III of Exhibit A of this Article with a half-life not longer than 100 days, in amounts not to exceed 555 MBq (15 millicuries) total;
3. Any radioactive material listed in Group I, Group II, or Group III of Exhibit A of this Article with half-life greater than 100 days in amounts not to exceed 7.4 MBq (200 microcuries) total; and
4. Technetium-99m in individual amounts not to exceed 1.85 GBq (50 millicuries).

Historical Note
New Section adopted by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-712. Sealed Sources

A. A licensee subject to this Article shall conduct a physical inventory every six months to account for all radioactive sealed sources received and possessed. A record of the inventories shall be maintained for three years for inspection by the Agency and shall include the quantities, kinds of radioactive material, location of sources, the date of the inventory, and signature of the person performing the inventory.

B. A licensee subject to this Article using a radioactive sealed source for a medical purpose, shall use it in accordance with R12-1-450(A) and (B).

Historical Note
New Section adopted by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-713. Dose Calibrators and Determination of Dosages

A. A licensee subject to this Article shall not administer to a person radioactive material in an unsealed form that has not had its radioactivity determined, using one of the methods described in subsections (C) or (D).

B. A licensee shall make and record in a patient use log the dosage determination in subsection (A) before any medical use.

C. For unit dosages, the licensee shall make the determination by:
1. Direct measurement of the radioactivity in a dose calibrator; or
2. Decay correction, based on the radioactivity or radioactivity concentration determined by a properly licensed:
   a. Manufacturer, or
   b. Nuclear pharmacy.

D. For other than unit dosages, the licensee shall make the determination by:
1. Direct measurement of the radioactivity in a dose calibrator;
2. A combination of subsection (D)(1) and applicable mathematical calculation; or
3. A combination of volumetric measurement and applicable mathematical calculation, based on a radioactivity measurement determined by a supplier listed in subsection (C)(2)(a) or (C)(2)(b).

E. The licensee shall calibrate a dose calibrator in accordance with nationally recognized standards or manufacturer's instructions.

Historical Note

New Section adopted by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-714. Brachytherapy

A. Accountability, storage, and transit.
1. Except as otherwise specifically authorized by the Agency, each licensee shall keep a record of the issue and return of all sealed sources.
2. When not in use, the licensee shall keep sealed sources and applicators containing sealed sources in a protective enclosure of such material and wall thickness as is necessary to assure compliance with the provisions of 12 A.A.C. 1, Article 4.
3. A licensee shall follow the radiation safety and handling instructions approved by the Agency, or furnished by the manufacturer on the label attached to the brachytherapy source, the device that contains the brachytherapy source, or the permanent container that houses the brachytherapy source, or in the leaflet or brochure that accompanies the brachytherapy source or device; and maintain the instructions in a legible and easily accessible form. If the handling instructions, label, leaflet, or brochure is no longer available and a copy cannot be obtained from the manufacturer, the licensee shall notify the Agency that the source information is no longer available.
4. An authorized user transporting a brachytherapy source or applicator that contains a brachytherapy source for use in the practice of medicine, shall transport the brachytherapy source or applicator according to the requirements in 12 A.A.C. 1, Article 15.

B. A licensee shall perform leak testing on brachytherapy sources for radioactive contamination as required in R12-1-417.

C. Radiation surveys.
1. An authorized user on a radioactive material license, qualified expert, or person approved by the licensee's radiation safety officer shall measure the maximum radiation level at a distance of 1 meter (40 in.) from the patient in whom a brachytherapy source has been inserted, using a calibrated survey instrument. This radiation level shall be entered on the patient's chart and signs posted as required in subsection (E). If the radioactive source is inserted for intravascular brachytherapy purposes for 10 seconds or less, the survey in this subsection is not required.
2. An authorized user on a radioactive material license, qualified expert, or person approved by the licensee's radiation safety officer shall measure and record the radiation level in the patient's room and the adjacent patient rooms. The licensee shall maintain the record three years for Agency inspection.
3. The licensee shall assure that patients treated with cobalt-60, cesium-137, iridium-192, or radium-226 implants remain hospitalized until a source count and a radiation survey of the patient, using a calibrated survey instrument, confirm that all radiation emitting implants have been removed.

D. A qualified expert who meets the following training and experience requirements shall perform all physics procedures necessary to prepare a patient for a therapeutic application of radiation. The qualified expert shall:
1. Be certified by the American Board of Radiology in: Therapeutic Radiological Physics, Radiological Physics, Roentgen-Ray and Gamma-Ray Physics, or X-ray and Radium Physics; or the American Board of Medical Physicists in Radiation Oncology Physics; or
2. Have the following minimum training and experience:
   a. A Master's or Doctor's degree in physics, biophysics, radiological physics, or health physics;
   b. One year of full-time training in therapeutic radiological physics; and
   c. One year of full-time experience at a radiotherapy facility, including personal experience calibrating brachytherapy radiation sources and planning associated patient treatment.
3. A candidate who does not meet the standard in subsection (D)(1) or (D)(2), may request a license amendment for an exemption from these training or experience requirements in accordance with A.R.S. § 30-654(B)(13). The request shall include the name of the proposed qualified expert, a description of the individual's training and experience, including information similar to that specified in subsection (D)(2), and a written endorsement, based on personal knowledge of the individual's qualifications, by a physicist certified by the American Board of Radiology in one of the specialties listed in subsection (D)(1).

E. Signs and records.
1. In addition to the requirements in R12-1-429, a licensee shall mark the bed, cubicle, or room of a hospital brachytherapy patient with a sign indicating the presence of brachytherapy sources. This sign shall incorporate the radiation symbol and specify the radionuclide, activity, date, and individual to contact for radiation safety instructions. The sign is not required if any of the exceptions in R12-1-430 apply.
2. A physician on a radioactive material license, qualified expert, or person approved by the licensee's radiation safety officer shall include the following information in the patient's records when the patient is undergoing brachytherapy:
   a. The radionuclide administered, the number of sources, the activity in millicuries, and the time and date of administration;
   b. The exposure or dose rate at 1 meter, the time the measurement was made, and by whom;
   c. The radiation symbol; and

d. The precautionary instructions necessary to assure that the exposure of individuals does not exceed that permitted in Article 4.

F. A licensee shall select a qualified expert to assist the authorized user in determining the therapeutic sealed source output.

Historical Note

New Section adopted by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 9 A.A.R. 1126, effective May 9, 2003 (Supp. 03-1). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-715. Reserved

Historical Note

New Section adopted by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-716. Teletherapy

A. A licensee shall use equipment that meets all of the following specifications:

1. The teletherapy equipment housing is constructed so that, at 1 meter (40 in.) from the teletherapy source, the maximum exposure rate does not exceed 100 μSv (10 mrem) per hour when the beam control mechanism is in the "off" position. The average exposure rate measure at a representative number of points about the housing, each 1 meter (40 in.) from the teletherapy source, does not exceed .20 μSv (2 mrem) per hour 1 meter (40 in.) from the source.
2. For teletherapy equipment installed after May 15, 1967, the leakage radiation measured at 1 meter from the source when the beam control mechanism is in the "on" position does not exceed 260 μC/kg (1 R) per hour or 0.1 percent of the useful beam exposure rate, whichever is less.
3. Adjustable or removable beam-defining diaphragms allow transmission of not more than 5% of the useful beam exposure rate.
4. The beam control mechanism is of a design capable of acting in any orientation of the housing. The mechanism is designed so that it can be manually returned to the "off" position with a minimum risk of exposure.
5. The closing device is designed to return automatically to the "off" position in the event of any breakdown or interruption of power and stays in the "off" position until activated from the control panel.
6. When any door to the treatment room is opened, the beam control mechanism automatically and rapidly restores the unit to the "off" position and causes it to remain there until the unit is reactivated from the control panel.
7. There is at the housing and at the control panel a warning device that plainly indicates whether the beam is on or off and an independent radiation monitoring device which:
   a. Continuously monitors the condition of the teletherapy beam and
   b. Provides a continuously visible signal to the operator.
8. The equipment has a locking device to prevent unauthorized use.
9. The control panel has a timer that automatically terminates the exposure after a preset time.
10. The equipment permits continuous observation of patients during irradiation.

B. The authorized user shall ensure that no individual is in the treatment room during irradiation unless that individual is the patient. Mechanical restraining or supporting devices shall be used for positioning the patient, if necessary.

C. The licensee shall test the teletherapy sources for leakage and contamination as required in R12-1-417. The licensee shall also wipe accessible surfaces of the housing port or collimator while the source is in the "off" position, measuring the wipe samples for transferred contamination.

D. Calibration requirements.

1. The licensee's qualified expert shall perform full calibration measurements on each teletherapy unit:
   a. Prior to the first use of the unit for treating humans.
   b. Prior to treating humans:
      i. Whenever spot-check measurements indicate that the output value differs by more than 5% from the value obtained at the last full calibration, corrected mathematically for decay;
      ii. Following replacement of the radiation source or following reinstallation of the teletherapy unit in a new location; or
      iii. Following any repair of the teletherapy unit that includes removal of the source or major repair of the components associated with the source exposure assembly; and
   c. At intervals not exceeding one year.
2. Full calibration measurements include determination of:
   a. The exposure or dose rate, to an accuracy within +/- 3% for the range of field sizes and for the range of distances or the axis distance used in radiation therapy;
   b. The congruence between the radiation field and the field indicated by the light beam localizing device;
   c. The uniformity of the radiation field and its dependence upon the orientation of the useful beam;
   d. Timer accuracy; and
   e. The accuracy of all distance measuring devices used for treating humans.
3. The qualified expert shall correct the exposure rate or dose rate values mathematically for cobalt-60 at intervals that do not exceed one month and for cesium-137 at intervals that do not exceed six months.

E. Spot check measurements.

1. The licensee's qualified expert or other authorized agent shall perform spot check measurements on each teletherapy unit at intervals that do not exceed one month.
2. Spot check measurements shall include determination of:
   a. Timer accuracy;
   b. The congruence between the radiation field and the field indicated by the light beam localizing device;
   c. The accuracy of all distance measuring devices used for treating humans;
   d. The exposure rate dose or a quantity related to this rate for one typical set of operating conditions; and
   e. The difference between the measurement made and the anticipated output, expressed as a percentage of the anticipated output (for example, the value obtained at last full calibration corrected mathematically for decay).
3. The qualified expert shall establish spot check measurement procedures. If the qualified expert does not perform the spot check measurements, the results of the spot check measurements shall be reviewed by the qualified expert within 15 days.

F. Dosimetry systems.

1. The licensee's qualified expert shall perform full calibration measurements using a dosimetry system that is calibrated by the National Institute of Standards and Technology or by a regional calibration laboratory accredited by the American Association of Physicists in

Medicine. The licensee shall ensure that the dosimetry system is calibrated every two years and after any servicing that may affect system calibration.

2. Spot check measurements shall be performed using a dosimetry system that has been calibrated as required in subsection (F)(1). Alternatively a dosimetry system used solely for spot check measurements may be calibrated by direct intercomparison with a system that has been calibrated according to the standards in subsection (F)(1). This alternative calibration method shall have been performed within the previous one year and after each servicing that may have affected system calibration. Dosimetry systems calibrated by this alternative method shall not be used for full calibration measurements.

G. The licensee shall maintain for inspection by the Agency records of measurements, tests, corrective actions, and instrument calibrations made under subsections (D) and (E), and records of the licensee's evaluation of the qualified expert's training and experience under subsection (H).

1. The licensee shall preserve records of the following for three years after completion of each full calibration:
   a. Full calibration measurements, and
   b. Calibration of the instruments used to make the full calibration measurements.
2. The licensee shall preserve records of the following for three years after completion of each spot check:
   a. Spot check measurements and corrective actions, and
   b. Calibration of instruments used to make spot check measurements.
3. The licensee shall preserve records of the licensee's evaluation of the qualified expert's training and experience for three years after the qualified expert's last performance of a full calibration on the licensee's teletherapy unit.

H. A licensee shall ensure that all physics procedures performed to prepare for application of radiation to a patient for therapy purposes are performed by a qualified expert who:

1. Is certified by the American Board of Radiology in Therapeutic Radiological Physics, Radiological Physics, Roentgen-Ray and Gamma-Ray Physics, or X-ray and Radium Physics or the American Board of Medical Physicists in Radiation Oncology Physics; or
2. Has the following minimum training and experience:
   a. A Master's or Doctor's degree in physics, biophysics, radiological physics, or health physics;
   b. One year of full-time training in therapeutic radiological physics; and
   c. One year of full-time experience at a radiotherapy facility, which included personal calibration of gamma stereotactic therapy system and associated patient treatment planning.
3. If an individual does not meet the standard in subsection (H)(1) or (H)(2), the licensee may request a license amendment that exempts the individual from these training requirements in accordance with A.R.S. § 30-654(B)(13). The request shall include the name of the proposed qualified expert, a description of the individual's training and experience, including information similar to that specified in subsection (H)(2), and a written endorsement based on personal knowledge of the individual's qualifications, by a physicist certified by the American Board of Radiology in one of the specialties listed in subsection (H)(1).

Historical Note

New Section adopted by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-717. High Dose Rate Remote After-loading Brachytherapy Devices

A. Each after-loading irradiation facility shall have a system permitting continuous observation of the patient from outside the treatment room during patient irradiation.

B. The licensee shall post written emergency instructions at the after-loading irradiation device operator console. These instructions shall inform the device operator of the procedures to be followed if the source fails to return to the shielded position.

C. The licensee shall ensure that the after-loading irradiator facility has the following:

1. Access to the room housing the after-loading irradiation device is controlled by a door at the entrance. The doors are normally closed.
2. The entrance to the treatment room is equipped with an electrical interlock system that will cause the source to return to the shielded position immediately if the entrance door is opened. The interlock system is connected in such a manner that the source cannot be exposed until the entrance door is closed and the source "on-off" control is reset at the control panel.

D. The licensee shall test the following for proper operation once each month. Records of test results shall be maintained for three years for inspection by the Agency:

1. The electrical interlock on the entrance door to the treatment room, and
2. The radiation source locking system.

E. In the event of malfunction of a door interlock or source locking system, the licensee shall secure from use the after-loading irradiation device and not use the after-loading, except as may be necessary to repair or replace the interlock system, until the interlock system is shown to be functioning properly.

F. Before initiation of a treatment program, and after each source exchange for the after-loading device:

1. The licensee shall perform radiation surveys of the following locations:
   a. The after-loading device source housing, with the source in the shielded position. The maximum radiation level at 20 centimeters from the surface of the source housing shall not exceed 3 milliroentgens per hour.
   b. All areas adjacent to the treatment room with the source in the exposed position. The survey shall clearly establish:
      i. That radiation levels in restricted areas are not likely to cause personnel exposure in excess of the limits specified in R12-1-408 and R12-1-414.
      ii. That radiation levels in unrestricted areas do not exceed the limits specified in R12-1-416.
      iii. The activity of the source, using an Agency approved procedure and a calibrated Farmer chamber, or equivalent.
2. The licensee shall retain records of the radiation surveys for three years for inspection by the Agency.

G. A person shall not perform the following work without written authorization by the Agency:

1. Installation and replacement of sources contained in an after-loading irradiation device; or
2. Any maintenance or repair operation on the after-loading irradiation device involving work on the source driving unit, or other mechanism that could expose the source,

reduce the shielding around the source, or compromise the safety of the unit and result in increased radiation levels.

H. Before making any changes to treatment room shielding, treatment room location, or use of the after-loading irradiation device which could result in an increase in radiation levels in unrestricted areas outside the treatment room, the licensee shall perform a radiation survey according to subsection (F)(1). A report describing each change, and giving the results of each survey shall be sent to the Agency.

I. A qualified expert who meets the following training and experience requirements shall perform all physics procedures necessary to prepare a patient for a therapeutic application of radiation. The qualified expert shall:

1. Be certified by the American Board of Radiology in: Therapeutic Radiological Physics, Radiological Physics, Roentgen-Ray and Gamma-Ray Physics, or X-ray and Radium Physics; or the American Board of Medical Physicists in Radiation Oncology Physics; or
2. Have the following minimum training and experience:
   a. A Master's or Doctor's degree in physics, biophysics, radiological physics, or health physics;
   b. One year of full-time training in therapeutic radiological physics; and
   c. One year of full-time experience at a radiotherapy facility, including personal experience calibrating brachytherapy radiation sources and planning associated patient treatment.
3. A candidate who does not meet the standards in subsections (I)(1) and (I)(2), may request a license amendment for an exemption from these training or experience requirements in accordance with A.R.S. § 30-654(B)(13). The request should include the name of the proposed qualified expert, a description of the individual's training and experience, including information similar to that specified in subsection (I)(2), and a written endorsement, based on personal knowledge of the individual's qualifications, by a physicist certified by the American Board of Radiology in one of the specialties listed in subsection (I)(1).

Historical Note

New Section adopted by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 9 A.A.R. 1126, effective May 9, 2003 (Supp. 03-1).

R12-1-718. Gamma Stereotactic Radiosurgery

A. A licensee shall provide the manufacturer's written radiological safety and operating instructions to each person responsible for operation of a stereotactic radiosurgery system.

B. A person licensed by the Agency shall install the stereotactic radiosurgery system and perform all service and maintenance involving exposure to persons in the treatment room beyond normal "Beam-off" conditions.

C. In lieu of a direct source inventory, the licensee shall perform an indirect source inventory through completion of absolute calibrations of the radiation dose-rate at the intersection of all beam axes of the radiosurgery radiation unit on a six-month basis. The magnitude of this dose-rate shall be compared with the appropriately decayed value of the initial or acceptance date, calibrated dose-rate at the intersection of all beam axes. This measured dose-rate serves as verification that all sources inserted into the gamma knife are still present.

D. A licensee shall ensure that a stereotactic radiosurgery facility has the following safeguards:

1. Access to the radiosurgery room is controlled by a door at each entrance. The doors are normally closed.
2. Each entrance to the radiosurgery room is equipped with an electrical interlock system that will turn the unit's primary beam of radiation off immediately if any entrance door is opened. The interlock system is connected in such a manner that the machine's primary beam of radiation cannot be turned on until all treatment room entrance doors are closed and the beam "ON-OFF" control is reset at the control panel.
3. In the event of malfunction of any door interlock, the radiosurgery system control is locked in the "OFF" position and not used, except as may be necessary to the repair or replacement of the interlock system, until the interlock system is shown to be functioning properly.
4. The radiosurgery room has a system permitting continuous observation of the patient from outside the radiosurgery room during patient irradiation.
5. Written instructions, including the manufacturer's radiological safety and operating procedures, are available at the stereotactic radiosurgery controls. These instructions inform the operator of the procedure to be followed in the event of malfunction. These instructions caution individuals on how to avoid exposure to radiation in the treatment room and include specific instructions for:
   a. Removing the patient from the treatment room;
   b. Securing the room against unauthorized entry; and
   c. Notifying the responsible physician or radiation safety officer.

E. The licensee shall test electrical interlocks on entrance doors to the radiosurgery room for proper operation at least once every three months. Records of test results shall be maintained for inspection by the Agency.

F. The licensee shall cease treatment of patients with the therapy unit if a safety related system of the unit is found inoperative, including couch or helmet drive mechanisms, positioning mechanisms, treatment timing systems, safety interlocks, or radiation field alarms.

G. Before initiation of a treatment program, and after each installation of radiosurgery sources.

1. The licensee shall perform radiation surveys of the following locations:
   a. The radiosurgery system source housing. The maximum and average radiation levels at 1 meter from the nearest source with the device's shielding door closed, shall not exceed 10 milliroentgens per hour and 2 milliroentgens per hour, respectively, for any of the device's sources, when all sources are installed.
   b. Unrestricted areas adjacent to the treatment room, with the device's shielding door open. The survey shall be performed with a phantom in the primary beam of radiation and shall clearly establish that radiation levels in restricted and unrestricted areas do not exceed the limits specified in 12 A.A.C. 1, Article 4.
2. The licensee shall test the following safety equipment:
   a. Electrical interlocks on entrance doors to the therapy treatment room;
   b. The therapy source "ON-OFF" indicators, both at the source housing and on the system control panel; and
   c. The radiosurgery system treatment timing device.

H. After any changes made in treatment room shielding, treatment room location, or use of the stereotactic radiosurgery system which could result in an increase in radiation levels in

unrestricted areas outside of the therapy treatment room, the licensee shall conduct a radiation survey according to subsection (G). A report describing the changes and giving the survey results shall be sent to the Agency no later than 30 days following completion of the changes.

I. A qualified expert who meets the following training and experience requirements shall perform all physics procedures necessary to prepare a patient for a therapeutic application of radiation. The qualified expert shall:
1. Be certified by the American Board of Radiology in: Therapeutic Radiological Physics, Radiological Physics, Roentgen-Ray and Gamma-Ray Physics, or X-ray and Radium Physics; or the American Board of Medical Physicists in Radiation Oncology Physics; or
2. Have the following minimum training and experience:
   a. A Master's or Doctor's degree in physics, biophysics, radiological physics, or health physics;
   b. One year of full-time training in therapeutic radiological physics; and
   c. One year of full-time experience at a radiotherapy facility, including personal experience calibrating a gamma stereotactic radiosurgery system and planning associated patient treatment.
3. A candidate who does not meet the standards in subsections (I)(1) and (I)(2), may request a license amendment for an exemption from these training or experience requirements in accordance with A.R.S. § 30-654(B)(13). The request should include the name of the proposed qualified expert, a description of the individual's training and experience, including information similar to that specified in subsection (I)(2), and a written endorsement, based on personal knowledge of the individual's qualifications, by a physicist certified by the American Board of Radiology in one of the specialties listed in subsection (I)(1).

Historical Note

New Section adopted by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 9 A.A.R. 1126, effective May 9, 2003 (Supp. 03-1).

R12-1-719. Release of Individuals Containing Radiopharmaceuticals or Radioactive Sealed Sources from Restricted Areas

A. A licensee may authorize the release of any individual who has received radiopharmaceuticals or permanent implants containing radioactive material if the total effective dose equivalent to any other individual from exposure to the released individual is not likely to exceed 5 millisieverts (0.5 rem) or an amount specified in license conditions.

B. The licensee shall provide the released individual with oral and written instructions, on recommended actions that will make doses to other individuals as low as is reasonably achievable, if the total effective dose equivalent to any other individual is likely to exceed 1 millisievert (0.1 rem).

C. The licensee shall maintain a record of the criteria used to authorize the release of an individual containing radioactive material. The record shall be maintained for three years after the date of release if the total effective dose equivalent is calculated by using:
1. The retained activity rather than the activity administered,
2. An occupancy factor of less than 0.25 at 1 meter,
3. The biological or effective half-life, or
4. The shielding by tissue.

Historical Note

New Section adopted by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

Exhibit A. Groups of Medical Uses of Radioactive Material

Group I.

A. Use of prepared radiopharmaceuticals for certain diagnostic studies involving measurements of uptake, dilution, and excretion. This group does not include uses involving diagnostic study imaging, and tumor localization.
1. Iodine-123
2. Iodine-125
3. Iodine-131
4. Cobalt-57
5. Cobalt-58
6. Cobalt-60
7. Chromium-51
8. Iron-59
9. Potassium-42
10. Sodium-24
11. Technetium-99m

B. A licensee shall use a radioactive material listed in subsection (A) in the form of a radiopharmaceutical prepared for medical purposes that is:
1. Obtained from a manufacturer or preparer licensed according to 10 CFR 32.72, 2003 edition, published January 1, 2003, by the Office of the Federal Register, National Archives and Records Administration, Washington, D.C. 20408, or equivalent Agreement State requirements. This incorporation by reference is on file with the Agency and contains no future editions or amendments; or
2. Prepared by a nuclear pharmacist or a physician who is an authorized user on a radioactive material license and meets the training and experience requirements in 10 CFR 35(Subpart J), or an individual under the supervision of an authorized user that meets the training and experience requirements in 10 CFR 35(Subpart J), 2003 edition, published January 1, 2003; by the Office of the Federal Register, National Archives and Records Administration, Washington, D.C. 20408, which is incorporated by reference and on file with the Agency. This incorporation contains no future editions or amendments.

Group II.

C. A use of prepared radiopharmaceuticals for diagnostic study, imaging, and tumor localization.
1. Iodine-123
2. Iodine-125
3. Iodine-131
4. Selenium-75
5. Technetium-99m
6. Ytterbium-169
7. Indium-111
8. Indium-113m
9. Chromium-51
10. Fluorine-18
11. Gallium-67
12. Gold-198
13. Thallium-201
14. Rubidium-82
15. Carbon-11

D. A licensee shall use a radioactive material listed in subsection (C) in the form of a radiopharmaceutical prepared for medical purposes that is:
1. Obtained from a manufacturer or preparer according to subsection (B)(1); or
2. Prepared by a nuclear pharmacist or a physician who is authorized according to subsection (B)(2)

Group III.

E. Use of generators and reagent kits for the preparation and use of radiopharmaceuticals containing radioactive material for certain diagnostic uses.
1. Molybdenum-99/Technetium-99m generators
2. Tin-113/Indium-113m generators
3. Technetium-99m (in bulk)
4. Rubidium-81/Krypton-81m

F. A licensee shall acquire and use a radioactive material listed in subsection (E) in the form of a radiopharmaceutical prepared for medical purposes that is:
1. Obtained from a manufacturer or preparer according to subsection (B)(1); or
2. Prepared by a nuclear pharmacist or a physician who is authorized according to subsection (B)(2)

Group IV.

G. Use of prepared radiopharmaceuticals for certain therapeutic uses that do not normally require hospitalization for purposes of radiation safety.
1. Iodine-131, in quantities less than 33 millicuries
2. Phosphorus-32
3. Strontium-89
4. Samarium-153
5. Yttrium-90

H. A licensee shall use a radioactive material listed in subsection (G) in the form of a radiopharmaceutical prepared for medical purposes that is:
1. Obtained from a manufacturer or preparer according to subsection (B)(1); or
2. Prepared by a nuclear pharmacist or a physician who is authorized according to subsection (B)(2)

Group V.

I. Use of prepared radiopharmaceuticals for certain therapeutic procedures that normally require hospitalization for purposes of radiation safety.
1. Iodine-131
2. Gold-198

J. A licensee shall use a radioactive material listed in subsection (I) in the form of a radiopharmaceutical prepared for medical purposes that is:
1. Obtained from a manufacturer or preparer according to subsection (B)(1); or
2. Prepared by a nuclear pharmacist or a physician who is authorized according to subsection (B)(2).

Historical Note

New Exhibit adopted by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-720. Decay in Storage

Radioactive waste held for decay in storage shall be handled according to R12-1-438(C).

Historical Note

New Section made by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

ARTICLE 8. RADIATION SAFETY REQUIREMENTS FOR ANALYTICAL X-RAY OPERATIONS

R12-1-801. Scope

The rules in this Article establish requirements for the use of analytical x-ray equipment by persons registered under R12-1-204. The provisions of this Article supplement other applicable provisions of this Chapter.

Historical Note

Former Rule Section H.1; Former Section R12-1-801 repealed, new Section R12-1-801 adopted effective June 30, 1977 (Supp. 77-3). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-802. Definitions

"Analytical x-ray equipment" means devices or machines used for x-ray diffraction or x-ray induced fluorescence analysis.

"Analytical x-ray system" means a group of components utilizing x-rays to determine the elemental composition or to examine the microstructure of materials.

"Enclosed beam x-ray system" means an analytical x-ray system constructed in such a way that access to the interior of the enclosure housing the x-ray source is precluded during operation except through bypassing of interlocks or other safety devices to perform maintenance or servicing.

"Fail-safe characteristic" means a design feature which causes beam port shutters to close, or otherwise prevents emergence of the primary beam, upon the failure of a safety or warning device.

"Local component" means part of an analytical x-ray system and includes each area that is struck by x-rays, such as radiation source housings, port and shutter assemblies, collimators, sample holders, cameras, goniometers, detectors and shielding, but does not include power supplies, transformers, amplifiers, readout devices, and control panels.

"Normal operating procedures" means instructions or procedures including, but not limited to, sample insertion and manipulation, equipment alignment, routine maintenance by the registrant, and data recording procedures which are related to radiation safety.

"Open beam x-ray system" means an analytical x-ray system which permits an individual to place some body part in the primary beam path during normal operation.

"Primary beam" means radiation which passes through an aperture of the source housing on a direct path from the x-ray tube.

Historical Note

Former Rule Section H.2; Former Section R12-1-802 repealed, new Section R12-1-802 adopted effective June 30, 1977 (Supp. 77-3). Amended effective Aug. 8, 1986 (Supp. 86-4). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-803. Enclosed-beam X-ray Systems

A. Enclosed beam x-ray systems are exempt from other equipment requirements contained in this Article provided the enclosed beam x-ray systems are designed and constructed so that radiation levels measured at 5 cm from any accessible surface of the enclosure housing the x-ray source do not exceed 5 μSv (0.5 mrem) in one hour.

B. A registrant using enclosed beam x-ray systems shall comply with applicable provisions of R12-1-804(A), R12-1-805(B), and 12 A.A.C. 1, Article 4.

C. A person who maintains or services analytical x-ray systems, shall:
1. Obtain permission in advance from the radiation safety officer before bypassing interlocks or other safety devices,
2. Label equipment as "out of service" until maintenance or service is completed,
3. Wear extremity personnel monitoring devices, and
4. Ensure that interlocks or other safety devices are operating upon completion of maintenance or service.

Historical Note

Former Rule Section H.3; Former Section R12-1-803 repealed, new Section R12-1-803 adopted effective June 30, 1977 (Supp. 77-3). Former Section R12-1-803 repealed, new Section R12-1-803 adopted effective Aug. 8, 1986 (Supp. 86-4). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-804. Open-beam X-ray Systems

A. A registrant shall label open beam x-ray systems with a readily discernible sign or signs bearing the radiation symbol and the words:
1. "CAUTION -- HIGH INTENSITY X-RAY BEAM," or a similar warning, on the x-ray source housing; and
2. "CAUTION RADIATION -- THIS EQUIPMENT PRODUCES RADIATION WHEN ENERGIZED" or a similar warning, near any switch that energizes an x-ray tube if the radiation source is an x-ray tube.

B. A registrant shall ensure that an open beam x-ray system has all of the following warning devices:
1. X-ray tube status (On-Off) indicator in systems where the primary beam is controlled in this fashion;
2. Shutter status (Open-Closed) indicators near each port on the radiation housing for systems which control the primary beam; and
3. A clearly visible warning light labeled with the words "X-RAY ON," or a similar warning located near any switch that energizes an x-ray tube, illuminated only when the tube is energized; and
4. The warning devices in subsections (B)(1) through (3) shall be labeled so that their purpose is easily identified.

C. A registrant shall ensure that any apparatus utilized in beam alignment procedures is designed in such a way that excessive radiation will not strike the operator. Particular attention shall be given to viewing devices, in order to ascertain that lenses and other transparent components attenuate the beam to an acceptable level.

D. A registrant shall provide an interlock device which prevents entry of any portion of an individual's body into the primary beam or causes the primary beam to be shut off upon entry into its path on all open-beam x-ray systems. A registrant may apply to the Agency for an exemption from the requirements of a safety device. An application for exemption shall include:
1. A description of the various safety devices that have been evaluated;
2. The reason each device cannot be used; and
3. A description of the alternative methods that will be used to minimize accidental exposure, including procedures to assure that operators and others in the area will be informed of the absence of safety devices.

E. A registrant shall use only systems constructed so that:
1. Each x-ray tube housing is equipped with an interlock that automatically shuts off the tube if the tube is removed from the radiation source housing or the housing is disassembled; and
2. With all shutters closed, radiation measured at a distance of 5 centimeters from the surface of the system is not capable of producing a dose that exceeds 25 Sv (2.5 mRem) in one hour for the specified tube rating of the x-ray tube.

F. A registrant shall supply each x-ray generating system with a protective cabinet that limits leakage radiation measured at a distance of 5 cm (2 in) from the cabinet surface, so that the system is not capable of producing a dose equivalent that exceeds 25 µSv (2.5 mrem) in one hour.

G. A registrant shall ensure that the local components of an analytical x-ray system are located and arranged and have sufficient shielding or access control for the specified tube rating to prevent the radiation level in any area adjacent to the local component group from exceeding the dose limits in R12-1-416.

H. A registrant shall perform a radiation survey of the local component group of each analytical x-ray system to demonstrate compliance with subsection (G) upon:
1. Installation,
2. Change in configuration, or
3. Maintenance that affects the radiation level in any area adjacent to the local component group.

I. A registrant shall maintain a record of each survey for three years or until the analytical x-ray system is no longer used, whichever period is shorter.

Historical Note

Former Rule Section H.4; Former Section R12-1-804 repealed, new Section R12-1-804 adopted effective June 30, 1977 (Supp. 77-3). Former Section R12-1-804 renumbered as Section R12-1-805 without change, new Section R12-1-804 adopted effective Aug. 8, 1986 (Supp. 86-4). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-805. Administrative Responsibilities

A. A registrant shall designate a radiation safety officer who shall:
1. Establish and maintain operational procedures so that the radiation exposure of each worker is kept ALARA;
2. Instruct all personnel who work with or near radiation producing machines in safety practices;
3. Maintain a system of personnel monitoring;
4. Establish radiation control areas, including placement of appropriate radiation warning signs or devices;
5. Provide a radiation safety inspection of radiation producing machines on a routine basis;
6. Review modifications to x-ray systems, including x-ray tube housing, cameras, diffractometers, shielding, and safety interlocks;
7. Investigate and report proper authorities any case of excessive exposure to personnel and take remedial action; and,
8. Be familiar with all applicable rules for control of ionizing radiation.

B. An individual shall not be permitted to operate or maintain an open beam analytical x-ray system unless the individual has received instruction in and demonstrated competence in all of the following:
1. Identification of radiation hazards associated with the use of the equipment;
2. Significance of all radiation warning and safety devices, interlocks incorporated into the equipment, or the reasons that devices or interlocks have not been installed on certain pieces of equipment and the extra precautions required in lieu of these precautions;
3. Proper operating procedures for the equipment;
4. Recognition of symptoms of acute localized radiation exposure; and
5. Proper procedure for reporting an actual or suspected exposure.

C. A registrant shall maintain records of instruction and competence for Agency inspection for three years from the date of course completion or demonstration.

Historical Note
Adopted effective June 30, 1977 (Supp. 77-3). Former Section R12-1-805 renumbered as Section R12-1-806 without change. Former Section R12-1-804 renumbered as Section R12-1-805 without change effective Aug. 8, 1986 (Supp. 86-4). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-806. Operating Requirements

A. A radiation safety officer shall establish written emergency procedures and post the procedures in a conspicuous location. The procedures shall include the telephone number of the radiation safety officer.

B. A registrant shall ensure that written operating procedures are available for all analytical x-ray equipment workers. An individual shall not operate analytical x-ray equipment in any manner other than that specified in the procedures unless the individual obtains the radiation safety officer's written approval.

C. An individual shall not bypass a safety device or interlock unless the individual has obtained Radiation Safety Officer approval. The approval shall be for a specific period of time. When a safety device or interlock has been bypassed, the Radiation Safety Officer shall place a readily discernible sign on the radiation source housing, warning the reader of the unsafe condition. A registrant shall maintain the written record of the bypass approval for three years after the approval expires.

D. Except as authorized in subsection (C), an individual shall not perform an operation involving removal of covers, shielding materials, or tube housings or modification of shutters, collimators, or beam stops without ascertaining that the tube is off and that it will remain off until all protective devices have been restored to the normal operating condition. An individual repairing analytical x-ray equipment shall use the main switch, rather than interlocks, for routine shutdown in preparation for repairs.

E. A registrant shall ensure that unused ports on radiation source housings are closed and secured against unauthorized access to the radiation source.

F. Finger or wrist personnel monitoring devices shall be used by:
1. Operators of open beam analytical x-ray equipment not equipped with a safety device; and
2. Personnel performing maintenance procedures that require the presence of a primary x-ray beam when any local component is disassembled or removed.

G. A registrant shall ensure that each safety and warning device is tested for proper operation at intervals that do not exceed one month and maintain a record of each test for three years from the date the test is completed.

Historical Note
Former Section R12-1-805 renumbered as Section R12-1-806 without change effective Aug. 8, 1986 (Supp. 86-4). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-807. Surveys

A. To ensure that personnel exposure does not result in a dose to an individual that exceeds the dose limits specified in Article 4, a registrant shall perform a radiation survey upon:
1. Installation of the equipment and at least once each year after installation;
2. Change in the initial arrangement, number, or type of local components in the system;
3. Maintenance that involves disassembly or removal of a local component in the system;
4. Maintenance that involves alignment, if alignment requires the generation of the primary x-ray beam while any local component of the system is disassembled or removed;
5. A visual inspection of the local components in the system that reveals an abnormal condition; or
6. Determination that personnel are being exposed to radiation in excess of established levels recorded in monitoring records for personnel during previous monitoring periods or the occupational dose limits specified in Article 4.

B. The radiation surveys in subsection (A) are not required if the registrant demonstrates that the local components of an analytical x-ray system are located and arranged, and have sufficient shielding or access control, to limit personnel exposure to a level that is ALARA and below the occupational dose limits in Article 4. The Agency shall determine ALARA radiation levels based on the specified x-ray tube rating.

Historical Note
New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-808. Posting

A registrant shall conspicuously post each area or room that contains analytical x-ray equipment with a sign or signs that bear the radiation symbol and the words "CAUTION – X-RAY EQUIPMENT" or words with a similar meaning.

Historical Note
New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-809. Training

A registrant shall not be allow an individual to operate or maintain analytical x-ray equipment unless the individual has received training and demonstrated competence in:
1. Identifying radiation hazards associated with use of the equipment;
2. Recognizing and using radiation warning and safety devices, including interlocks that are incorporated into the equipment, and understanding why these devices are sometimes not installed;
3. Taking precautions associated with use of the equipment;
4. Recognizing symptoms of an acute localized exposure; and
5. Following proper procedure for reporting a suspected personnel exposure.

Historical Note
New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

ARTICLE 9. PARTICLE ACCELERATORS

R12-1-901. Purpose and Scope

A. This Article establishes procedures and requirements for the registration and the use of particle accelerators.

B. In addition to the requirements of this Article, all registrants are subject to the requirements of Articles 1, 2, 4 and 10. Registrants engaged in industrial radiographic operations are subject to the requirements of Article 5, and registrants engaged in the healing arts are subject to the requirements of Article 6 of this Chapter. Registrants using a particle accelerator for the production of radioactive material are subject to the require-

ments of Article 3, and if the radioactive material is used for medical purposes, Article 7.

Historical Note

Former Rule Section I.1; Former Section R12-1-901 repealed, new Section R12-1-901 adopted effective June 30, 1977 (Supp. 77-3). Amended effective June 13, 1997 (Supp. 97-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-902. Definitions

"Added filter" (See Article 6)

"Arc therapy" means radiation therapy that uses electrons to treat large, superficial volumes that follow curved surfaces, as in postmastectomy patients.

"Beam-limiting device" (See Article 6)

"Beam-monitoring system" means a system of devices that will monitor the useful beam during irradiation and terminate irradiation when a preselected number of monitor units has been accumulated.

"Control panel" (See Article 6)

"Full beam detector" means a radiation detector of such size that the total cross section of the maximum size useful beam is intercepted.

"Gantry" means that part of a linear accelerator that supports the radiation source so that it can rotate about a horizontal axis.

"Interlock" (See Article 1).

"Isocenter" means the point of intersection of the collimator axis and the axis of rotation of the gantry.

"Monitor unit" means a unit response from the beam monitoring system from which the absorbed dose can be calculated.

"Moving beam therapy" means radiation therapy in which there is displacement of the useful beam relative to the patient. Moving beam therapy includes arc therapy, skip therapy, and rotational beam therapy.

"Rotational beam therapy" means radiation therapy that is administered to a patient from a radiation source that rotates around the patient's body or the patient is rotated while the beam is held fixed.

"Skip therapy" means rotational beam therapy that is administered in a way that maximizes the dose to an area of interest and minimizes the dose to surrounding healthy tissue.

"Spot check" (See Article 6)

"Stationary beam therapy" means radiation therapy that involves a beam from a radiation source that is aimed at the patient from different directions. The distance of the source from the isocenter remains constant irrespective of the beam direction.

"Virtual source" means a point from which radiation appears to originate.

Historical Note

Former Rule Section I.2; Former Section R12-1-902 repealed, new Section R12-1-902 adopted effective June 30, 1977 (Supp. 77-3). Amended effective June 13, 1997 (Supp. 97-2). Section repealed by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). New Section made by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-903. General Registration Requirements

A. The requirements in this Section supplement the registration requirements in 12 A.A.C. 1, Article 2.

B. The Agency shall approve a registration application for use of a particle accelerator only if the Agency determines that:

1. The applicant is qualified by training and experience to use the accelerator for the purpose in the application submitted to the Agency under Article 2;
2. The applicant's proposed equipment, facilities, and operating and emergency procedures are adequate to protect public health;
3. The applicant satisfies any other applicable l requirements in this Section; and 4.The applicant has appointed a radiation safety officer.

Historical Note

Former Rule Section I.3; Former Section R12-1-903 repealed, new Section R12-1-903 adopted effective June 30, 1977 (Supp. 77-3). Amended effective Aug. 8, 1986 (Supp. 86-4). Amended effective June 13, 1997 (Supp. 97-2). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-904. Registration of Particle Accelerators Used in the Practice of Medicine

A. The requirements in this Section supplement the registration requirements in R12-1-903.

B. An applicant that is a "medical institution," as defined in 12 A.A.C. 1, Article 7, and performing human research shall appoint a radiation safety committee, meeting the requirements in R12-1-706.

C. The applicant shall ensure that an individual designated as an authorized user on the application is an Arizona licensed physician; approved by the radiation safety committee, if applicable; and is:

1. Certified in:
   a. Radiology, therapeutic radiology, or radiation oncology by the American Board of Radiology; or
   b. Radiation oncology by the American Osteopathic Board of Radiology; or
   c. Radiology, with specialization in radiotherapy, as a British "Fellow of the Faculty of Radiology" or "Fellow of the Royal College of Radiology"; or
   d. Therapeutic radiology by the Canadian Royal College of Physicians and Surgeons; or
2. Engaged in the active practice of therapeutic radiology, and has completed 200 hours of instruction in basic techniques applicable to the use of a particle accelerator, 500 hours of supervised work experience, and a minimum of three years of supervised clinical experience.
   a. To satisfy the requirement for instruction, the classroom and laboratory training shall include all of the following subjects.
      i. Radiation physics and instrumentation;
      ii. Radiation protection;
      iii. Mathematics pertaining to the use and measurement of radiotherapy; and
      iv. Radiation biology.
   b. To satisfy the requirement for supervised work experience, training shall occur under the supervision of an authorized user at a medical institution and shall include:
      i. Reviewing full calibration measurements and periodic spot checks;

ii. Preparing treatment plans and calculating treatment times;
iii. Using administrative controls to prevent misadministration;
iv. Implementing emergency procedures to be followed in the event of the abnormal operation of a particle accelerator; and
v. Checking and using survey meters.

c. To satisfy the requirement for a period of supervised clinical experience, training shall include one year in a formal training program approved by the Residency Review Committee for Radiology of the Accreditation Council for Graduate Medical Education or the Committee on Postdoctoral Training of the American Osteopathic Association and an additional two years of clinical experience in therapeutic radiology under the supervision of an authorized user at a medical institution. The supervised clinical experience shall include:
i. Examining individuals and reviewing their case histories to determine their suitability for treatment, noting any limitations or contraindications;
ii. Selecting the proper dose and how it is to be administered;
iii. Calculating the therapy doses and collaborating with the authorized user in the review of patients' or human research subjects' progress and consideration of the need to modify originally prescribed doses, as warranted by patients' or human research subjects' reaction to radiation; and
iv. Post-administration follow up and review of case histories.

D. With the application the applicant shall provide the name of each authorized user, and the training and experience that satisfies the requirements in subsection (C).

E. Each registrant shall establish and maintain a written quality management program to provide high confidence the radiation produced by the particle accelerator will be administered as directed by an authorized user. The quality management program shall include written policies and procedures to meet the specific patient safety objectives established by the Radiation Safety Officer or Radiation Safety Committee if applicable, and at minimum, contain a quality control program that addresses the tests and checks listed in Appendix A.

F. Each particle accelerator shall be calibrated by a qualified expert meeting the training and experience qualifications in R12-1-716(G).

G. At the time of application for registration or when a therapy program is expanded to multiple sites, each applicant or registrant shall provide the Agency with a description of the quality management program, a listing of the professional staff assigned to the facility, and the expected ratio of patient workload to staff member for programs involving multiple therapy sites. If the staffing ratio exceeds the recommended levels in Radiation Oncology in Integrated Cancer Management, 1986 edition, published in November 1986 by the Inter-Society Council for Radiation Therapy, which is incorporated by reference and on file with the Agency, the applicant shall provide to the Agency for approval the justification for the larger ratio and the safety considerations that have been addressed in establishing the program. This incorporation contains no future additions or amendments.

Historical Note
Former Rule Section I.4; Former Section R12-1-904 repealed, new Section R12-1-904 adopted effective June 30, 1977 (Supp. 77-3). Amended effective Aug. 8, 1986 (Supp. 86-4). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-905. Medical Particle Accelerator Equipment, Facility and Shielding, and Spot Checks

A. Equipment
1. Leakage radiation
a. X-ray leakage radiation from the source housing assembly shall not exceed 0.1% of the maximum dose equivalent rate of the unattenuated useful beam.
b. Neutron leakage radiation from the source housing assembly shall not exceed 0.5% of the maximum dose equivalent rate of the unattenuated useful beam.
c. Leakage radiation measurements made at any point one meter from the path of the charged particle between its point of origin and the target, window or scattering foil shall meet the requirements of subsection (A)(1)(a) and (b) when computed as a percentage of the dose rate equivalent of the unattenuated useful beam measured at one meter from the virtual source. Leakage radiation measurements at each point shall be averaged over an area up to but not exceeding 100 square centimeters (15.5 square inches).
d. The registrant shall maintain, for inspection by the Agency, records that show leakage radiation measurements for the life of the operation.
2. Beam limiting devices (not to include blocks or wedges). Adjustable or interchangeable beam limiting devices shall be provided and shall transmit no more than 2% of the useful beam for the portion of the useful beam that is to be attenuated by the beam limiting device. The neutron component of the useful beam shall not be included in this requirement. Measurements shall be averaged over an area up to but not exceeding 100 square centimeters (15.5 square inches) at the normal treatment distance.
3. Filters. The following requirements apply to systems that use a system of wedge filters, interchangeable field flattening filters, or interchangeable beam scattering filters:
a. Irradiation shall not be possible until a selection of a filter has been made at the treatment control panel;
b. An interlock system shall be provided to prevent irradiation if the filter selected is not in the correct position;
c. An indication of the wedge filter orientation with respect to the treatment field shall be provided at the control panel, by direct observation, or by electronic means, when wedge filters are used;
d. A display shall be provided at the treatment control panel showing the filter or filters in use;
e. Each filter that is removable from the system shall be clearly identified as to that filter's material of construction, thickness, and the nominal wedge angle for wedge filters, or a record tracing these factors for each filter shall be maintained at the system console, and
f. An interlock shall be provided to prevent irradiation if any filter selection operation carried out in the treatment room does not agree with the filter selec-

tion operation carried out at the treatment control panel.

4. Beam monitor. Equipment installed after the effective date of this Section shall be provided with at least one radiation detector in the radiation head. This detector shall be incorporated into a primary system so that all of the following criteria are met:
   a. Each primary system shall have a detector that is a transmission detector and a full beam detector and that is placed on the patient side of any fixed added filters other than a wedge filter;
   b. The detectors shall be removable only with tools and shall be interlocked to prevent incorrect positioning;
   c. Each detector shall be capable of independently monitoring and controlling the useful beam;
   d. Each detector shall form part of a dose-monitoring system from which the absorbed dose can be calculated at a reference point in the treatment volume;
   e. Each dose monitoring system shall have a legible display at the treatment control panel that:
      i. Maintains a reading until intentionally reset to 0;
      ii. Has only one scale and no scale multiplying factors in replacement equipment; and
      iii. Utilizes a design such that increasing dose is displayed by increasing numbers and is designed so that, in the event of an overdosage of radiation, the absorbed dose may be accurately determined under all nominal conditions of use or foreseeable failures;
   f. In the event of power failure, the dose monitoring information required in subsection (A)(4) displayed at the control panel at the time of failure shall be retrievable in at least one system; and
   g. Selection and display of dose monitor units
      i. Irradiation shall not be possible until a selection of dose monitor units has been made at the treatment control panel.
      ii. Each primary system shall terminate irradiation when the preselected number of dose monitor units has been detected by the system.
      iii. Each secondary system shall terminate irradiation when 110% of the preselected number of dose monitor units has been detected by the system.
      iv. It shall be possible to interrupt irradiation and equipment movements at any time from the operator's position at the treatment control panel. Following an interruption, it shall be possible to restart irradiation by operator action without any reselection of operating conditions. If any change is made of a preselected value during an interruption the equipment shall go to termination condition.
      v. It shall be possible to terminate irradiation and equipment movements, or go from an interruption condition to termination conditions at any time from the operator's position at the treatment control panel.
5. Beam monitoring system. All accelerator systems shall be provided with a beam monitoring system in the radiation head capable of monitoring and terminating irradiation.
   a. Each beam monitoring system shall have a display at the treatment control panel that registers the accumulated monitor units.
   b. The beam monitoring system shall terminate irradiation if the preselected number of monitor units has been detected by the system.
   c. For units with a secondary beam monitoring system, the primary beam monitoring system shall terminate irradiation if the preselected number of monitor units has been detected. The secondary beam monitoring system shall terminate irradiation if the primary system fails.
   d. In the event of a power failure, the display information required in subsection (A)(5)(a) shall be retained in at least one system following the power failure.
   e. An interlock device shall prevent irradiation if any beam monitoring system is inoperable.
   f. For purposes of this rule:
      i. "Beam monitoring system" means a system of devices that will monitor the useful beam during irradiation and will terminate irradiation if a preselected number of monitor units is accumulated.
      ii. "Monitor unit" means a unit response from the beam monitoring system from which the absorbed dose can be calculated.
6. Treatment beam mode selection. In equipment capable of both x-ray and electron therapy:
   a. Irradiation shall not be possible until a selection of radiation type is made at the treatment control panel;
   b. An interlock system shall be provided to prevent irradiation if any selected operations carried out in the treatment room do not agree with the selected operations indicated at the treatment control panel;
   c. An interlock system shall be available and in operating condition on a therapy machine, and shall be used to prevent unwanted x-ray or electron irradiation when preparing for, or performing radiation therapy procedures. The interlock system need not be available for use, if the therapy machine is only used to make an image of an inanimate object; and
   d. The radiation type selected shall be displayed at the treatment control panel before and during irradiation.
7. Treatment beam energy selection. Equipment capable of generating radiation beams of different energies shall meet all of the following requirements:
   a. Irradiation shall not be possible until a selection of energy is made at the treatment control panel;
   b. An interlock system shall be provided to ensure that the equipment can emit only the energy of radiation that is selected;
   c. An interlock system shall be provided to prevent irradiation if any selected operations carried out in the treatment room do not agree with the selected operations indicate at the treatment control panel; and
   d. The energy selected shall be displayed at the treatment control panel before and during irradiation.
8. Selection of stationary or moving beam therapy. Equipment capable of both stationary and moving beam therapy modes shall meet all of the following requirements:
   a. Irradiation shall not be possible until a selection of stationary beam therapy or moving beam therapy is made at the treatment control panel;
   b. An interlock system shall be provided to ensure that the equipment can operate only in the mode that is selected;

c. An interlock system shall be provided to prevent irradiation if any selected operations carried out in the treatment room do not agree with the selected operations indicated at the treatment control panel;
d. An interlock system shall be provided to terminate irradiation if the movement stops during moving beam therapy;
e. Moving beam therapy shall be so controlled that the required relationship between the number of dose monitor units and movement is obtained; and
f. The mode of operation shall be displayed at the treatment control panel.

9. Focal spot location and beam orientation. The registrant shall determine, or obtain from the manufacturer, the location in reference to an accessible point on the radiation head of all of the following:
a. The x-ray target or the virtual source of x-rays,
b. The electron window or the scattering foil, and
c. All possible orientations of the useful beam.

10. System checking facilities. Capabilities shall be provided for checking of all safety interlock systems.

B. Facility and shielding requirements.

1. In addition to protective barriers sufficient to ensure compliance with R12-1-907, all of the following design requirements apply:
a. Except for entrance doors or beam interceptors, all the required barriers shall be fixed barriers;
b. The treatment control panel shall be located outside the treatment room;
c. Windows, mirrors, operable closed-circuit television, or other equivalent viewing systems shall be provided to permit continuous observation of the patient during irradiation and shall be so located that the operator may observe the patient from the treatment control panel;
d. Provision shall be made for two-way oral communication between the patient and the operator at the treatment control panel;
e. Each point of entry into the treatment room shall be provided with warning lights that will indicate when the useful beam is "on" in a readily observable position outside of the room; and
f. Interlocks shall be provided and shall result in all entrance doors being closed before treatment can be initiated or continued. If the radiation beam is interrupted by any door opening, it shall be possible to restore the machine to operation only by closing the door and reinitiating exposure by manual action at the control panel.

2. A qualified expert trained and experienced in the principles of radiation protection shall perform a radiation protection survey on all installations before human use and after any change in an installation that might produce a radiation hazard. The person shall provide the survey results in writing to the individual in charge of the installation and transmit a copy of the survey results to the Agency.

3. Calibrations.
a. Calibration of the therapy system, including radiation output calibration, shall be performed before placing new installations into operation for the purpose of irradiation of patients. Subsequent calibrations shall be made at intervals not to exceed 12 months, and after any change that may cause the calibration of the therapy system to change.
b. Calibration of the radiation output of the therapy beam shall be performed with an instrument that has been calibrated using a method that is traceable to the National Institute of Standards and Technology (NIST), within the preceding two years.
c. Calibration of a particle accelerator shall be performed by, or under the supervision of a person who meets the qualification requirements specified in R12-1-716(G), and a copy of the calibration report shall be maintained by the registrant for inspection by the Agency
d. Calibration of the therapy beam shall include, but not necessarily be limited to, all of the following determinations:
i. Verification that the equipment is operating within the design specifications concerning the light localizer, the side light and back pointer alignment with the isocenter, when applicable, variation in the axis of rotation for the table, gantry and jaw system, and beam flatness and symmetry at specific depths;
ii. The exposure rate or dose rate in air or at various depths of water for the range of field sizes used for each effective energy, and for each treatment distance used for radiation therapy;
iii. The congruence between the radiation field and the field defined by the localizing device;
iv. The uniformity of the radiation field and its dependency upon the direction of the useful beam; and
v. The calibration determinations above shall be provided in sufficient detail, to allow the absorbed dose to tissue in the useful beam to be calculated to within +/- 5%.
e. Records of calibrations shall be maintained for two years following the date the calibration was performed.
f. A copy of the current calibration report shall be available in the therapy facility for use by the operator, and the report shall contain the following information:
i. The action taken by the person performing the calibration if it indicates a change has occurred since the last calibration;
ii. A listing of the persons informed of the change in calibration results; and
iii. A statement as to the effect the change in calibration has had on the therapy doses prior to the current calibration finding.

C. Spot checks.

1. The spot check procedures shall be in writing and shall have been developed by a person trained and experienced in performing calibrations.
2. The measurements taken during spot checks shall demonstrate the degree of consistency of the operating characteristics which can affect the radiation output of the system or the radiation dose delivered to a patient during a therapy procedure.
3. The written spot check procedure shall indicate the frequency at which tests or measurements are to be performed, not to exceed monthly.
4. The spot check procedure shall note conditions that require recalibration of the therapy system before further human irradiation.
5. Records of spot checks shall be maintained available for inspection by the Agency for two years following the spot

check measurements. Records of spot checks not performed by a qualified expert shall be signed by a qualified expert within 15 days of the spot check.

D. Operating procedures
1. Only the patient shall be in the treatment room during irradiation.
2. If a patient must be held in position during treatment only, mechanical supporting or restraining devices shall be used for this purpose.

Historical Note
Adopted effective June 30, 1977 (Supp. 77-3). Repealed effective August 8, 1986 (Supp. 86-4). New Section made by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-906. Limitations

A. A registrant shall not permit an individual to act as:
1. A particle accelerator operator of any type unless the individual:
   a. Has received copies of and instruction in this Article and the registrant's operating and emergency procedures,
   b. Demonstrates an understanding of the material, and
   c. Has demonstrated competence in the use the particle accelerator, related equipment, and survey instruments that will be employed during the operation of the particle accelerator;
2. A medical particle accelerator operator unless the individual is certified as required in A.R.S. § 32-2811 or the operator meets the requirements in R12-1-603(B); or
3. An industrial particle accelerator operator unless the individual has been instructed in radiation safety.

B. A registrant shall provide either the Radiation Safety Committee or the Radiation Safety Officer with the authority to terminate operations at a particle accelerator facility if this is necessary to protect health and safety or property.

C. If equipment is capable of both stationary and moving beam therapy, the registrant shall ensure that:
1. Irradiation is not possible unless either stationary or moving beam therapy has been selected at the control panel,
2. An interlock is provided to ensure that the machine will operate only in the mode that has been selected,
3. An interlock is provided that terminates irradiation if the gantry fails to move properly during moving beam therapy,
4. A means is provided to prevent movement during stationary therapy, and
5. The mode of operation is displayed at the control panel.

Historical Note
Adopted effective June 30, 1977 (Supp. 77-3). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-907. Shielding and Safety Design

A. A person experienced in the principles of radiation protection and installation design shall be consulted in the design of a particle accelerator installation and called upon to perform a radiation survey when the accelerator is first capable of producing radiation. The registrant shall provide a copy of the installation radiation survey to the Agency before an Agency inspection conducted according to R12-1-904(G).

B. The registrant shall shield each particle accelerator installation with the primary and secondary protective barriers necessary to comply with R12-1-408 and R12-1-416.

Historical Note
Adopted effective June 30, 1977 (Supp. 77-3). Amended subsection (A) effective Aug. 8, 1986 (Supp. 86-4). Amended effective June 13, 1997 (Supp. 97-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-908. Particle Accelerator Controls and Interlock Systems

A registrant shall ensure that:
1. Instrumentation, readouts and controls on the particle accelerator control panel are clearly identified and easily discernible;
2. All entrances into the area that contains the particle accelerator room, target room, or other high radiation area, are provided with interlocks that shut down the machine if an entrance door is opened;
3. If an interlock system connected to an entrance door that provides access to the therapy suite has been tripped, it is not possible to resume operation of the particle accelerator by resetting the interlock switch at the entrance where it had been tripped;
4. Each safety interlock is on a circuit that allows it to operate independently of all other safety interlocks;
5. If possible, the interlock system is fail-safe in design, so that any defect or component failure in the interlock system prevents operation of the particle accelerator; and
6. A scram button or other emergency power cutoff switch is located and easily identifiable in the area that contains the particle accelerator. The registrant shall ensure that the scram button prevents persons from restarting the particle accelerator at the accelerator control panel without resetting the button or switch.

Historical Note
Adopted effective June 30, 1977 (Supp. 77-3). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-909. Warning Systems

A registrant shall ensure that:
1. High radiation areas and entrances to the high radiation areas in medical facilities are equipped with a continuously-operating warning light system that operates when, and only when, radiation is produced;
2. High radiation areas and entrances to the high radiation areas in nonmedical facilities are equipped with an easily-observable flashing or rotating warning light system that operates when, and only when, radiation is produced;
3. High radiation areas associated with nonmedical particle accelerators have an audible warning device that is activated for 15 seconds before creation of the high radiation area; and the warning device is clearly discernible in all high radiation areas and all radiation areas; and
4. High radiation areas associated with any particle accelerator are posted according to R12-1-428 and R12-1-429.

Historical Note
Adopted effective June 30, 1977 (Supp. 77-3). Amended effective June 13, 1997 (Supp. 97-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-910. Operating Procedures

A. A registrant shall secure from use a particle accelerator when it is not being used to prevent unauthorized use.

B. A particle accelerator operator shall use the switch on the control panel to turn the accelerator beam on and off during nor-

mal operations. The safety interlock system may be used to turn off the accelerator beam in emergencies.

C. A registrant shall ensure that all safety and warning systems, including interlocks, are tested for proper operation at intervals not to exceed three months, and maintain results of each test for Agency inspection for at least three years from the date of the test.

D. A registrant shall keep current electrical circuit diagrams of a particle accelerator and the associated interlock systems, and maintain the diagrams for inspection by the Agency.

E. By-pass of an interlock is prohibited unless the by-pass is:
1. Authorized in writing by the Radiation Safety Committee or Radiation Safety Officer;
2. Recorded in a permanent log with a notice of the by-pass posted at any affected interlock and at the control panel, and
3. Terminated as soon as possible.

F. A registrant shall maintain a copy of the current operating and emergency procedures at the particle accelerator control panel.

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Amended subsection (D) effective Aug. 8, 1986 (Supp. 86-4). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-911. Radiation Surveys

A. The registrant shall ensure that a portable survey instrument is available at all times in a particle accelerator facility.

B. A person experienced in the principles of radiation protection and installation design shall:
1. Check the operation of the portable survey instrument required in subsection (A), using a known radiation source, before each use;
2. Perform and document a radiation protection survey when changes have been made in shielding, operation, equipment, or occupancy of adjacent areas;
3. For particle accelerator facilities greater than 30 Mev, establish a program of radiation protection surveys that will evaluate the airborne radiation hazards, and ensure that the particulate radioactivity present in the accelerator facility will not result in personnel exposure that exceeds the limits in Article 4; and
4. Perform radiation protection surveys, including smear surveys of the particle accelerator facility, as prescribed in the written procedures established by the Radiation Safety Officer of the particle accelerator facility and approved by the Agency at the time of application for registration.

C. The registrant shall maintain the following records
1. Radiation protection surveys required in subsection (B)(2), and the associated facility description, required in R12-1-202(E), until the registration is terminated; and
2. Records of the surveys required in subsections (B)(3) and (B)(4) for three years following the measurement.

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Amended effective Aug. 8, 1986 (Supp. 86-4). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-912. Repealed

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Amended effective Aug. 8, 1986 (Supp. 86-4). Amended effective June 13, 1997 (Supp. 97-2). Section repealed by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-913. Misadministration

A. For purposes of this rule "misadministration" means:
1. A therapeutic radiation dose from a machine:
   a. Delivered to the wrong patient;
   b. Delivered using the wrong mode of treatment;
   c. Delivered to the wrong treatment site; or
   d. Delivered in one week to the correct patient, using the correct mode, to the correct therapy site, but greater than 130% of the prescribed weekly dose; or
2. A therapeutic radiation dose from a machine with errors in the calibration, time of exposure, or treatment geometry that result in a calculated total treatment dose differing from the final, prescribed total treatment dose by more than 20%, except for treatments given in 1 to 3 fractions, in which case a difference of more than 10% constitutes a misadministration.

B. Reports of therapy misadministration
1. Within 24 hours after a misadministration, a registrant shall notify the Agency by telephone. The registrant shall also notify the referring physician of the affected patient and the patient or a responsible relative or guardian, unless the referring physician personally informs the registrant either that he or she will inform the patient, or that in his or her medical judgment, telling the patient or the patient's responsible relative or guardian would be harmful to one or the other, respectively. If the referring physician or the patient's responsible relative or guardian cannot be reached within 24 hours, the registrant shall notify them as soon as practicable. The registrant shall not delay medical care for the patient because of notification problems.
2. Within 15 days following the verbal notification to the Agency, the registrant shall report, in writing, to the Agency and individuals notified under subsection (B)(1). The written report shall include the registrant's name, the referring physician's name, a brief description of the event, the effect on the patient, the action taken to prevent recurrence, whether the registrant informed the patient or the patient's responsible relative or guardian, and if not, why not. The report shall not include the patient's name or other information that could lead to identification of the patient.
3. Records of misadministration shall be maintained according to R12-1-708(C).

Historical Note

New Section made by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

R12-1-914. Initial Inspections of Particle Accelerators Used in the Practice of Medicine

The Agency shall inspect a particle accelerator, used in the practice of medicine, before its initial use to treat human disease.

Historical Note

New Section made by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).

Appendix A. Quality Control Program

A. Mechanical Tests
1. Patient support assembly motions
2. Gantry angle indicators
3. Optical distance indicators
4. Alignment lights

5. Congruence of radiation beam and light field
6. Accuracy of field size indicators
7. Mechanical isocenter- gantry and collimator
8. Mechanical interlocks

B. Radiation Beam Tests
1. Machine operating parameters
2. Dose per monitor unit for x-ray and electron beams
3. Dose per degree for moving beam therapy
4. Radiation isocenter
5. Flatness and symmetry
6. Wedge transmission factors
7. Shadow tray transmission factors
8. Energy check on central axis
9. Radiation output versus field size.

C. Control Panel Checks
1. Radiation "ON" condition
2. Indicator lamp check
3. Computer control of accelerator
4. Interlock display
5. Digital display
6. Analog display
7. Status display
8. Reset display

D. Facility Checks
1. Patient audio-visual communication
2. Entrance door interlock
3. Warning lights
4. Emergency off button

E. Dose Output Check
1. Each registrant shall use the services of a third party qualified expert or third party TLD system to verify the accelerator's radiation output every two years.
2. If the output check is not within +/- 5% of the calibrated output, the accelerator shall be recalibrated and the discrepancy investigated.
3. Records of output checks shall be maintained for three years.

F. Patient Dosimetry Calculation Checks
1. Calculation of patient treatment times
2. Computer calculation of patient treatment times

Historical Note
New Appendix made by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

ARTICLE 10. NOTICES, INSTRUCTIONS, AND REPORTS TO IONIZING RADIATION WORKERS; INSPECTIONS

R12-1-1001. Purpose and Scope
This Article establishes requirements for notices, instructions, and reports by licensees or registrants to individuals working for a licensee or registrant. This Article explains the options available to these individuals in connection with ARRA inspections of licensees or registrants regarding radiological working conditions. The rules in this Article apply to all persons who receive, possess, use, own, or transfer sources of radiation licensed or registered by the ARRA.

Historical Note
Adopted effective June 30, 1977 (Supp. 77-3). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-1002. Posting of Notices to Workers
A. Each licensee or registrant shall post current copies of the following documents:
1. The rules in this Chapter;
2. The license, certificate of registration, conditions, or documents incorporated into the license or registration by reference, and any amendments to the license or registration;
3. The operating procedures applicable to work under the license or registration;
4. Any notice of violation involving radiological working conditions, proposed imposition of a civil penalty, or order issued under 12 A.A.C. 1, Article 12, and any response from the licensee or registrant.

B. If posting of a document specified in subsections (A)(1), (2) and (3) is not practicable, the licensee or registrant may post a notice which describes the document and states where it may be examined.

C. Form ARRA-6 (shown following R12-1-1008), "Notice to Employees" shall be posted by each licensee or registrant wherever individuals work in or frequent any portion of a restricted area.

D. Each licensee or registrant shall post documents, notices, or forms, as required by this Section, so that they are conspicuous and appear in a sufficient number of places to permit individuals engaged in work under the license or registration to observe them on the way to or from any particular work location to which the document applies and shall replace any document if it is defaced or altered.

E. Agency documents posted as required in subsection (A)(4) shall be posted within two working days after receipt of the documents from the Agency; the licensee's or registrant's response, if any, shall be posted within two working days after dispatch from the licensee or registrant. The documents shall remain posted for a minimum of five working days or until action correcting the violation has been completed, whichever is later.

Historical Note
Adopted effective June 30, 1977 (Supp. 77-3). Amended effective February 25, 1985 (Supp. 85-1). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-1003. Instructions to Workers
A. The licensee or registrant shall inform all individuals working in or frequenting any portion of a restricted area of:
1. The storage, transfer, or use of radioactive material or of radiation in the restricted area and the health protection problems associated with exposure to radioactive material or radiation;
2. Precautions or procedures to minimize exposure, and the purposes and functions of protective devices employed;
3. The applicable provisions of Agency rules and licenses for the protection of personnel from exposures to radiation or radioactive material occurring in each restricted area;
4. Their responsibility to report promptly to the licensee or registrant any condition which may lead to or cause a violation of Agency rules and licenses, or unnecessary exposure to radiation or radioactive material;
5. The appropriate response to warnings made in the event of any unusual occurrence or malfunction that may involve exposure to radiation or radioactive material; and
6. The radiation exposure reports which workers may request under R12-1-1004.

B. The extent of these instructions shall be commensurate with potential radiological health protection problems in the restricted area.

Historical Note
Adopted effective June 30, 1977 (Supp. 77-3). Amended effective February 25, 1985 (Supp. 85-1). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12,

1999 (Supp. 99-2).

R12-1-1004. Notifications and Reports to Individuals

A. A licensee or registrant shall report radiation exposure data for an individual and the results of any measurements, analyses, and calculations of radioactive material deposited or retained in the body to the individual as specified in this Section. The information reported shall include data and results obtained under Agency rules, orders, or license conditions, as shown in records maintained by the licensee or registrant. Each notification and report shall be in writing; include appropriate identifying data, such as the name of the licensee or registrant, the name of the individual, and the individual's social security number; include the individual's exposure information; and contain the following statement:

"This report is furnished to you under the provisions of 12 A.A.C. 1. You should preserve this report for future reference."

B. Each licensee or registrant shall provide annual notification of exposure to radiation or radioactive material for each worker, as shown in records maintained by the licensee or registrant under R12-1-419 (D).

C. At the request of a worker formerly engaged in work controlled by the licensee or the registrant, each licensee or registrant shall furnish to the worker a report of the worker's exposure to radiation or radioactive material. The report shall be furnished within 30 days from the time the request is made, or within 30 days after the exposure of the individual has been determined by the licensee or registrant, whichever is later; the report shall cover, within the period of time specified in the request, each calendar quarter in which the worker's activities involved exposure to radiation from radioactive material licensed by, or radiation machines registered with, the Agency; and the report shall include the dates and locations of work under the license or registration in which the worker participated during this period.

D. Reports to individuals of their exposure to radiation shall be made according to R12-1-446.

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3) Amended effective January 2, 1996 (Supp. 96-1). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-1005. Licensee, Registrant, and Worker Representation During Agency Inspection

A. As a condition of licensure or registration, each licensee or registrant shall afford to the Agency, at all reasonable times and without undue delay, an opportunity to inspect materials, machines, activities, facilities, premises, and records.

B. During an inspection, the licensee or registrant shall permit Agency inspectors to consult privately with workers as specified in Section R12-1-1006. The licensee or registrant may accompany Agency inspectors during other phases of an inspection.

C. A worker authorized to consult with an Agency inspector under R12-1-1006 may authorize another individual to represent the worker's interests during the Agency inspection. The licensee or registrant shall notify the inspectors of the worker's authorization and give the worker's representative an opportunity to accompany the inspectors during the inspection of physical working conditions.

D. Each worker's representative shall be routinely engaged in work under control of the licensee or registrant or shall have received instructions under R12-1-1003.

E. Different representatives of licensees or registrants and workers may accompany the inspectors during different phases of an inspection if there is no resulting interference with the inspection. However, only one worker's representative at a time may accompany the inspectors.

F. With the approval of the licensee or registrant and the worker's representative an individual who is not routinely engaged in work under control of the licensee or registrant, for example, a consultant to the licensee or registrant or to the worker's representative, shall be afforded the opportunity to accompany Agency inspectors during the inspection of physical working conditions.

G. Notwithstanding the other provisions of this Section, Agency inspectors are authorized to refuse to permit accompaniment by any individual who deliberately interferes with a fair and orderly inspection. With regard to any area containing proprietary information the worker's representative for that area shall be an individual previously authorized by the licensee or registrant to enter that area. With regard to areas containing information classified by an agency of the U.S. Government in the interest of national security, any individual who accompanies an inspector may have access to such information only if authorized by the classifying agency.

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Amended effective February 25, 1985 (Supp. 85-1). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-1006. Consultation with Workers During Inspections

A. A licensee or registrant shall afford Agency inspectors talking to a licensee or registrant representative the opportunity to consult privately with workers concerning matters of occupational radiation protection and other matters related to applicable provisions of Agency rules, licenses, and registrations to the extent the inspectors deem consultation necessary for conducting an effective and thorough inspection.

B. During the course of an inspection, any worker may privately bring to the attention of the inspectors, either orally or in writing, any past or present condition which the worker has reason to believe may have contributed to or caused any violation of the Act, these rules, or a license or registration condition, or any unnecessary exposure of an individual to radiation from licensed radioactive material or a registered radiation machine under the licensee's or registrant's control. If this notification is in writing, the worker shall comply with the requirements of R12-1-1007(A).

C. The provisions of R12-1-1006(B) shall not be interpreted as authorization to disregard instructions required by R12-1-1003.

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Amended effective February 25, 1985 (Supp. 85-1). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-1007. Inspection Requests by Workers

A. Any worker or representative of workers who believes that a violation of the Act, these rules, license, or registration conditions exists, or has occurred with regard to radiological working conditions in which the worker is engaged, may request an inspection of the facility by the Agency. Any request shall be in writing, addressed to the Director, set forth the specific grounds for the request, and be signed by the worker or representative of the workers. The Agency shall provide a copy to the licensee or registrant no later than at the time of inspection except that, upon the request of the worker, the Agency shall protect the worker's name and the name of individuals referred

to in the request to the extent authorized by law, except for good cause shown.

B. If, upon receipt of a request for inspection, the Agency's Director deter mines that there are reasonable grounds to believe that the alleged violation exists or has occurred, the Director shall initiate an inspection as soon as practicable, to determine if the alleged violation exists or has occurred. Inspections performed under this subsection need not be limited to matters referred to in the complaint.

C. A licensee or registrant shall not discharge or in any manner discriminate against any worker because the worker has filed any complaint or caused to be instituted any proceeding under these rules or has testified or is about to testify in the instituted proceeding or because the worker exercises on behalf of the worker or others, any option afforded by this Article.

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Amended effective February 25, 1985 (Supp. 85-1). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-1008. Inspection not Warranted; Review

If the Agency determines, with respect to a complaint under R12-1-1007, that an inspection is not warranted or there are no reasonable grounds to believe that a violation exists or has occurred, the Agency shall notify the complainant in writing of the determination. The complainant may obtain review of the determination by submitting a written request for hearing to the Agency. The Agency shall provide for a hearing before the Radiation Regulatory Hearing Board under 12 A.A.C. 1, Article 12 and A.R.S. Title 41, Chapter 6, Article 1.

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Amended effective February 25, 1985 (Supp. 85-1). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

Exhibit A. Form ARRA-6 (1993) Notice to Employees
ARRA-6 (1993) ARIZONA RADIATION REGULATORY AGENCY

NOTICE TO EMPLOYEES

STANDARDS FOR PROTECTION AGAINST IONIZING RADIATION; NOTICES, INSTRUCTIONS, AND REPORTS TO WORKERS; INSPECTIONS

In Article 4 of the Arizona Radiation Regulatory Agency (ARRA) rules for the Control of Ionizing Radiation, the Arizona Radiation Regulatory Agency has established standards for your protection against radiation hazards. In Article 10 of the rules for the Control of Ionizing Radiation, the Arizona Radiation Regulatory Agency has established certain provisions for the options of workers engaged in work under an ARRA license or registration.

YOUR EMPLOYER'S RESPONSIBILITY

Your employer is required to -

1. Apply these rules to work involving sources of ionizing radiation.
2. Post or otherwise make available to you a copy of the Arizona Radiation Regulatory Agency rules, licenses, and operating procedures which apply to work you are engaged in, and explain their provisions to you.
3. Post notice of violation involving radiological working conditions, proposed imposition of civil penalties, and orders.

YOUR RESPONSIBILITY AS A WORKER

You should familiarize yourself with those provisions of the Arizona Radiation Regulatory Agency rules and the operating procedures which apply to the work you are engaged in. You should observe their provisions for your own protection and protection of your co-workers.

WHAT IS COVERED BY THESE RULES

1. Limits on exposure to radiation and radioactive material in restricted and unrestricted areas.
2. Measures to be taken after accidental exposure;
3. Personnel monitoring, surveys, and equipment;
4. Caution signs, labels, and safety interlock equipment;
5. Exposure records and reports;
6. Options for workers regarding ARRA inspections; and
7. Related matters.

REPORTS ON YOUR RADIATION EXPOSURE HISTORY

1. The Arizona Radiation Regulatory Agency rules require that your employer give you a written report if you receive an exposure in excess of any applicable limit set forth in the rules or in the license. The basic limits for exposure to employees are set forth in Article 4 of the rules. These Sections specify limits on exposure to radiation and exposure to concentrations of radioactive material in air and water.
2. If you work where personnel monitoring is required, and if you request information on your radiation exposures,
   a. Your employer must give you a written report, upon termination of your employment, of your radiation exposures; and
   b. Your employer must advise you annually of your exposure to radiation.

INSPECTIONS

All licensed or registered activities are subject to inspection by representatives of the Arizona Radiation Regulatory Agency. In addition, any worker or representative of workers who believes that there is a violation of the regulations issued thereunder, or the terms of the employer's license or rules with regard to radiological working conditions in which the worker is engaged, may request an inspection by sending a notice of the alleged violation to the Arizona Radiation Regulatory Agency. The request must set forth the specific grounds for the notice and must be signed by the worker on his own behalf or as a representative of the workers. During inspections, ARRA inspectors may confer privately with workers, and any worker may bring to the attention of the inspectors any past or present condition which he believes contributed to or caused any violation as described above.

INQUIRIES

Inquiries dealing with the matters outlined above can be sent to the:

ARIZONA RADIATION REGULATORY AGENCY

POSTING REQUIREMENT

IN ACCORDANCE WITH A.A.C. R12-1-1002, COPIES OF THIS NOTICE SHALL BE POSTED IN SUCH A MANNER TO PERMIT EMPLOYEES WORKING IN OR FREQUENTING ANY PORTION OF A RESTRICTED AREA, USED FOR ACTIVITIES LICENSED OR REGISTERED PURSUANT TO ARTICLE 2 OR ARTICLE 3 OF THE AGENCY'S RULES, TO OBSERVE A COPY OR COPIES ON THE WAY TO OR FROM THEIR WORK AREA.

ARTICLE 11. INDUSTRIAL USES OF X-RAYS, NOT INCLUDING ANALYTICAL X-RAY SYSTEMS

R12-1-1101. Repealed

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Repealed effective June 13, 1997 (Supp. 97-2).

R12-1-1102. Repealed

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Repealed effective June 13, 1997 (Supp.

R12-1-1103. Repealed

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Repealed effective June 13, 1997 (Supp. 97-2).

R12-1- 1104. Registration Requirements

A. The Agency shall review an application for registration of a radiation machine for use in industrial radiography and approve the registration if an applicant meets all of the following requirements:
   1. The applicant satisfies the general requirements in Article 2 and any special requirements contained in this Article,
   2. The applicant submits a program for training radiographer's assistants that complies with R12-1-1146, and
   3. The applicant submits procedures for verifying and documenting the certification status of each radiographer and for ensuring that the certification remains valid.

B. An applicant shall submit written operating and emergency procedures, as prescribed in R12-1-1128.

C. An applicant shall submit a description of a program for review of job performance of each radiographer and radiogra-

pher's assistant at intervals that do not exceed six months, as prescribed in R12-1-1146(E).

D. An applicant shall submit a description of the applicant's overall organizational structure as it applies to radiation safety responsibilities in industrial radiography, including specified delegation of authority and responsibility.

E. An applicant shall submit and list the qualifications of each individual designated as an RSO under R12-1-1120 and indicate which designee is responsible for ensuring that the registrant's radiation safety program is implemented.

F. If an applicant intends to perform "in-house" calibrations of survey instruments, the applicant shall describe each calibration method to be used, the relevant experience of each person who will perform a calibration, and procedures to ensure that all calibrations are performed according to the procedures prescribed in R12-1-1108.

G. An applicant shall identify and describe the location of all field stations and permanent radiographic installations.

H. An applicant shall identify each location where records required by this Chapter will be maintained.

Historical Note

Adopted effective June 30, 1977 (Supp. 77-3). Repealed effective June 13, 1997 (Supp. 97-2). New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-1105. Reserved

R12-1-1106. Equipment Performance

A registrant shall ensure that each x-ray machine has a lock or other security system designed to prevent unauthorized use or accidental production of radiation and is secured against unauthorized use at all times, except when under the direct surveillance of a radiographer or radiographer's assistant.

Historical Note

New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-1107. Reserved

R12-1-1108. Radiation Survey Instruments

A. A registrant shall maintain at least two calibrated and operable radiation survey instruments at each location where sources of radiation are present to make radiation surveys required by this Article and Article 4 of this Chapter. Instrumentation required by this Section shall be capable of measuring a range from 0.02 millisieverts (2 millirems) per hour through 0.01 sievert (1 rem) per hour.

B. A registrant shall ensure that each radiation survey instrument required under subsection (A) is calibrated:

1. At intervals that do not exceed six months, and after instrument servicing, except for battery changes;
2. For linear scale instruments, at two points located approximately one-third and two-thirds of full-scale on each scale; for logarithmic scale instruments, at midrange of each decade, and at two points of at least one decade; and for digital instruments, at 3 points between 0.02 and 10 millisieverts (2 and 1000 millirems) per hour; and
3. So that an accuracy within plus or minus 20% of the calibration source can be demonstrated at each point checked.

C. A registrant shall make a record each time a radiation survey instrument is calibrated, and maintain each record for three years after it is made.

Historical Note

New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-1109. Reserved

R12-1-1110. Quarterly Inventory

A. A registrant shall conduct a quarterly physical inventory to account for all x-ray machines received and possessed under the registration.

B. A registrant shall maintain a record of the quarterly inventory required under subsection (A) for three years after it is made.

C. The record required by subsection (B) shall include the date of the inventory, name of the individual who conducted the inventory, location of each x-ray machine, and manufacturer, model, and serial number of each x-ray machine.

Historical Note

New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-1111. Reserved

R12-1-1112. Utilization Logs

A. A registrant shall maintain for each x-ray machine a utilization log that provides all of the following information:

1. A description, including the make, model, and serial number of each x-ray machine;
2. The identity and signature of the radiographer using the machine; and
3. The plant or site where the machine is used and dates of use, including each date when the machine is removed from or returned to storage.

B. A registrant shall retain a log required by subsection (A) for three years after the log is made.

Historical Note

New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-1113. Reserved

R12-1-1114. Inspection and Maintenance of Radiation Machines, Survey Instruments, and Associated Equipment

A. A registrant shall perform visual and operability checks on survey instruments and radiation machines before use on each day the equipment is to be used to ensure that the equipment is in good working condition and required labeling is present. Survey instrument operability checks shall be performed using check sources or other authorized means. If equipment problems are found, the registrant shall remove the equipment from service until it is repaired.

B. A registrant shall have written inspection and maintenance procedures for radiation machines and survey instruments that require inspection and maintenance, at intervals that do not exceed three months or before first use of the equipment and to ensure the proper functioning of components important to safety. Replacement components shall meet design specifications. If equipment problems are discovered, the registrant shall remove the equipment from service until the equipment is repaired.

C. A registrant shall maintain records of equipment problems found in daily checks and quarterly inspections and retain each record for three years after it is made. The record shall include the date of the check or inspection, name of the inspector, equipment involved, any problems found, and any repair or needed maintenance performed.

Historical Note

New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-1115. Reserved

R12-1-1116. Surveillance

During each radiographic operation a radiographer, or the radiographer's assistant as permitted by R12-1-1118, shall maintain continuous direct visual surveillance of the operation to protect against unauthorized entry into a high radiation area, except at permanent radiographic installations where all entrances are locked and the registrant is in compliance with R12-1-1136.

Historical Note

New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-1117. Reserved

R12-1-1118. Industrial Radiographic Operations

A. If industrial radiography is performed at a location other than a permanent radiographic installation, a registrant shall ensure that the radiographer is accompanied by at least one other radiographer or radiographer's assistant, qualified under R12-1-1146. The additional radiographer or radiographer's assistant shall observe the operations and be capable of providing immediate assistance to prevent unauthorized entry. The registrant shall not allow industrial radiography if only one qualified individual is present.

B. A registrant shall ensure that each industrial radiographic operation is conducted at a location of use authorized on the registration of a permanent radiographic installation, unless another permanent location is specifically authorized by the Agency.

Historical Note

New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-1119. Reserved

R12-1-1120. Radiation Safety Officer (RSO)

A. A registrant shall have a radiation safety officer (RSO) who is responsible for implementing procedures and regulatory requirements in the daily operation of the radiation safety program.

B. A registrant shall ensure that the RSO has satisfied the following minimum requirements:
1. The training and testing requirements in R12-1-1146;
2. Two thousand hours of hands-on experience as a qualified radiographer for an industrial radiographic operation; and
3. Formal training in the establishment and maintenance of a radiation safety program.

C. A registrant may use an individual in the position of RSO who does not have the training and experience required in subsection (B), if the registrant provides the Agency with a description of the individual's training and experience in the field of ionizing radiation and training with respect to the establishment and maintenance of a radiation safety protection program.

D. The specific duties and authorities of the RSO include, but are not limited to:
1. Establishing and overseeing operating, emergency, and ALARA procedures as required in Article 4 of this Chapter, and reviewing the procedures every year to ensure that they conform to current Agency rules and registration conditions;
2. Overseeing and approving all phases of the training program for radiographic personnel, ensuring that appropriate and effective radiation protection practices are taught;
3. Overseeing radiation surveys and associated documentation to ensure that the surveys are performed in accordance with the rules and taking corrective measures if levels of radiation exceed established action limits;
4. Overseeing the personnel monitoring program to ensure that monitoring devices are calibrated and used properly by occupationally exposed personnel and ensuring that records are kept of the monitoring results and timely notifications are made as required in R12-1-444; and
5. Overseeing operations to ensure that they are conducted safely and instituting corrective actions, which may include ceasing operations if necessary.

Historical Note

New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-1121. Reserved

R12-1-1122. Form of Records

A registrant shall maintain records in accordance with R12-1-405.

Historical Note

New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-1123. Reserved

R12-1-1124. Reserved

R12-1-1125. Reserved

R12-1-1126. Posting

A registrant shall post any area in which industrial radiography is being performed as required by R12-1-429. Exceptions listed in R12-1-430 do not apply to industrial radiographic operations.

Historical Note

New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-1127. Reserved

R12-1-1128. Operating and Emergency Procedures

A. A registrant shall have operating and emergency procedures that include, at minimum, instructions in the following, as applicable:
1. Use of radiation machines, so that persons are not exposed to radiation that exceeds the limits in Article 4 of this Chapter;
2. Methods and occasions for conducting radiation surveys;
3. Methods for controlling access to radiographic areas;
4. Methods and occasions for locking and securing a radiation machine;
5. Personnel monitoring and associated equipment;
6. Inspection, maintenance, and operability checks of a radiation machine and survey instruments;
7. Actions to be taken immediately by radiography personnel if a pocket dosimeter is found to be off-scale or an alarm rate meter sounds an alarm;
8. Procedures for identifying and reporting defects and noncompliance, as required by R12-1-448;
9. The procedure for notifying the RSO and the Agency in the event of an accident;
10. Minimizing exposure of persons in the event of an accident, and
11. Maintenance of records.

B. The registrant shall maintain copies of current operating and emergency procedures until the Agency terminates the registration. Superseded procedures shall be maintained for three years after a change is made. Additionally, records shall be maintained in accordance with R12-1-1138.

Historical Note

New Section made by final rulemaking at 10 A.A.R.

2122, effective July 3, 2004 (Supp. 04-2).

R12-1-1129. Reserved

R12-1-1130. Personnel Monitoring

A. An individual shall not act as a radiographer or a radiographer's assistant unless, at all times during radiographic operations, the individual wears, on the trunk of the body, a direct reading dosimeter, an operating alarm rate meter, and either a film badge, a TLD, or an optically stimulated luminescence (OSL) dosimeter. At permanent radiography installations where other required alarm or warning devices are in routine use, an alarm rate meter is not required.

1. A registrant shall provide pocket dosimeters that have a range from zero to 2 millisieverts (200 millirems) and ensure that the dosimeters are recharged at the start of each shift. Electronic personnel dosimeters are permitted in place of ion-chamber pocket dosimeters.
2. The registrant shall assign a film badge, TLD, or OSL dosimeter to one individual, who shall wear the assigned equipment.
3. The registrant shall replace film badges at least monthly and replace TLDs or OSL dosimeters at least quarterly.
4. After replacement, the registrant shall ensure that each film badge or TLD is processed as soon as possible.

B. A radiographer or radiographer's assistant shall record exposures noted from direct reading dosimeters, such as pocket dosimeters or electronic personnel dosimeters, at the beginning and end of each shift.

C. A registrant shall check each pocket dosimeter or electronic personnel dosimeter at least yearly for correct response to radiation, and discontinue use of a dosimeter if it is not accurate within plus or minus 20% of the true radiation exposure.

D. If an individual's pocket dosimeter has an off-scale reading, or the electronic personnel dosimeter reads greater than 2 millisieverts (200 millirems), and radiation exposure cannot be ruled out as the cause, a registrant shall send the individual's film badge, TLD, or OSL dosimeter for processing within 24 hours. The registrant shall not allow the individual to work with a radiation machine until the individual's radiation exposure is determined. Using the information from the badge or dosimeter, the RSO or the RSO's designee shall calculate the affected individual's cumulative radiation exposure, as prescribed in Article 4 of this Chapter and include the results in records maintained in accordance with subsection (G).

E. If an individual's monitoring device is lost or damaged, the individual shall cease work immediately until the registrant provides a replacement film badge, TLD, or OSL dosimeter and the RSO or the RSO's designee calculates the exposure for the time period from issuance to discovery of a lost or damaged film badge, TLD, or OSL dosimeter. The registrant shall include the calculated exposure and the time period for which the film badge, TLD, or OSL dosimeter was lost or damaged in the records maintained in accordance with subsection (G).

F. For each alarm rate meter a registrant shall ensure that:

1. At the start of a shift each individual with an alarm rate meter checks that the alarm functions (sounds) before using the device;
2. Each device is set to give an alarm signal at a preset dose rate of 5 mSv/hr (500 mrem/hr) with an accuracy of plus or minus 20% of the true radiation dose rate;
3. A special means is necessary to change the preset alarm function on the device; and
4. Each device is calibrated at periods that do not to exceed 12 months for correct response to radiation

G. Each registrant shall maintain the following personnel monitoring records:

1. Each dosimeter reading and the yearly operability check required by subsections (B) and (C) for three years after each record is made;
2. A record of each alarm rate meter calibration for three years after the record is made;
3. Any report received from the film badge, TLD, or OSL processor. The registrant shall maintain these records until the Agency terminates the registration; and
4. Any estimation of an exposure evidenced by an off-scale personnel direct-reading dosimeter or a lost or damaged film badge, TLD, or OSL dosimeter. The records shall be maintained until the Agency terminates the registration.

Historical Note

New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-1131. Reserved

R12-1-1132. Supervision of a Radiographer's Assistant

If a radiographer's assistant uses a radiation machine or conducts a radiation survey required by R12-1-1134(B), the registrant shall ensure that the assistant is under the personal supervision of a radiographer. For purposes of this Section "personal supervision" means:

1. The radiographer is physically present at the site where the radiation machine is being used;
2. The radiographer is available to give immediate assistance if required; and
3. The radiographer is able to observe directly the assistant's performance.

Historical Note

New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-1133. Reserved

R12-1-1134. Radiation Surveys

A. A registrant shall conduct surveys with a calibrated and operable radiation survey instrument that meets the requirements of R12-1-1108.

B. A registrant shall conduct a survey of a radiographic machine any time the machine is placed in storage to ensure that the machine will not expose personnel to radiation.

C. A registrant shall maintain a record of each exposure survey conducted before a machine is placed in storage under subsection (B), if that survey is the last one performed during the workday. Each record shall be maintained for three years after it is made.

Historical Note

New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-1135. Reserved

R12-1-1136. Permanent Radiographic Installations

A. If a registrant maintains a permanent radiographic installation that does not fall within the definition of "enclosed radiography" in R12-1-102, the registrant shall ensure that each entrance used for personnel access to the high radiation area has either:

1. An entrance control device of the type described in R12-1-420(A)(1), which reduces the radiation level upon entry into the area, or
2. Both conspicuous visible and audible alarm signals to warn of the presence of radiation. The registrant shall ensure that the visible signal is actuated by radiation if the x-ray tube is energized and the audible signal is actuated

if a person attempts to enter the installation while the x-ray tube is energized.

B. A registrant shall test the alarm system for proper operation with a radiation source each day before the installation is used for radiographic operations. The test shall include a check of both the visible and audible signals. The registrant shall test each device referenced in subsection (A)(1) monthly. If an entrance control device or alarm signal is operating improperly, the registrant shall immediately label the device or signal as "defective" and repair the device or signal within seven calendar days. The registrant may continue to use the facility during this seven-day period, if the registrant implements continuous surveillance requirements of R12-1-1116 and uses an alarm rate meter.

C. A registrant shall maintain each record of alarm system and entrance control device tests for three years after the record is made.

Historical Note

New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-1137. Reserved

R12-1-1138. Location of Documents and Records

A. A registrant shall maintain a copy of each record required by this Article and other applicable Articles of this Chapter at the location specified on the registration application.

B. A registrant shall maintain a copy of the following at each field station and temporary job site:

1. The registration that authorizes use of a radiation machines;
2. A copy of Articles 4, 10, and 11 of this Chapter;
3. Utilization logs for each radiation machine dispatched from that location, as required by R12-1-1112;
4. Records of equipment problems identified in daily checks of equipment, as required by R12-1-1114;
5. Records of alarm system and entrance control device checks, as required by R12-1-1136;
6. Records of direct-reading dosimeters such as pocket dosimeters and electronic personnel dosimeters, as required by R12-1-1130;
7. Operating and emergency procedures, as required by R12-1-1128;
8. A report on the most recent calibration of the radiation survey instruments in use at the site, as required by R12-1-1108;
9. A report on the most recent calibration of each alarm rate meter and operability check of each pocket dosimeter, or electronic personnel dosimeter, as required by R12-1-1130;
10. Most recent survey record, as required by R12-1-1134; and
11. If a registrant is operating in the state under R12-1-207, a copy of the out-of-state machine registration and a written authorization from the Agency to operate in the state.

Historical Note

New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-1139. Reserved

R12-1-1140. Reserved

R12-1-1141. Reserved

R12-1-1142. Reserved

R12-1-1143. Reserved

R12-1-1144. Reserved

R12-1-1145. Reserved

R12-1-1146. Training

A. A registrant shall not allow an individual to act as a radiographer until the individual has received training in the subjects in subsection (G), has participated in a minimum of two months of on-the-job training, and is certified through a radiographer certification program by a independent certifying organization in accordance with the criteria specified in Appendix A.

1. A registrant shall provide the Agency with proof of an individuals's certification upon request.
2. A registrant shall maintain proof of an individual's certification at the job site where the individual is performing field radiography.
3. A registrant that employs a certified radiographer in Arizona shall ensure that:
   a. The radiographer has obtained initial certification or recertification within the last five years; and
   b. An uncertified radiographer works only as a radiographer's assistant until certified.
4. A radiographer shall recertify every five years by:
   a. Taking an approved radiography certification examination in accordance with this subsection; or
   b. Providing written evidence that the radiographer is active in the practice of industrial radiography and has participated in continuing education during the previous five-year period.
5. If an individual cannot provide the written evidence required in subsection (4)(b), the individual shall retake the certification examination.
6. A radiographer shall provide the registrant with proof of certification in the form of a card issued by the certifying organization that contains:
   a. A picture of the certified radiographer,
   b. The radiographer's certification number,
   c. The date the certification expires, and
   d. The radiographer's signature.

B. A registrant shall not allow an individual to act as a radiographer until the individual:

1. Receives copies of and instruction in the requirements of this Article, applicable Sections of Articles 4 and 10 and R12-1-107, the Agency registration or registrations under which the individual will perform industrial radiography, and the registrant's operating and emergency procedures;
2. Demonstrates an understanding of the registrant's registration and operating and emergency procedures by successful completion of a written or oral examination that covers the relevant material;
3. Receives training in:
   a. Use of the registrant's radiation machine,
   b. Daily inspection of the radiation machine, and
   c. Use of radiation survey instruments; and
4. Demonstrates an understanding of the use of the radiation machines and survey instruments described in subsection (B)(3) by successful completion of a practical examination covering this material.

C. A registrant shall not allow an individual to act as a radiographer's assistant until the individual:

1. Receives copies of and instruction in the requirements of this Article, applicable Sections of Articles 4 and 10 and R12-1-107, the Agency registration or registrations under which the radiographer will perform industrial radiography, and the registrant's operating and emergency procedures;
2. Develops competence to use, under the personal supervision of the radiographer, the registrant's radiation machine and radiation survey instruments; and

3. Demonstrates understanding of the instructions provided under subsection (C)(1) by successfully completing a written test on the subjects covered and demonstrates competence using the hardware described in subsection (C)(2) by successfully completing a practical examination.

D. A registrant shall provide refresher safety training for each radiographer and radiographer's assistant at intervals that do not exceed 12 months.

E. Except where an individual serves both as a radiographer and an RSO, the RSO or the RSO's designee shall design and implement an inspection program to examine the job performance of each radiographer and radiographer's assistant and ensure that the Agency's rules and registration requirements, and the registrant's operating and emergency procedures, are followed. The inspection program shall:

1. Include observation of the performance of each radiographer and radiographer's assistant during an actual industrial radiographic operation, at intervals that do not exceed six months; and
2. Provide that, if a radiographer or a radiographer's assistant has not participated in an industrial radiographic operation for more than six months since the last inspection, each radiographer shall demonstrate knowledge of the training requirements in subsection (B)(3) and each radiographer's assistant shall demonstrate knowledge of the training requirements of subsection (C)(2) by a practical examination before these workers can participate in a radiographic operation.

F. A registrant shall maintain records of the training required in this Section, including certification documents, written and practical examinations, refresher safety training documents, and inspection documents, in accordance with subsection (I).

G. A registrant shall include the following subjects in the training required under subsection (A):

1. Fundamentals of radiation safety, including:
   a. Characteristics of x-ray radiation;
   b. Units of radiation dose and quantity of radioactivity;
   c. Hazards of exposure to radiation;
   d. Levels of radiation from x-ray machines; and
   e. Methods of controlling radiation dose (time, distance, and shielding);
2. Radiation detection instruments, including:
   a. Use, operation, calibration, and limitations of radiation survey instruments;
   b. Survey techniques; and
   c. Use of personnel monitoring equipment;
3. Equipment topics, including:
   a. Operation and control of radiation machines; and
   b. Inspection and maintenance of each radiation machine and survey instrument;
4. The requirements of pertinent Agency rules; and
5. Case histories of accidents in radiography.

H. A registrant shall maintain records of radiographer certification in accordance with subsection (I)(1) and provide proof of certification as required in subsection (A)(1).

I. A registrant shall maintain the following records for three years after each record is made:

1. Records of training for each radiographer and each radiographer's assistant. For radiographers, the records shall include radiographer certification documents and verification of certification status. All records shall include copies of written tests, dates of oral and practical examinations, and names of individuals who conducted and took the oral and practical examinations; and
2. Records of annual refresher safety training and semi-annual inspections of job performance for each radiographer and each radiographer's assistant. The records for the annual refresher safety training shall list topics discussed during training, the date of training, and names of each instructor and attendee. For inspections of job performance, the records shall include a list of items checked during the inspection and any non-compliance observed by the RSO.

Historical Note

New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

Appendix A. Standards for Organizations that Provide Radiography Certification

Note: For purposes of this Article an "independent certifying organization" means an organization that meets all of the criteria in this Appendix.

I. Requirements for an Organization that Provides Radiographer Certification

To qualify to provide radiography certification, an organization shall:

A. Be a society or association, with members who participate in, or have an interest in, the field of industrial radiography;

B. Not restrict membership because of race, color, religion, sex, age, national origin, or disability;

C. Have a certification program that is open to nonmembers, as well as members;

D. Be an incorporated, nationally recognized organization that is involved in setting national standards of practice within its fields of expertise;

E. Have a staff comparable to other nationally recognized organizations, a viable system for financing its operations, and a policy-and decision-making review board;

F. Have a set of written, organizational by-laws and policies that address conflicts of interest and provide a system for monitoring and enforcing the by-laws and policies;

G. Have a committee, with members who can carry out their responsibilities impartially, review and approve the certification guidelines and procedures, and advise the organization's staff in implementing the certification program;

H. Have a committee, with members who can carry out their responsibilities impartially, review complaints against certified individuals, and determine sanctions;

I. Have written procedures that describe all aspects of the organization's certification program;

J. Maintain records of the current status of each individual's certification and administration of the certification program;

K. Have procedures to ensure that certified individuals are provided due process with respect to administration of the certification program, including a process for becoming certified and a process for imposing sanctions against certified individuals;

L. Have procedures for proctoring examinations and qualifying proctors. The organization, through these procedures, shall ensure that an individual who proctors an examination is not employed by the same company or corporation (or a wholly-owned subsidiary of the company or corporation) that employs an examinee;

M. Exchange information about certified individuals with the Agency, other independent certifying organizations, the NRC, or Agreement States and allow periodic review of its certification program and related records; and

N. Provide a description to the Agency of its procedures for choosing examination sites and providing a favorable examination environment.

II. Requirements for a Certification Program

An independent certifying organization shall ensure that its certification program:

A. Requires an applicant for certification to:
1. Obtain training in the subjects listed in R12-1-1146(G), and
2. Satisfactorily complete a written examination that covers these subjects;

B. Require an applicant for certification to provide documentation demonstrating that the applicant has:
1. Received training in the subjects listed in R12-1-1146(G);
2. Satisfactorily completed the on-the-job training required in R12-1-1146(A); and
3. Received verification from a registrant that the applicant has demonstrated the capability of independently working as a radiographer;

C. Provides procedures that protect examination questions from disclosure;

D. Provides procedures for denying certification to an applicant and revoking, suspending, and reinstating a certificate;

E. Provides a certification period that is not less than three years or more than five years, procedures for renewing certifications and, if the procedures allow renewals without examination, a system for assessing evidence of recent full-time employment and annual refresher training; and

F. Provides a timely response to inquiries, by telephone or letter, from members of the public, about an individual's certification status.

III. Requirements for a Written Examination

An independent certifying organization shall ensure that its examination:

A. Is designed to test an individual's knowledge and understanding of the subjects listed in R12-1-1146(G) or equivalent NRC or Agreement State requirements;

B. Is written in a multiple-choice format; and

C. Has psychometrically valid questions drawn from a question bank and based on the material in R12-1-1146(G).

Historical Note

New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

ARTICLE 12. ADMINISTRATIVE PROVISIONS

R12-1-1201. Timeliness

A. Any application, request, response, or report required by any rule, order, application, or letter shall be considered timely if it is postmarked on or before the due date, or hand-delivered to the Agency office before 5:00 p.m. on the due date. If the due date falls on a Saturday, a Sunday, or a legal holiday, the due date is extended to the end of the next day that is not a Saturday, a Sunday, or legal holiday.

B. As used in this Article, "working days" are all days other than Saturdays, Sundays, or legal holidays prescribed in A.R.S. § 1-301.

Historical Note

Adopted effective June 23, 1983 (Supp. 83-3). Section repealed, new Section adopted effective January 2, 1996 (Supp. 96-1). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-1202. Administrative Hearings

A. All hearings shall be governed by Title 41, Chapter 6, Article 10.

B. If the Radiation Regulatory Hearing Board is conducting a hearing, all motions and rulings shall be in writing, except those made during the hearing may be oral. The Board shall ensure that any agreements reached during a conference are incorporated in the record, and that all hearings are recorded.

C. If it is necessary for an administrative law judge or the Board to visit the site of an alleged violation or activity that is regulated by the Agency in order to supplement testimonial or documentary evidence presented at the hearing, the party that proposed the visit shall enter the purpose of the visit and all pertinent observations into the record.

Historical Note

Adopted effective June 23, 1983 (Supp. 83-3). Section repealed, new Section adopted effective January 2, 1996 (Supp. 96-1). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-1203. Procedures for Rulemaking Public Hearings

A. Hearings on proposed rulemaking by the Agency shall be held before the Director or another person designated by the Director to act as the hearing officer.

B. All hearings shall be governed by the Administrative Procedure Act, A.R.S. §§ 41-1021, 41-1021.01 through 41-1025, 41-1028, 41-1029, and 41-1031.

C. The hearing shall be recorded and shall be retained as part of the record of the rulemaking.

D. A written summary of the comments presented shall be prepared along with a written response to the comments by the Agency staff and retained with the record of the rulemaking.

E. The request for hearing shall identify the rule involved or propose a new rule.

Historical Note

Adopted effective June 23, 1983 (Supp. 83-3). Section repealed, new Section adopted effective January 2, 1996 (Supp. 96-1).

R12-1-1204. Initiation of Administrative Hearings

A. An administrative hearing shall be initiated by the Director or commenced in response to the request of any person directly affected by an order of the Director or a proposed licensing or registration action by the Agency.

B. If the Director initiates an administrative hearing pursuant to R12-1-1220, the order may incorporate a notice of hearing; otherwise a notice of any hearing and the notice of violation shall be issued separately.

C. For any hearing on a proposed licensing or registration action, only a notice of hearing shall be issued.

D. A notice of hearing shall specify the time, place, and nature of the hearing and may include specification of the legal authority and jurisdiction under which the hearing is to be held; the particular sections of the statutes, rules, or license conditions involved; the amount of the penalty and other sanctions proposed, if appropriate; and a statement of matters asserted and issues involved.

E. A hearing may be requested by filing a written request for hearing with the Director within the time limit specified in the pertinent order or notice. A request for hearing on a regulatory action not subject to public notice requirements may be filed at any time, provided that a request to reconsider a licensing or registration action shall be filed within 30 days of the issuance of the licensing or registration action.
1. The request for a hearing to appeal an order shall identify the order which the person desires to appeal and include a statement reciting the matters asserted, issues involved, and the applicable statutes or rules. The Agency shall respond within 30 calendar days to the person and for-

ward the request and response to the Chairperson of the Board.

2. The request for a hearing to appeal a licensing or registration action shall identify the action appealed. The Agency shall respond within 30 calendar days to the person and forward the request and response to the Chairperson of the Board.
3. The request for hearing shall include a statement identifying the interest claimed to be affected by the action. If a statement is not provided or is clearly insufficient, the Chairperson may deny the request and notify the person of that action.
4. If the request for hearing is denied for insufficiency, the requestor shall have five days from the notice of denial within which to file an amended request for hearing. The amended request shall refer back to the original request for hearing.

Historical Note
Adopted effective January 2, 1996 (Supp. 96-1).

R12-1-1205. Intervention in Administrative Hearings; Director as a Party

A. Any person may submit a timely motion to intervene in a proceeding if an unconditional right to intervene is granted by law or the applicant claims an interest to any property or transaction affected by the proceeding.

B. A motion to intervene shall be in writing and shall state the reason why the applicant should be allowed to intervene. If the applicant claims an interest in property or in a transaction affected by the proceeding, the applicant shall demonstrate that the result of the proceeding may as a practical matter impair or impede protection of that interest.

C. The applicant shall serve the motion upon the administrative law judge or the Board, as appropriate, and the Director as a party at least five working days before the hearing. An application for leave to intervene shall not be granted, if by doing so, the issues will be unduly broadened.

D. If two or more persons have substantially similar positions, the administrative law judge may declare them a class of interested persons for purposes of the hearing. The members of a class shall designate one person to be spokesperson for the class. More than one class may be established for a hearing.

E. The Director is party to all administrative hearings.

Historical Note
Adopted effective June 23, 1983 (Supp. 83-3). Section repealed, new Section adopted effective January 2, 1996 (Supp. 96-1). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-1206. Repealed

Historical Note
Adopted effective January 2, 1996 (Supp. 96-1). Section repealed by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-1207. Rehearing or Review

A. The Board may grant a rehearing or review of a decision for any of the following reasons, materially affecting a party's rights:

1. Irregularity in the administrative proceedings or any order or abuse of discretion, that deprived a party of a fair hearing;
2. Misconduct of the Board, an administrative law judge, or the prevailing party;
3. Accident or surprise that could not have been prevented by ordinary prudence;
4. Newly discovered material evidence that could not, with reasonable diligence have been discovered and produced at the original hearing;
5. Excessive or insufficient penalties;
6. Error in the admission or rejection of evidence or other errors of law occurring at the administrative hearing or during the progress of the proceedings;
7. That the decision is not justified by the evidence or is contrary to law.

B. The Board may affirm or modify a decision or grant a rehearing to all or any of the parties and on all or part of the issues for any of the reasons listed in subsection (A). An order modifying a decision or granting a rehearing shall specify with particularity the ground or grounds for the order. A rehearing shall cover only the subject matters specified in the order.

C. No later than 15 working days after the date on the decision the Board may, on its own initiative, order a rehearing or review of its decision for any reason for which it might have granted a rehearing on motion of a party. After giving the parties notice and an opportunity to be heard on the matter, the Board may grant a motion for rehearing or review for a reason not stated in the motion.

D. If a motion for rehearing or review is based upon affidavits, they shall be served with the motion. An opposing party may, within 30 calendar days after service, serve opposing affidavits. This period of time may be extended by the Board if good cause is shown or a written stipulation is received from both parties. The Board may permit reply affidavits.

Historical Note
Adopted effective January 2, 1996 (Supp. 96-1).
Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-1208. Repealed

Historical Note
Adopted effective January 2, 1996 (Supp. 96-1). Section repealed by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-1209. Notice of Violation

A. Except as provided in R12-1-1220, the Agency shall issue a notice of violation and provide time, as specified in R12-1-1210, for the registrant or licensee to respond before the Director issues any order to modify, suspend, or revoke a license or registration, or to impose a civil penalty.

B. The notice shall specify:

1. The severity level and circumstances of the alleged violation;
2. The particular statute, rule, or registration or license condition violated; and
3. The division of the registration or license.

C. The notice shall specify a civil penalty if one is proposed by the Agency.

Historical Note
Adopted effective January 2, 1996 (Supp. 96-1).
Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 7 A.A.R. 2584, effective June 8, 2001 (Supp. 01-2).
Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-1210. Response to Notice of Violation

A. Except as provided in subsection (D), within 30 calendar days of the date of the notice, or longer time period specified in the notice, the person charged with the violation shall submit a written response that includes a description of:

1. The actions taken to achieve compliance and the results of the actions;
2. The actions that are proposed and the date when full compliance is expected to be achieved; and
3. If the violation is a repeat violation, why corrective actions taken previously did not prevent the violation from recurring and why the new actions will be effective.

B. If the person charged with a violation submits a timely response, the Director, in consideration of the answer and the severity level of the violation, shall do one of the following:
1. Issue an initial order conditionally imposing the full amount of the proposed civil penalty and any other sanctions proposed;
2. Issue an initial order conditionally mitigating or waiving the proposed civil penalty under R12-1-1214(B);
3. Waive the penalty as authorized under R12-1-1216(C);
4. Enter into a consent agreement as authorized under R12-1-1222.

C. If the Agency does not receive an adequate and timely response to the notice, the Director shall issue an initial order conditionally imposing any or all sanctions and civil penalties proposed in the notice of violation. If no civil penalty was proposed, the initial order may impose the base civil penalty listed in R12-1-1216.

D. Response to the notice of violation as otherwise required in this Section may be waived by the Agency, if the Agency determines that a response is not required.

Historical Note
Adopted effective January 2, 1996 (Supp. 96-1).
Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-1211. Initial Orders

A. Initial orders are valid for 30 calendar days after the date of the order, or until the other time specified in the order, during which time the person charged may:
1. Pay the civil penalty proposed and accept any proposed sanction, or
2. Request a hearing before the Board.

B. If a timely request for a hearing is not received, the order shall become final.

Historical Note
Adopted effective January 2, 1996 (Supp. 96-1).
Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-1212. Request for Hearing in Response to an Initial Order

A. In a request for a hearing, a person charged with a violation shall include a statement of the issues and the explanations and the arguments supporting denial of the violation or demonstrating extenuating circumstances, errors in notice, or any other reasons for not imposing the civil penalty, sanction, or both.

B. The statement shall identify all issues. The failure to include an issue may, at the option of the Board, foreclose consideration of that issue. If a statement is not provided or is insufficient, the Board may summarily determine the issues.

C. The person charged may admit the violation and request a reduction of the proposed civil penalty based on extenuating circumstances.

D. The person charged may waive oral proceedings and request dismissal of any or all of the charged violations, reduction of the civil penalties, or modification of any other imposed sanction based on consideration by the Board of the written statement.

Historical Note
Adopted effective January 2, 1996 (Supp. 96-1).
Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-1213. Severity Levels of Violations

A. The following violations are classified as severity level I violations:
1. Any failure, malfunction, or insufficiency of a safety system which may result in
   a. Radiation exposure to a person,
   b. A concentration of radionuclides; or
   c. A radiation level,in excess of 10 times the limits specified in 12 A.A.C.1, or 10 times the prescribed therapeutic patient dose.
2. Any inaccurate or incomplete information that is intentionally provided by a licensee or registrant official, and if the information had been complete and accurate at the time it was provided, would have likely resulted in action such as an immediate order required to protect the public health and safety.
3. Any information that the Agency requires be kept by a licensee or registrant that is incomplete or inaccurate because of falsification by or with the knowledge of a licensee or registrant official, and if the information had been complete and accurate at the time it was reviewed by the Agency, would have likely resulted in action such as an immediate order required to protect the public health and safety.
4. Any concealment or attempted concealment of a severity level I violation of the Act, 12 A.A.C. 1, or a license condition. This is a separate violation in addition to the original violation.
5. Any concealment or attempted concealment of a severity level II violation of the Act, 12 A.A.C. 1, or a license condition. This violation shall increase the severity level of the original violation by one level.
6. For the purposes of subsections (A)(2) and (3) above the term "licensee or registrant official" means the owner, a partner, a corporate officer, a radiation safety officer, the individual signing an application for a license or registration, or the chairman of any radiation safety committee supervising the radiation safety program of the licensee or registrant.

B. The following violations are classified as severity level II violations:
1. Any failure, malfunction, or insufficiency of a safety system which may result in:
   a. Radiation exposure to a person,
   b. A concentration of radionuclides, or
   c. A radiation level,in excess of two times the limits specified in 12 A.A.C. 1, or two times the prescribed therapeutic patient dose.
2. Any attempt to prevent an Agency inspection.
3. Any concealment or attempted concealment of a severity level III violation of the Act, 12 A.A.C. 1, or a license condition by a licensee or registrant official as defined in subsection (A)(6). This violation shall increase the severity level of the original violation by one level.
4. Significant information provided and designated by a licensee or registrant and not previously provided to the Agency because of careless disregard on the part of a licensee official or registrant.

C. The following violations are classified as severity level III violations:
1. Any failure, malfunction, or insufficiency of a safety system, or loss of control over a radiation source, which may result in:
   a. Radiation exposure to a person,
   b. A concentration of radionuclides, or
   c. A radiation level in excess of the limits specified in 12 A.A.C. 1, or 20% higher than the prescribed therapeutic patient dose.
2. Any concealment or attempted concealment of a severity level IV or V violation of the Act, 12 A.A.C. 1, or a registration or license condition. This violation shall increase the severity level of the original violation by one level.
3. Any violation of the safety requirements for the use, storage, disposal, or the preparation for transportation of sources of radiation, as prescribed in the Act, 12 A.A.C. 1, or in a license or registration condition, provided the violation does not meet the criteria for a severity level I or II violation and the licensee or registrant does not maintain a radiation protection program meeting the requirements of R12-1-407.
4. Any factually incorrect statement upon which the Agency relied or would have relied in consideration of any action.
5. Any unlawful attempt to interfere with the progress of an inspection by the Agency.
6. The acquisition of any source of radiation without the applicable current registration or license, unless otherwise authorized by these rules; or use of the source outside the scope of the current registration or license.
7. The continued use of sources of radiation after April 1, if the annual fee has not been paid for the current year.

D. The following violations are classified as severity level IV violations:
1. Any violation of R12-1-407;
2. Any violation of the safety requirements for the use, storage, disposal, or preparation for transportation of sources of radiation, prescribed in the Act, 12 A.A.C. 1, or in a license or registration condition, provided the violation does not meet the criteria for a severity level I, II or III violation;
3. Failure to maintain records of mammography quality control tests required in R12-1-614.
4. Any failure to comply with the reporting requirements in the Act or 12 A.A.C. 1.

E. The following violations are classified as severity level V violations:
1. Failure of a registrant or a licensee to comply with the recordkeeping requirements of:
   a. The Act;
   b. 12 A.A.C. 1; or
   c. A registration or facility certification, or license condition, provided that all safety requirements prescribed in the Act, 12 A.A.C. 1, or in a license or registration condition are met or otherwise demonstrated.
2. If compliance with all safety requirements cannot be demonstrated by the registrant or licensee the failure to comply with the recordkeeping requirements is classified as a level IV violation.

Historical Note

Adopted effective January 2, 1996 (Supp. 96-1).
Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-1214. Mitigating Factors

A. The Agency may refrain from issuing a Notice of Violation for Severity Level IV or V violations identified by the registrant or licensee provided the severity level IV or V violations are identified in an inspection report, the report includes a brief description of the corrective action, and the violation meets all of the following criteria:
1. It was identified by the licensee, as a result of an event discovered by the licensee or registrant;
2. It was not a violation that could reasonably be expected to have been prevented by the licensee's or registrant's corrective action for a previous violation or a previous licensee or registrant finding;
3. It was or will be corrected within a reasonable time, by specific corrective action committed to by the registrant or licensee by the end of the inspection. The corrective action shall include comprehensive measures that will prevent reoccurrence;
4. It was not a willful violation or, if it was willful:
   a. The violation was reported to the Agency;
   b. The violation appears to be the isolated action of an employee without management involvement and the violation was not caused by lack of management oversignt;
   c. Significant remedial action was taken by the licensee or registrant, demonstrating the seriousness of the violation to all affected personnel.

B. The Director may:
1. Reduce the scheduled civil penalty, including any augmentation, by 50% for the discovery, remedy, and voluntary reporting of a severity level I or II violation by the registrant or licensee; or
2. Waive the scheduled civil penalty, including augmented civil penalties, for the discovery, remedy, and voluntary reporting of a severity level III, IV, or V violation by the registrant or licensee. For the purposes of this rule, "voluntary reporting" means that the registrant or licensee has notified the Agency of a violation, the reporting of which may or may not be required under 12 A.A.C. 1.

Historical Note

Adopted effective January 2, 1996 (Supp. 96-1).
Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-1215. License and Registration Divisions

A. Each registrant or license type is classified into one of three administrative sanction divisions.
1. Division I licenses and registrations:
   Broad Academic Class A
   Broad Academic Class B
   Broad Academic Class C
   Broad Industrial Class A
   Broad Medical
   Class C Laser Facility
   Distribution
   Fixed Gauge Class A
   Industrial Radiography Class A
   Low Level Radioactive Waste Disposal Site
   Major Accelerator Facility
   Medical Materials Class A
   Medical Teletherapy
   NORM Commercial Disposal Site
   Nuclear Laundry
   Nuclear Pharmacy
   Open Field Irradiator
   Secondary Uranium Recovery

Waste Processor Class A
Well Logging
X-Ray Machine Class A

2. Division II licenses and registrations:
   Broad Industrial Class B
   Broad Industrial Class C
   Class B Industrial Radiofrequency Facility
   Class B Laser Facility
   Class C Industrial Radiofrequency Facility
   Fixed Gauge Class B
   Health Physics Class A
   Industrial Radiation Machine
   Industrial Radiography Class B
   Laser Light Show
   Limited Academic
   Medical Laser
   Medical Materials Class B
   Medical Radiofrequency Device Facility
   NORM Commercial Disposal Site
   Medical Imaging Facility
   Research and Development
   Self Shielded Irradiator
   Tanning Facility
   Waste Processor Class B
   X-Ray Machine Class B
3. Division III licenses and registrations:
   Class A Laser Facility
   Class A Industrial Radiofrequency Facility
   Depleted Uranium
   Gas Chromatograph
   General Depleted Uranium
   General Industrial
   General Medical
   General Veterinary Medicine
   Health Physics Class B
   Laboratory
   Leak Detector
   Limited Industrial
   Medical Materials Class C
   Other Ionizing Radiation Machine
   Other Nonionizing Radiation Machine
   Portable Gauge
   Possession Only
   Radioactive waste transfer-for-disposal
   Unclassified
   Veterinary Medicine
   X-ray Machine Class C

B. Any person required by the Act to register the use of a general license with the Agency, or to obtain a specific license from the Agency, is considered a licensee of the appropriate type notwithstanding the failure of the person to register or obtain a license.

C. The Agency shall classify each person that possesses an out-of-state specific license for the use of radioactive material and operates in Arizona under reciprocal recognition, as prescribed in R12-1-320 and authorized in R12-1-1302(D)(16), by placing the person into the administrative sanction division listed in subsection (A) that best defines the out-of-state, licensed activities.

D. For administrative purposes, the following persons are classified with the Division III licensees and registrants in subsection (A)(3):
1. Any person not required to register the use of a general license;
2. Any person not required to obtain a specific license;
3. Any l person not required to register a source of radiation who violates the Act or 12 A.A.C. 1; and
4. Any person registered to provide x-ray machine service.

Historical Note
Adopted effective January 2, 1996 (Supp. 96-1). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-1216. Civil Penalties

A. Except as augmented by R12-1-1217, the schedule of civil penalties is as follows:
1. Severity level I violations:
   a. Division I registration or license -- $4,000;
   b. Division II registration or license -- $3,000;
   c. Division III registration or license -- $2,000.
2. Severity level II violations:
   a. Division I registration or license -- $3,000;
   b. Division II registration or license -- $2,000;
   c. Division III registration or license -- $1,000.
3. Severity level III violations:
   a. Division I registration or license -- $2,000;
   b. Division II registration or license -- $1,000;
   c. Division III registration or license -- $500.
4. Severity level IV violations:
   a. Division I registration or license -- $1,000;
   b. Division II registration or license -- $500;
   c. Division III registration or license -- $250.
5. Severity level V violations:
   a. Division I registration or license -- $500,
   b. Division II registration or license -- $250,
   c. Division III registration or license -- $125.

B. Payment of civil penalties for severity level I and severity level II violations may not be avoided merely by rectifying the condition; however, the Board may mitigate or waive the penalty upon determining a violation meets all of the following:
1. It was not a violation that could reasonably be expected to have been prevented by the licensee's or registrant's corrective action for a previous violation or a previous licensee or registrant finding;
2. It was or will be corrected within the time given for corrections, by specific corrective action committed to by the licensee or registrant by the end of the inspection, which includes immediate and comprehensive measures to prevent recurrence;
3. It was not a willful violation.

C. The Director or Board shall waive payment of penalties for severity level III through severity level V violations provided:
1. The violation is not subject to augmentation under R12-1-1217; and
2. The registrant or licensee submits a timely and adequate response to the notice; rectifies the conditions which appear to have caused the violation; and complies with the Act, 12 A.A.C. 1, registration, and license conditions.

Historical Note
Adopted effective January 2, 1996 (Supp. 96-1). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-1217. Augmentation of Civil Penalties

A. A continuing violation, for the purposes of calculating the proposed civil penalty, is considered a separate violation for each

day it continues. The second (or successive) day of a continuing violation is not considered a repeat violation of the violation occurring on the first day.

B. If a second severity level I violation is committed within five years, the Agency shall increase the base civil penalty by 100%, provided the registration or license is not revoked under R12-1-1219.

C. If a second severity level II violation is committed within a period of five years, the Agency shall increase the base civil penalty by 50%, provided the registration or license is not revoked under R12-1-1219.

D. If a severity level III violation is repeated within five years, the Agency shall increase the base civil penalty by 50%. If the same severity level III violation is repeated a second time within five years, the base civil penalty shall be increased by 100%, provided the registration or license is not revoked under R12-1-1219.

E. If a severity level IV violation is repeated within five years, the Agency shall propose the base d civil penalty.
1. If the same violation occurs three times within five years, the Agency shall increase the base civil penalty by 50%.
2. If the same violation occurs four times within five years, the Agency shall increase the base civil penalty by 100%, provided the registration or license is not revoked under R12-1-1219.

F. If more than three severity level V violations are observed during two consecutive inspections, the Agency shall impose a civil penalty for each violation. The base civil penalty for each violation is the base civil penalty assessed for a severity level V violation. If the inspection shows repetition of a violation the base civil penalty for each repeat violation is the base civil penalty assessed for a severity level IV violation. Subsection (E) does not apply to penalties under this subsection.

G. Other rights and procedures are not affected by the repeat nature of a violation.

H. A person may avoid the penalties in subsections (D) and (E) by demonstrating to the Director in the response to the penalty that the violation meets all of the following criteria:
1. It was not a violation that could reasonably be expected to have been prevented by the licensee's or registrant's corrective action for a previous violation or a previous licensee or registrant finding;
2. It was or will be corrected within the time given for correction, by specific corrective action committed to by the licensee or registrant by the end of the inspection, which includes immediate and comprehensive measures to prevent recurrence;
3. It was not a willful violation.

I. Notwithstanding any other provision of this Section, the Agency shall not impose a penalty that exceeds a maximum of $5,000 for each violation for each day up to a maximum of $25,000 for any 30-day period.

Historical Note
Adopted effective January 2, 1996 (Supp. 96-1).
Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-1218. Payment of Civil Penalties

A. A person shall pay civil penalties imposed under this Article by certified check or money order payable to the Agency and mailed or delivered to the Agency at the address shown on the notice of violation.

B. Payment of a civil penalty is due 30 calendar days after the effective date of the final order imposing the civil penalties, unless an alternate payment schedule is agreed upon before that date. A payment schedule shall not extend beyond one year after the due date.

Historical Note
Adopted effective January 2, 1996 (Supp. 96-1).
Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-1219. Additional Sanctions-Show Cause

A. If a severity level I violation is repeated or if any second severity level I violation is committed within 10 years, the Agency shall require the registrant or licensee to show cause why the registration or license should not be suspended or revoked.

B. If any second severity level II violation is committed within five years, or if a severity level II violation involving radioactive effluent releases, excessive radiation levels, or radiation overexposure to an individual is committed within five years of a similar severity level I violation, the Agency shall require the registrant or licensee to show cause why the registration or license should not be suspended or revoked.

C. If repeated or different severity level III violations are committed on three separate occasions within any five year period, the Agency may require the registrant or licensee to show cause why the registration or license should not be suspended or revoked.

Historical Note
Adopted effective January 2, 1996 (Supp. 96-1).
Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-1220. Escalated Enforcement

A. The Director may issue an order to suspend, revoke, or modify a registration or license, or impound a radiation source for:
1. Any severity level I violation; or
2. Any of the following occurring within a five-year period:
   a. A repeat severity level II violation,
   b. A different second severity level II violation, or
   c. A severity level II violation after a severity level I violation.

B. The Director may issue an order impounding the radiation source or suspending, revoking, or modifying the registration or license upon determining that conditions exist which cause a potential for a severity level I or severity level II violation.

C. The Agency shall hold hearings according to A.R.S. § 30-688.

D. An order to impound a radiation source, or an order to suspend, revoke, or modify a registration or a license shall remain in effect until the order is suspended or modified by the Board according to A.R.S. § 30-688.

Historical Note
Adopted effective January 2, 1996 (Supp. 96-1).
Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-1221. Reserved

R12-1-1222. Enforcement Conferences

A. An enforcement conference consists of a meeting in person between management personnel of the registrant or licensee and the Agency.

B. The enforcement conference is informal; however, the Agency shall make a record of items discussed and decisions reached. Statements made at the conference shall not be introduced in evidence at a formal hearing unless all parties have consented.

C. Based on the results of the conference, the Agency may:
1. Dismiss the notice of violation;
2. Enter into a consent agreement; or
3. Continue with, or initiate, formal proceedings.

Historical Note
Adopted effective January 2, 1996 (Supp. 96-1).
Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-1223. Registration and Licensing Time-frames
The Agency shall perform an administrative completeness review and substantive review of an application for a new or renewal license or registration; or an amendment to a license or registration within the time-frames in Table A. The Agency shall review an application for an amendment to an existing license or registration that changes the license category listed in R12-1-1306, using the time-frames specified for the requested category.

Historical Note
Adopted effective December 9, 1998 (Supp. 98-4).
Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

Table A. Registration and Licensing Time-frames

REGISTRATION AND LICENSING TIME-FRAMES

License or Registration category in R12-1-1306	Administrative Completeness Review Time-frame, in days	Substantive Review Time-frame, in days	Overall Time-frame, in days
A1	90	30	120
A2	90	30	120
A3	90	30	120
A4	60	30	90
B1	90	30	120
B2	90	30	120
B3	90	30	120
B4	90	30	120
B5	90	30	120
B6	40	20	60
C1	60	30	90
C2	60	30	90
C3	60	30	90
C4	60	30	90
C5	60	30	90
C6	60	30	90
C7	60	30	90
C8	90	30	120
C9	60	30	90
C10	40	20	60
C11	90	30	120
C12	90	30	120
C13	90	30	120
C14	90	30	120
C15	90	30	120
C16	90	30	120
C17	90	30	120
D1	90	30	120
D2	90	30	120
D3	90	30	120
D4	40	20	60
D5	40	20	60
D6	90	30	120
D7	40	20	60
D8	60	30	90
D9	90	30	120
D10	90	30	120
D11	1095	365	1460
D12	730	180	910
D13	365	90	455
D14	90	30	120
D15	40	20	60
D16	20	10	30
D17	40	20	60
D18	90	30	120
D19	365	120	485
E1	40	20	60
E2	40	20	60
E3	40	20	60
E4	40	20	60

E5	90	30	120
E6	90	30	120
F1	40	20	60
F2	40	20	60
F3	40	20	60
F4	40	20	60
F5	20	10	30
F6	40	20	60
F7	40	20	60
F8	40	20	60
F9	40	20	60
F10	40	20	60
F11	40	20	60
F12	90	30	120

Footnote: "administrative completeness review time-frame"; "substantive review time-frame," and "overall time-frame" are defined in A.R.S. § 41-1072.

Historical Note

Adopted effective December 9, 1998 (Supp. 98-4). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

ARTICLE 13. LICENSE AND REGISTRATION FEES

R12-1-1301. Definition

"Combined" means the Agency has granted authorized activities contained in two or more license types in a single license document, requiring the payment of a single license fee for the more expensive license of the planned combination.

Historical Note

Adopted effective November 19, 1982 (Supp. 82-6). Amended effective November 28, 1983 (Supp. 83-6). Amended subsection (B) and added a new subsection (C) effective November 28, 1986 (Supp. 86-6). Section repealed, new Section adopted effective November 5, 1993 (Supp. 93-4). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-1302. License and Registration Categories

A. Category A licenses are those specific licenses which authorize a school, college, university, or other teaching facility to possess and use radioactive materials for instructional or research purposes.

1. A broad academic class A license is any category A license which meets the specifications of R12-1-310(A)(1).
2. A broad academic class B license is any category A license other than a broad academic class A license which meets the specifications of R12-1-310(A)(2).
3. A broad academic class C license is any category A license other than a broad academic class A or B license which meets the specifications of R12-1-310(A)(3).
4. A limited academic license is any category A license which authorizes only those radioisotopes, forms, and quantities individually specified in the license.

B. Category B licenses are those specific or general licenses which authorize the application of radioactive material or the radiation from it to a human being for medical diagnostic, therapeutic, or research purposes, or the use of radioactive material in medical laboratory testing. Except for a type B6, general medical license, the Agency shall not combine a category B license with a license of any other category.

1. A broad medical license is any category B license which meets the specifications of R12-1-310(A)(1) and meets the requirements of 12 A.A.C. 1, Article 7. A broad medical license may authorize any medical use other than teletherapy.
2. A medical materials class A license is any specific category B license other than a broad medical license, which authorizes the use of radiopharmaceuticals and sealed sources containing radioactive materials for a therapeutic purpose in quantities which require hospitalization of the patient for radiation safety purposes. The license may authorize other radioactive materials and other medical uses, except teletherapy.
3. A medical materials class B license is any specific category B license which authorizes the diagnostic or therapeutic use, other than teletherapy, of radioactive materials only in limited quantities such that the patient need not be hospitalized for radiation safety purposes.
4. A medical materials class C license is any specific category B license which authorizes possession of specified radioisotopes only in the form of sealed sources for treatment of the eye or skin or for use in diagnostic medical imaging devices.
5. A medical teletherapy license is a specific category B license which solely authorizes radioisotopes in the form of multi-curie sealed sources for use in external beam therapy. The Agency shall not combine a medical teletherapy license with any other type of category B license.
6. A general medical license is a registration of the use of radioactive material pursuant to R12-1-306(E) or R12-1-306(F). A general medical license may be combined into a broad medical, medical materials class A, or medical materials class B license.

C. Category C licenses are those specific or general licenses authorizing the use of radioactive materials in any activity other than those authorized by a category A, B, or D license. Except as specifically authorized in this Section, the Agency shall not combine a category C license with any other type of license.

1. A broad industrial class A license is any category C license which meets the specifications of R12-1-310(A)(1). The Agency may combine a broad industrial class A license with any other category C license except industrial radiography, open field irradiator, or well logging licenses.

2. A broad industrial class B license is any category C license other than a broad industrial class A license which meets the specifications of R12-1-310(A)(2). The Agency may combine a broad industrial class B license with any other category C license except industrial radiography, open field irradiator, or well logging licenses.
3. A broad industrial class C license is any category C license other than a broad industrial class A or B license which meets the specifications of R12-1-310(A)(3). The Agency may combine a broad industrial class C license with any other category C license except industrial radiography, open field irradiator, or well logging licenses.
4. A limited industrial license is a specific category C license authorizing the possession of the radioactive materials authorized in R12-1-305(A), or R12-1-306(A), (B), (D) or (G) for uses authorized in those subsections, but in quantities greater than authorized by those subsections.
5. A portable gauge license is a specific category C license which authorizes radioactive materials in the form of sealed sources for use in measuring or gauging devices designed and manufactured to be transported to the location of use. The Agency may combine a portable gauge license with any broad scope industrial license or a fixed gauge class A license.
6. A fixed gauge class A license is a specific category C license which authorizes the possession of 50 or more measuring or gauging devices containing radioactive materials, where each device is permanently mounted for use at a single location.
7. A fixed gauge class B license is a specific category C license which authorizes the possession of 1 through 49 measuring or gauging devices containing radioactive materials, where each device is permanently mounted for use at a single location.
8. A leak detector license is a specific category C license which authorizes the use of radioisotopes in the form of a gas to test hermetic seals on electronic packages.
9. A gas chromatograph license is a specific category C license which authorizes the use of radioactive materials as ionization sources in gas chromatography or electron capture devices.
10. A general industrial license means a registration of the use of a material, source, or device generally licensed pursuant to R12-1-305 or R12-1-306, except R12-1-305(C), R12-1-306(E), or R12-1-306(F).
11. An industrial radiography class A license is a specific category C license which authorizes industrial radiography using sealed radioisotope sources at specific facilities identified in the license conditions or at temporary field job sites.
12. An industrial radiography class B license is a specific category C license which authorizes industrial radiography using sealed radioisotope sources only at specific facilities identified in the license conditions.
13. An open field irradiator license is a specific category C license authorizing the use of radioisotopes in the form of sealed sources not permanently mounted within a shielding container, for irradiation of materials.
14. A self-shielded irradiator license is a specific category C license authorizing the use radioisotopes in the form of sealed sources for irradiation of materials in a shielding device from which the sources are not removed during irradiation. The Agency may combine a self-shielded irradiator license with any broad license.
15. A well logging license is a specific category C license which authorizes the use of radioactive material in sealed or unsealed sources for wireline services or field tracer studies.
16. A research and development license is a specific category C license which authorizes a licensee to utilize radioactive material in unsealed and sealed form for industrial, scientific, or biomedical research, not including administration of radiation or radioactive material to human beings.
17. A laboratory license is a specific category C license which authorizes a licensee to perform specific in-vitro or in-vivo medical or veterinary testing, while possessing quantities of radioactive material greater than the general license quantities authorized in R12-1-306.

D. Category D licenses are the following specific radioactive material licenses. Except for type D4, depleted uranium; type D8 and D9, health physics; and type D14, additional facilities licenses, the Agency shall not combine a category D license with any other license.

1. A distribution license is one which authorizes the commercial distribution of radioactive materials or radioisotopes in products to persons holding an appropriate general or specific license. The Agency shall ensure that a distribution license does not:
   a. Authorize distribution of radiopharmaceuticals or distribution to persons exempt from regulatory control; or
   b. Authorize any other use of the radioactive material. An appropriate category C license is required for possession of radioisotopes and their incorporation into products.
2. A nuclear pharmacy license is one which authorizes the preparation, compounding, packaging, or dispensing of radiopharmaceuticals for use by other licensees.
3. A nuclear laundry license is one authorizing the collection and cleaning of items contaminated with radioactive materials.
4. A depleted uranium license is one which authorizes the use of depleted uranium as a concentrated mass or as shielding for other radiation sources within a device or machine. The Agency may combine a depleted uranium license with a medical teletherapy license; a broad industrial A, B or C license; a portable gauge license; a fixed gauge class A or B license; an industrial radiography class A or B license; or a self-shielded irradiator license.
5. A depleted uranium general license is a registration of the use of the general license authorized pursuant to R12-1-305(C).
6. A veterinary medicine license is one which authorizes the use of radioactive materials for specific applications in veterinary medicine as authorized in the license.
7. A general veterinary medicine license is a registration of the use of the general license authorized in R12-1-306(F) in veterinary medicine.
8. A health physics class A license is one which authorizes the use of radioactive materials for performing instrument calibrations, processing leak test or environmental samples, or providing radiation dosimetry services.
9. A health physics class B license is one which authorizes only the collection, possession, and transfer of radioactive materials in the form of leak test samples for processing by others.
10. A secondary uranium recovery license is one which authorizes the extraction of natural uranium or thorium from an ore stream or tailing which is being or has been

processed primarily for the extraction of another mineral. The Agency shall not combine a secondary uranium recovery license with any other license.

11. A low-level, radioactive waste disposal facility license is a license that is issued for a "disposal facility," as that term is used in R12-1-439 and R12-1-442, which has a closure or long-term care plan and is constructed and operated according to the requirements in 10 CFR 61, 2003 edition, published January 1, 2003, by the Office of the Federal Register, National Archives and Records Administration, Washington, D.C. 20408, which is incorporated by reference and on file with the Agency, and contains no future editions or amendments.
12. A waste processor class A license is one authorizing the incineration, compaction, repackaging, or any other treatment or processing of low-level radioactive waste prior to transfer to another person authorized to receive or dispose of the waste. The Agency shall not combine a waste processor class A license with any other license.
13. A waste processor class B license is one which authorizes a waste broker to receive prepackaged, low-level radioactive waste from other licensees; combine the waste into shipments; and transfer the waste without treating or processing the waste in any manner and without repackaging except to place damaged or leaking packages into overpacks. The Agency shall not combine a waste processor class B license with any other license.
14. An additional facility license is an endorsement, by license condition to an existing specific license, authorizing one or more additional separate facilities where radioactive material may be stored or used for a period exceeding six months.
15. A possession-only license is a license of any other category which authorizes only the possession in storage, but no use of, the authorized materials. A license which has been suspended as an enforcement action is not considered a possession-only license.
16. A reciprocal license is the registration of the general license authorized by R12-1-320. This license is subject to a special fee as provided by R12-1-1307 but is exempt from annual fees.
17. A radioactive waste transfer-for-disposal license is an authorization for the generator of radioactive waste to transfer the radioactive waste for disposal at a licensed disposal site under R12-1-439 and R12-1-442. This license is subject to a special fee as provided by R12-1-1307 but is exempt from annual fees.
18. An "unclassified" radioactive material license is one authorizing radioisotopes, physical or chemical forms, possession limits, or uses not included in any other type of license specified in this Section.
19. A NORM commercial disposal site license is one that authorizes the receipt of waste material contaminated with naturally occurring radioactive material from other licensees for permanent disposal, provided the concentration of the radioactive material does not exceed 74kBq (2,000 picocuries)/gram.

E. Category E registrations are those that register the possession of x-ray machine(s) under 12 A.A.C. 1, Article 2. The Agency shall not combine Category E registrations with any other registration.

1. An X-ray machine class A registration is one authorizing the possession of X-ray machines and particle accelerators in a hospital or other facility offering inpatient care.
2. An X-ray machine class B registration is one authorizing the possession of X-ray machines and particle accelerators in a medical, osteopathic, or chiropractic office or clinic not offering inpatient care; or the possession of X-ray machines in a school, college, university, or other teaching facility.
3. An X-ray machine class C registration is one authorizing the possession of X-ray machines in dental, podiatry, and veterinarian offices or clinics.
4. An industrial radiation machine registration is one authorizing the possession of X-ray machines, or the possession of particle accelerators not capable of producing a high radiation area, in a nonmedical facility.
5. An accelerator facility registration is one authorizing the possession and nonmedical operation of one or more particle accelerators of any kind capable of accelerating any particle and producing a high radiation area.
6. A radiation machine, "other," is one authorizing possession or use of an ionizing radiation machine not included in any other category specified in subsection (E) of this Section.

F. Category F registrations are those that register nonionizing radiation producing sources regulated under 12 A.A.C. 1, Article 14. The Agency shall not combine Category F registrations with any other registration.

1. A tanning registration authorizes the commercial operation of any number of tanning booths, beds, cabinets, or other devices in a single establishment.
2. A Class A laser registration authorizes the operation of one to 10 laser devices subject to R12-1-1433.
3. A Class B laser registration authorizes the operation of 11 to 49 laser devices subject to R12-1-1433.
4. A Class C laser registration authorizes operation of 50 or more laser devices subject to R12-1-1433.
5. A laser light show registration authorizes the operation of a laser device subject to R12-1-1440.
6. A medical laser registration authorizes the operation of one or more laser devices subject to R12-1-1439.
7. A Class II surgical device registration authorizes the operation of one or more Class II surgical devices subject to R12-1-1417.
8. A medical radiofrequency device registration authorizes the operation of one or more medical radiofrequency devices.
9. A class A industrial radiofrequency device registration authorizes the operation of one to five radiofrequency heat sealers or industrial microwave ovens.
10. A class B industrial radiofrequency device registration authorizes the operation of six to 20 radiofrequency heat sealers or industrial microwave ovens.
11. A class C industrial radiofrequency device registration authorizes the operation more than 20 radiofrequency heat sealers or industrial microwave ovens.
12. An "other" nonionizing radiation device authorizes the operation of a nonionizing radiation device or other device not included in any other category specified in subsection (F).

Historical Note

Adopted effective November 19, 1982 (Supp. 82-6). Amended effective November 28, 1983 (Supp. 83-6). Section repealed, new Section adopted effective November 5, 1993 (Supp. 93-4). Amended effective June 13, 1997 (Supp. 97-2). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 9 A.A.R. 1126, effective May 9, 2003 (Supp. 03-1). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-1303. Fee for Initial License and Initial Registration
An applicant shall remit for a new license or new registration the appropriate fee as prescribed in R12-1-1306, except that the fee will be prorated on a quarterly basis for applications submitted after March 31.

Historical Note
Adopted effective November 19, 1982 (Supp. 82-6).
Amended effective November 28, 1983 (Supp. 83-6).
Amended subsections (A), (C), and (D) effective November 28, 1986 (Supp. 86-6). Section repealed, new Section adopted effective November 5, 1993 (Supp. 93-4).
Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-1304. Annual Fees for Licenses and Registrations
A. Each license or registration issued by the Agency shall identify the category by a letter and number corresponding to the appropriate subsection of R12-1-1302 or category type listed in R12-1-1306.
B. Except for types D16 and D17, each licensee or registrant shall submit payment of the annual fee in the amount prescribed in R12-1-1306(A) on or before January 1 of each year. This single annual fee will cover any and all renewals, amendments, and regular inspections of the license during the forthcoming calendar year.
C. If a licensee or registrant fails to pay the annual fee by January 1, the license is not current.
D. If a licensee or registrant fails to pay the annual fee by April 1, the Agency shall apply administrative sanction provisions of 12 A.A.C. 1, Article 12.

Historical Note
Adopted effective November 5, 1993 (Supp. 93-4).
Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-1305. Method of Payment
A. An applicant licensee or registrant shall pay fees by check or money order, payable to the "State of Arizona" at the address shown on the application, license, registration, or renewal notice.
B. Once a license or registration has been issued, no portion of the application fee or any annual fee will be refunded.

Historical Note
Adopted effective November 5, 1993 (Supp. 93-4).
Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-1306. Table of Fees
A. The application and annual fee for each category type are shown in Table 13-1.

Table 13-1

Category	Type	Annual fee
A1.	Broad academic class A	$2,600
A2.	Broad academic class B	$1,500
A3.	Broad academic class C	$1,200
A4.	Limited academic	$600
B1.	Broad medical	$1,650
B2.	Medical materials class A	$1,400
B3.	Medical materials class B	$1,000
B4.	Medical materials class C	$500
B5.	Medical teletherapy	$1,650
B6.	General medical	$75
C1.	Broad industrial class A	$2,200
C2.	Broad industrial class B	$1,600
C3.	Broad industrial class C	$1,250
C4.	Limited industrial	$500
C5.	Portable gauge	$500
C6.	Fixed gauge class A	$800
C7.	Fixed gauge class B	$500
C8.	Leak detector	$500
C9.	Gas chromatograph	$300
C10.	General industrial	No Fee
C11.	Industrial radiography class A	$1,650
C12.	Industrial radiography class B	$1,500
C13.	Open field irradiator	Full Cost
C14.	Self-shielded irradiator	$600
C15.	Well logging	$1,750
C16.	Research and development	$750
C17.	Laboratory	$600
D1.	Distribution	$2,150
D2.	Nuclear pharmacy	$2,150
D3.	Nuclear laundry	$2,250
D4.	Depleted uranium	$100
D5.	General depleted uranium	$75
D6.	Veterinary medicine	$500
D7.	General veterinary medicine	$75
D8.	Health physics class A	$600
D9.	Health physics class B	$450
D10.	Secondary uranium recovery	$4,000
D11.	Low-level radioactive waste disposal site	(3)
D12.	Waste processor class A	$2,250
D13.	Waste processor class B	$500
D14.	Additional storage and use site	(1)
D15.	Possession only	(2)
D16.	Reciprocal	(3)
D17.	Radioactive waste transfer-for-disposal	(3)
D18.	Unclassified	Full Cost
D19.	NORM commercial disposal site	$200,000
E1.	X-ray machine Class A (per tube)	$64
E2.	X-ray machine class B (per tube)	$44
E3.	X-ray machine class C (per tube)	$36
E4.	Industrial radiation machine (per device)	$36
E5.	Major accelerator facility	Full Cost
E6.	Other ionizing radiation machine	Full Cost
F1.	Tanning device (per device)	$24
F2.	Class A (1 to 10 laser devices)	$150
F3.	Class B (11 to 49 laser devices)	$350
F4.	Class C (50 or more laser devices)	$600
F5.	Laser light show or laser demonstration	$350
F6.	Medical laser (per laser device)	$40
F7.	Class II surgical (per device)	$40
F8.	Medical RF (per device)	$40
F9.	Class A industrial (1 to 5 radiofrequency devices)	$60
F10.	Class B industrial (6 to 20 radiofrequency devices)	$180
F11.	Class C industrial more than 20 radiofrequency devices)	$300
F12.	Other nonionizing radiation device or other device	Full Cost

Notes: (1) An additional 20% of the annual base fee is added to the annual base fee for each additional site, not to exceed an additional 100% for all sites.
(2) The fee is 50% of the annual base fee for the category under which the radioactive material will be stored.
(3) See R12-1-1307.

B. The annual fee for a license or registration for which the scheduled fee is "Full Cost" is approximately 18% of the full actual cost to the Agency for the personnel, consultants, facilities, equipment, supplies, and transportation used in evaluating the original application. The cost of all applications for amendments and all regular inspections during the five-year normal life of the license or registration, calculated as follows:
1. The application fee is based on estimates of the cost which are based on consideration of (in order of preference):
   a. The experience of the Agency in issuing and servicing licenses and registrations of the same or a similar type;
   b. The experience of the U.S. NRC or other states in issuing and servicing licenses and registrations of the same or a similar type; or
   c. The general experience of the Agency, the U.S. NRC and other states in the costs of issuing and servicing different types of licenses and registrations and any estimates submitted by the applicant.
2. Annual fees for the second through fourth years are determined by recalculation of the estimate made under subsection (B)(1), considering the actual cost based on experience in previous years and any revision of the estimated future costs.
3. The fee for the fifth year is 22.5% of the total actual cost to the Agency to issue and service the license or registration over the first four years of the license.

Historical Note
Amended effective November 5, 1993 (Supp. 93-4). Amended effective June 13, 1997 (Supp. 97-2). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2). Amended by final rulemaking at 9 A.A.R. 1126, effective May 9, 2003 (Supp. 03-1).

R12-1-1307. Special License Fees

A. The fee for a Type D16 license providing reciprocal recognition under R12-1-320 of a radioactive materials license issued by the U.S. NRC or another state is half of the annual fee for an Arizona license of the appropriate type. The fee is due and payable at the time reciprocity is requested, and the general license does not become current until the fee is paid.

B. The fee for a Type D17 radioactive waste transfer-for-disposal license is $2.50 per cubic foot of waste transferred, including packaging.
1. A standard 55-gallon drum waste package is considered to be 7 1/2 cubic feet of waste.
2. The fee is due at the time the waste is shipped, unless a prior written agreement between the person and the Agency is in effect. The total fee due shall be paid to the Agency in accordance with R12-1-1305(A).

C. For a low-level radioactive waste disposal site the initial application fee is $3,000,000. The annual fee for the second through fifth years is $3,000,000. The Agency shall promulgate a new fee rule for years subsequent to year five. Based on data gathered during the first five years, the Agency shall set a reasonable fee after consideration of the following factors:
1. Unrecovered costs which the Agency may charge under A.R.S. § 30-654(B)(18).
2. Actual costs incurred by the Agency.

Historical Note
Adopted effective November 5, 1993 (Supp. 93-4). Amended effective January 2, 1996 (Supp. 96-1). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-1308. Fee for Requested Inspections

A. A licensee or registrant may request an inspection of its facility at any time. The Agency shall bill the licensee or registrant 90% of the full cost of the inspection, based on personnel time for preparation, travel, onsite inspection, review of findings, and preparation of a report, charged at $25 per hour and mileage charged at 25¢ per mile.

B. The fee specified in this Section does not apply to:
1. Regular inspections as scheduled by the Agency,
2. Enforcement reinspections conducted to ensure the correction of violations or safety hazards, or
3. Inspections requested by workers pursuant to R12-1-1007.

Historical Note
Adopted effective November 5, 1993 (Supp. 93-4). Amended by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

R12-1-1309. Abandonment of License or Registration Application

A. Any license or registration application for which the applicant has been provided a written notification of deficiencies in the application and for which the applicant does not make a written attempt to supply the requested information or request an extension in writing within 90 days of the date of the written notice of deficiencies, is considered abandoned and will not be processed.

B. If an applicant does not act in the time-frame specified in subsection (A), the applicant shall submit a new application with the appropriate fee.

Historical Note
New Section adopted by final rulemaking at 5 A.A.R. 1817, effective May 12, 1999 (Supp. 99-2).

ARTICLE 14. THE CONTROL OF NONIONIZING RADIATION

R12-1-1401. Repealed

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Repealed effective January 2, 1996 (Supp. 96-1).

R12-1-1402. Definitions

A. The following terms have the meaning given when used in rules pertaining to radio frequency and microwave radiation:
1. "Accessible emission level" means the level of radio frequency radiation emitted from any source, expressed in terms of power density in milliwatts per square centimeter or electric and magnetic field strength as appropriate, and to which human access is normally possible.
2. "Far field region" means the region in which locally uniform distribution of electric and magnetic field strengths exists in planes transverse to the direction of propagation. The far field region shall be taken to exist at distances greater than $2D^2/\lambda$ from the antenna, where λ is the wavelength and D is the largest antenna aperture dimension.
3. "Near field region" means the region near an antenna in which the electric and magnetic field components vary considerably in strength from point to point. For most

antennas the outer boundary of the region shall be taken to exist at a distance $\lambda/2\pi$ from the antenna surface, where λ is the wavelength.

4. "Radio frequency controlled area" means any area to which access is controlled for the purpose of protection from radio frequency radiation.
5. "Radio frequency exposure limits" means the maximum permissible whole body exposure to humans, from any source of radio frequency radiation.
6. "Radio frequency machine" means a radiation machine or system which produces electromagnetic radiation in the frequency spectrum.
7. "Radio frequency radiation" means that electromagnetic radiation (including microwave radiation) with frequencies in the range of 0.3 megahertz to 100 gigahertz.
8. "Safety device" means any device incorporated into a radio frequency machine which is designed to prevent human access to excessive levels of radio frequency radiation.

B. The following terms have the meaning given when used in rules applicable to lasers:

1. "Accessible emission level" means the magnitude of emission of laser or collateral radiation to which human access is possible.
2. "Accessible emission limit" means the maximum accessible emission level of laser radiation permitted within a particular class.
3. "Angular subtense" means the apparent visual angle, α, as calculated from the source size and distance from the eye.
4. "Aperture" means any opening in a protective housing through which radiation is emitted, thereby allowing human access to the radiation.
5. "Aperture stop" means an opening serving to limit the size and to define the shape of the area over which radiation is measured.
6. "Certified laser product" means that the product is certified by a manufacturer pursuant to the requirements of 21 CFR 1040, 1993 edition, published April 1, 1993, by the Office of the Federal Register, National Archives and Records Administration, incorporated by reference and on file with the Department and the Office of the Secretary of State. This incorporation by reference contains no future editions or amendments.
7. "Class I laser" means any laser which permits human access during operation to laser radiation less than the accessible emission limits for any combination of emission duration and wavelength range.
   a. "Class I dual limits" means, for classification purposes, laser or collateral radiation in the wavelength range of greater than 400 nanometers but less than or equal to 1,400 nanometers exceeds the accessible emission limits of Class I if it exceeds both:
      i. The Class I accessible emission limits for radiant energy within any range of emission duration, and
      ii. The Class I accessible emission limits for integrated radiance within any range of emission duration.
8. "Class II Laser" means any laser which permits human access during operation to laser radiation above the Class I accessible emission limits, up to the accessible emission limits of Class II accessible emission limits and does not permit human access to laser radiation in excess of the accessible emission limits of Class I for any other emission duration or wavelength range.
9. "Class IIa laser products" means any laser product that permits human access during operation to levels of visible laser radiation in excess of the Class II accessible emission limits but does not permit human access during operation to levels of laser radiation in excess of the accessible Class IIa emission limits.
10. "Class III Laser" means any laser which permits human access during operation to laser radiation above the Class I accessible emission limits and, if applicable, Class II, but below the Class IIIa accessible emission limits. Class III lasers are separately designated as Class IIIa or Class IIIb.
    a. Class IIIa lasers are those lasers with an emission duration greater than 380 microseconds and in the wavelength range greater than 400 nanometers but less than or equal to 710 nanometers, with a radiant power of less than or equal to 5 milliwatts.
    b. Class IIIb lasers are all other Class III lasers as defined above.
11. "Class IV laser" means any laser which permits human access during operation to laser radiation above the Class III accessible emission limits.
12. "Class I, II, III, IV facility" means a facility which has one or more Class I, II (including IIa), III (including IIIa and IIIb), or IV lasers respectively. Facilities containing more than one class of laser shall be classified according to the highest laser class contained therein.
13. "Collateral radiation" means any electronic product radiation, except laser radiation, emitted by a laser as a result of the operation of the laser or any component of the laser product that is physically necessary for the operation of the laser. The accessible emission and maximum permissible exposure limits for collateral radiation are specified in 21 CFR 1040.10, 1993 edition, published April 1, 1993, by the Office of the Federal Register, National Archives and Records Administration, incorporated by reference and on file with the Department and the Office of the Secretary of State. This incorporation by reference contains no future editions or amendments.
14. "Demonstration laser" means any laser manufactured, designed, intended, or used for purposes of demonstration, entertainment, advertising display, or artistic composition.
15. "Federal performance standard for light-emitting products" means the regulations in 21 CFR 1040.10, 1993 edition, published April 1, 1993, by the Office of the Federal Register, National Archives and Records Administration, incorporated by reference and on file with the Department and the Office of the Secretary of State. This incorporation by reference contains no future editions or amendments.
16. "Human access" means access to laser or collateral radiation by any part of the human body.
17. "Incident" means an event or occurrence which results in a real or suspected accidental exposure to laser radiation which caused or is likely to cause biological damage.
18. "Integrated radiance" means radiant energy per unit area of a radiating surface per unit solid angle of emission, expressed in joules per square centimeter - steradian.
19. "Irradiance" means the radiant power incident on an element of a surface divided by the area of that element, expressed in watts per square centimeter.
20. "Laser controlled area" means any area into which human access is restricted for the purpose of radiation protection.
21. "Laser energy source" means any device intended for use in conjunction with a laser to supply energy for the opera-

tion of the laser. General energy sources, such as electrical supply mains or batteries, shall not be considered to constitute laser energy sources.

22. "Laser product" means any manufactured product, or assemblage of components which constitutes, incorporates, or is intended to incorporate a laser or laser system. A laser or laser system which is intended for use as a component of an electronic product shall itself be considered a laser product.
23. "Laser protective device" means any device used to reduce or prevent exposure of personnel to laser radiation. Such devices shall include protective eye wear, garments, engineering controls, and operational controls.
24. "Laser radiation" means all electromagnetic radiation emitted by a laser product, within the spectral range specified in the definition in Article 1, which is produced as a result of controlled stimulated emission.
25. "Laser Safety Officer" (LSO) means any individual, qualified by training and experience in the evaluation and control of laser hazards, who is designated by the licensee and has the authority and responsibility to establish and administer the laser radiation protection program for a particular facility.
26. "Laser system" means a laser in combination with an appropriate laser energy source, with or without additional incorporated components.
27. "MPE" means the maximum permissible exposure limits for human exposure to laser or collateral radiation established by this Article. MPE limits for eye and skin exposure listed in ANSI Z136.1-1993, American National Standard for Safe Use of Lasers, 1993 edition, published by the Laser Institute of America, incorporated by reference and on file with the Department and the Office of the Secretary of State (this incorporation by reference contains no future editions or amendments) and for collateral radiation, in 21 CFR 1040.10, 1993 edition, published April 1, 1993, by the Office of the Federal Register, National Archives and Records Administration, incorporated by reference and on file with the Department and the Office of the Secretary of State. This incorporation by reference contains no future editions or amendments.
28. "Maintenance" means the performance of those adjustments or procedures by the user to keep equipment in its intended operating condition. Maintenance does not include operation or service.
29. "Protective housing" means any panel, partition, dividing wall, or similar device which prevents human access to laser or collateral radiation in excess of the prescribed accessible emission limit.
30. "Pulse duration" means the time increment measured between the halfpeak power points at the leading and trailing edges of a pulse.
31. "Pulse interval" means the time duration between identical points on two successive pulses.
32. "Radiance" means the time-averaged radiant power per unit area of a radiating surface per unit solid angle of emission, expressed in watts per square centimeter per steradian.
33. "Radiant energy" means energy emitted, transferred or received in the form of radiation, expressed in joules.
34. "Radiant exposure" means the radiant energy incident on an element of a surface divided by the area of that element, expressed in joules per square centimeter.
35. "Radiant power" means the time-averaged power emitted, transferred, or received in the form of radiation, expressed in watts.
36. "Safety interlock" means a device associated with the protective housing of a laser product, system, or facility which prevents human access to laser and collateral radiation in excess of the prescribed accessible emission limit.
37. "Sampling interval" means the time interval during which the level of accessible laser or collateral radiation is sampled by a measurement process. The magnitude of the sampling interval in units of seconds is represented by the symbol "t".
38. "Secured enclosure" means an enclosure to which casual access is impeded by appropriate means, such as a door secured by lock, by latch, or by screws.
39. "Uncertified laser product" means any laser which has not been certified in accordance with the requirements of 21 CFR 1040, 1993 edition, published April 1, 1993, by the Office of the Federal Register, National Archives and Records Administration, incorporated by reference and on file with the Department and the Office of the Secretary of State. This incorporation by reference contains no future editions or amendments.

C. The following terms have the meaning given when used in rules on ultraviolet and high-intensity light sources:

1. "High-intensity mercury vapor discharge (HID) lamp" means any mercury vapor or metal halide lamp incorporating a high-pressure arc discharge tube that has a fill consisting primarily of mercury and that is contained within an outer envelope but does not include the tungsten filament self-ballasted mercury vapor or metal halide lamp.
2. "Protective sunlamp eye wear" means any device designed to be worn by users of a sunlamp product to reduce radiation exposures to the eyes.
3. "Self-extinguishing lamp" means any HID lamp which ceases operation in conformance with the requirements of the performance standard in 21 CFR 1040.30(d), 1993 edition, published April 1, 1993, by the Office of the Federal Register, National Archives and Records Administration, incorporated by reference and on file with the Department and the Office of the Secretary of State. This incorporation by reference contains no future editions or amendments.
4. "Sunlamp product" means any electronic device which incorporates one or more ultraviolet lamps and is intended for use to induce skin tanning.
5. "Tanning device" means any room, booth, cabinet, tanning bed, or other enclosure which houses sunlamp products for the purpose of irradiating any part of the human body for cosmetic or nonmedical purposes.
6. "Ultraviolet lamp" means any light source that produces ultraviolet radiation and that is intended for use in any sunlamp product.
7. "Ultraviolet radiation" means electromagnetic radiation with a wavelength in air of between 200 and 400 nanometers.

Historical Note

Adopted effective April 2, 1990 (Supp. 90-2). Amended effective January 2, 1996 (Supp. 96-1).

R12-1-1403. General Safety Provisions and Exemptions

A. The Agency may waive compliance with specific requirements of this Article if:

1. Compliance requires replacement, or substantial modification, to an installation, and
2. The licensee provides sufficient information to enable the Agency to determine that alternative methods of achieving the same or a greater level of radiation protection will be used.

B. The licensee shall:
1. Ensure that nonionizing radiation machines are operated only by individuals who have been trained and have demonstrated competence in the safe use of the equipment.
2. Provide safety rules to individuals operating nonionizing radiation machines and shall make these individuals aware of any restrictions in operating techniques required for the safe use of the machines.
3. Make, or cause to be made, physical radiation surveys as may be necessary to ensure compliance with the provisions of this Article.
4. Retain records, including but not limited to:
   a. Results of all physical surveys and calibrations required by this Article for five years,
   b. The calibration of radiation survey instruments for five years,
   c. Inventories to account for sources of radiation for two years,
   d. Records of maintenance, servicing or modifications which could affect the radiation emission characteristics of a machine for the life of the machine plus two years, and
   e. Permanent documentation of each incident involving known or suspected exposure to nonionizing radiation in excess of the maximum permissible exposure limits specified in this Article.

C. The licensee shall not operate, nor permit the operation of, a nonionizing radiation machine unless the machine complies with all applicable requirements of this Article.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Section heading amended effective January 2, 1996 (Supp. 96-1).

R12-1-1404. Radio Frequency Equipment Requirements

A. Radiation machines emitting accessible emission levels exceeding the maximum permissible radio frequency exposure levels for uncontrolled areas specified in IEEE C95.1-1991, Institute of Electrical and Electronics Engineers Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300 GHz, 1991 edition, published by the Institute of Electrical and Electronic Engineers, Inc., incorporated by reference and on file with the Department and the Office of the Secretary of State, containing no future editions or amendments, shall be operated only in a radio frequency-controlled area, so arranged as to prevent human exposure in excess of the applicable values. Each point of access into a radio frequency-controlled area shall be posted with warning signs meeting the specifications indicated in R12-1-1406, Figure 1.

B. Radio frequency machines which are required to be operated in a radio frequency-controlled area shall incorporate visual or audible emission indicators which function only during production of radiation.

C. Sources of radio frequency emissions, which are physically separated from the means of activation of the sources by a distance greater than 2 meters, shall be provided with visual or audible emission indicators at both the source and the point of activation.

D. Visual emission indicators shall be so located that observation does not require human exposure to radio frequency radiation in excess of the applicable values in the radio frequency exposure limits.

E. Safety devices designed to prevent human exposure to excessive radio frequency radiation shall be inspected for proper operation at intervals not to exceed one month.

F. Machines emitting mechanically scanned radio frequency radiation shall not, as the result of scan failure or any other malfunction causing a change in angular velocity or amplitude, allow human exposure in excess of the radio frequency exposure limits.

G. Radio frequency machines shall be physically secured against unauthorized use or being tampered with when not in use.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Amended effective January 2, 1996 (Supp. 96-1).

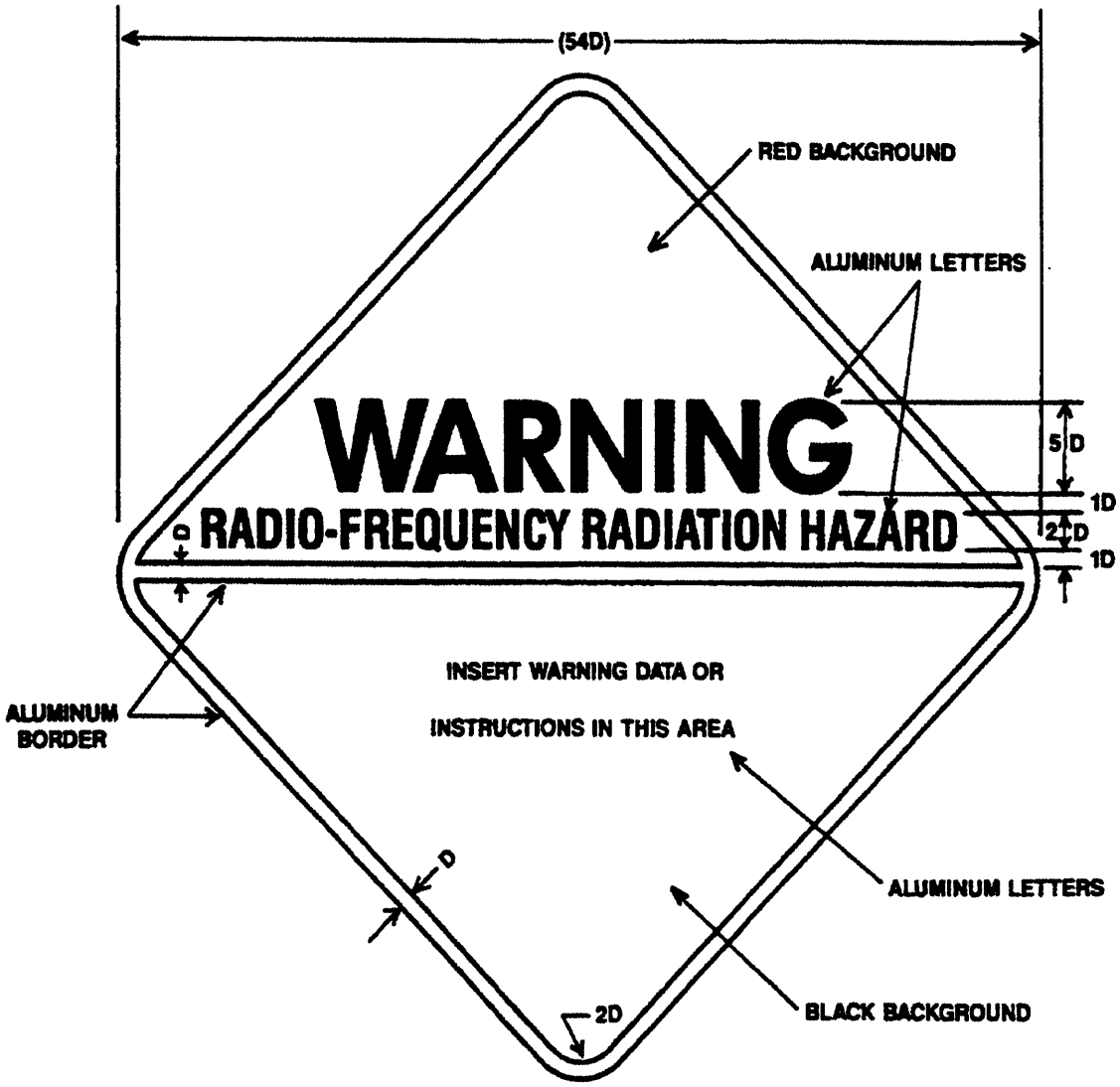
R12-1-1405. Radio Frequency Exposure Limits

The licensee shall not allow, as a result of operation of radio frequency machines under the licensee's control, human exposure to radio frequency radiation in excess of the maximum permissible radio frequency exposure levels in IEEE C95.1-1991, Institute of Electrical and Electronics Engineers Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300 GHz, 1991 edition, published by the Institute of Electrical and Electronic Engineers, Inc., incorporated by reference and on file with the Department and the Office of the Secretary of State, containing no future editions or amendments, with the following exclusions:
1. At frequencies between 300 kHz and 100 GHz, IEEE C95.1-1991, Institute of Electrical and Electronics Engineers Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300 GHz, 1991 edition, published by the Institute of Electrical and Electronic Engineers, Inc., incorporated by reference and on file with the Department and the Office of the Secretary of State, containing no future editions or amendments, limits may be exceeded if the exposure conditions can be shown by laboratory procedures to produce specific absorption rates (SARs) below 0.4 watts per kilogram averaged over the whole body, and spatial peak SAR values below 8 watts per kilogram averaged over any 1 gram of tissue.
2. At frequencies between 300 kHz and 1 GHz, the IEEE C95.1-1991, Institute of Electrical and Electronics Engineers Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300 GHz, 1991 edition, published by the Institute of Electrical and Electronic Engineers, Inc., incorporated by reference and on file with the Department and the Office of the Secretary of State, containing no future editions or amendments, limits may be exceeded if the radio frequency input power to the radiating device is 7 watts or less.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Amended effective January 2, 1996 (Supp. 96-1).

R12-1-1406. Radio Frequency Hazard Caution Signs, Symbols, Labeling, and Posting

A. Radio frequency controlled areas shall be clearly posted with caution signs of the type designated in Figure 1 at each point of access to such areas.



1. Place handling and mounting instructions on reverse side.
2. D = Scaling unit
3. Lettering: Ratio of letter height to thickness of letter lines.
   Upper triangle: 5 to 1 Large
   6 to 1 Medium
   Lower triangle: 4 to 1 Large
   6 to 1 Medium
4. Symbol is square, triangles are right-angle isosceles.

Fig. 1

B. Any limitations or restriction in operating procedures required to prevent unnecessary or excessive exposure to radio frequency radiation shall be posted in a location clearly visible to the operator.

C. Warning signs and labels shall be located such that observation does not require unnecessary or excessive exposure to radio frequency radiation.

Historical Note

Adopted effective April 2, 1990 (Supp. 90-2). Section heading amended effective January 2, 1996 (Supp. 96-1).

R12-1-1407. Special Requirements for Microwave Ovens

A. The power density of microwave radiation emitted by a microwave oven measured at any time subsequent to acquisition by a user shall not exceed 5 milliwatts per square centimeter at any point 5 centimeters from the external surface of the oven.

B. Compliance measurements shall be made with the oven operating at its maximum output, and containing a load of 275 ±15 milliliters of tap water at 20 ± 5° C, within the oven cavity at the center of the load-carrying surface provided by the manufacturer. The water container shall be a low-form 600 milliliter beaker having an inside diameter of approximately 8.5 centimeters and made of an electrically nonconductive material such as glass or plastic.

C. Microwave ovens shall be provided with at least two safety interlocks, one of which is not accessible to humans without disassembly of the oven or door. The interlocks shall prevent microwave radiation emission in excess of the requirements of subsection (A). The failure of one interlock shall not cause failure of the second.

D. Service performed on microwave ovens shall not result in failure of safety interlocks or the emission limits specified in subsection (A) to be exceeded.

E. Microwave ovens not meeting the standards prescribed in this Section shall be removed from service and not put back into service until the repairs necessary to achieve compliance have been completed.

F. Microwave ovens manufactured after October 6, 1971, shall be maintained in conformance with the requirements of 21 CFR 1040.30, 1993 edition, published April 1, 1993, by the Office of the Federal Register, National Archives and Records Administration, incorporated by reference and on file with the Department and the Office of the Secretary of State. This incorporation by reference contains no future editions or amendments.

Historical Note

Adopted effective April 2, 1990 (Supp. 90-2). Amended effective January 2, 1996 (Supp. 96-1).

R12-1-1408. Reporting of Radio Frequency Radiation Incidents

A. When it is known or suspected that any individual has been exposed to radio frequency radiation in excess of the limits in R12-1-1405, the licensee shall report the incident to the Agency in writing within 15 days.

B. When it is known or expected that any individual has been exposed to radio frequency radiation in excess of 150% of the limits in R12-1-1405, the licensee shall report the incident to the Agency within 24 hours.

C. Immediate notification shall be made to the Agency when radio frequency radiation exposure exceeds 500% of the limits.

Historical Note

Adopted effective April 2, 1990 (Supp. 90-2). Amended effective January 2, 1996 (Supp. 96-1).

R12-1-1409. Medical Surveillance for Radio Frequency Occupational Workers

A. The Agency may require the licensee to provide medical examinations as necessary to protect the health of any individual exposed to radio frequency radiation produced by equipment under the licensee's control.

B. The licensee shall request the individual to provide to the Agency a copy of the results of medical examinations ordered pursuant to subsection (A). Such reports shall be held confidential by the Agency, unless all information which could identify the patient has been removed.

Historical Note

Adopted effective April 2, 1990 (Supp. 90-2). Section heading amended effective January 2, 1996 (Supp. 96-1).

R12-1-1410. Radio Frequency Compliance Measurements Criteria

A. Measurements made to determine compliance with R12-1-1405 shall be made with instrumentation appropriate for the field strength and frequency of the radiations to be evaluated.

B. Instrumentation used for compliance measurements shall have been calibrated within the preceding year. The calibration shall be traceable to a national standard maintained by the National Institute of Standards and Technology (formerly known as the National Bureau of Standards.)

C. Compliance measurement of exposure conditions in the near field shall consist of measurements of the electric and magnetic field components. The applicable protection standards for near field measurements shall be the mean squared electric and magnetic field strengths in IEEE C95.1-1991, Institute of Electrical and Electronics Engineers Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300 GHz, 1991 edition, published by the Institute of Electrical and Electronic Engineers, Inc., incorporated by reference and on file with the Department and the Office of the Secretary of State. This incorporation by reference contains no future editions or amendments.

D. Measurements to determine compliance in far-field exposure conditions may be actual measurements of power density in milliwatts per square centimeter, or the calculated equivalent plane wave power density based on measurement of either the electric or magnetic field strength. The applicable protection standards shall be the power density values in IEEE C95.1-1991, Institute of Electrical and Electronics Engineers Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300 GHz, 1991 edition, published by the Institute of Electrical and Electronic Engineers, Inc., incorporated by reference and on file with the Department and the Office of the Secretary of State. This incorporation by reference contains no future editions or amendments.

E. The measurement requirements of this Section shall be met if:

1. Measurements of both electric and magnetic field strengths are obtained where the emission frequency is 300 megahertz or less, and
2. Measurement of electric or magnetic field strength is expressed in terms of power density.

F. For mixed or broadband fields at a number of frequencies for which there are different values of protection standards in IEEE C95.1-1991, Institute of Electrical and Electronics Engineers Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300 GHz, 1991 edition, published by the Institute of Electrical and Electronic Engineers, Inc., incorporated by reference and on file with the Department and the Office of the Secretary of State, containing no future editions or amendments, the fraction of the appropriate exposure limit incurred within each frequency interval shall be determined, and the sum of all such fractions shall not exceed unity.

G. Compliance measurements shall be made at distances 5 centimeters or greater from any object.

H. Measurements shall be averaged over a six-minute period for pulsed and non-pulsed modes of radio frequency emission. Correction shall be made for duty cycle in determining the average field strength.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Amended effective January 2, 1996 (Supp. 96-1).

R12-1-1411. Licensing of Tanning Facilities

A. No person shall operate a tanning facility unless the person has properly applied for a license pursuant to the R12-1-202(B).

B. A facility operating prior to the effective date of this Section may continue to operate, provided that the use of the license shall be registered within six months of the effective date.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Amended effective January 2, 1996 (Supp. 96-1).

R12-1-1412. General Safety Requirements for the Operation of Tanning Facilities

The licensee shall establish and maintain a program of written policies and procedures for radiation safety sufficient to assure compliance with the requirements in R12-1-1412 through R12-1-1416.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Amended effective January 2, 1996 (Supp. 96-1).

R12-1-1413. Tanning Equipment Standards

A. Only sunlamp products manufactured and certified to comply with 21 CFR 1040.20, 1993 edition, published April 1, 1993, by the Office of the Federal Register, National Archives and Records Administration, incorporated by reference and on file with the Department and the Office of the Secretary of State, and this incorporation by reference contains no future editions or amendments, "Sunlamp products and ultraviolet lamps intended for use in sunlamp products," shall be used in tanning facilities. Compliance shall be based on the standard in effect at the time of manufacture as shown on the device identification label.

B. Defective or burned-out lamps or filters shall be replaced before further use of the tanning device.

C. The defective or burned-out lamp or filter shall be replaced with a type intended for use in that device as specified on the product label on the sunlamp products or with lamps or filters that are equivalent under the FDA regulations and polices applicable at the time of manufacture.

D. Each sunlamp product shall have a timer and control system which complies with the requirements of 21 CFR 1040.10, 1993 edition, published April 1, 1993, by the Office of the Federal Register, National Archives and Records Administration, incorporated by reference and on file with the Department and the Office of the Secretary of State. This incorporation by reference contains no future editions or amendments.

E. There shall be physical barriers as needed to protect users from injury induced by touching or breaking lamps.

F. Each tanning facility using stand-up booths shall comply with the following special requirements.

1. There shall be physical barriers, handrails, floor markings, or other means to indicate the proper exposure distance between the ultraviolet lamps and the user's skin.
2. The construction of the booth shall be such that it will withstand the stress of use and the impact of a falling person.
3. Access to booths shall be through doors of rigid construction, opening outwardly. Handrails and non-slip floors shall be provided.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Amended effective January 2, 1996 (Supp. 96-1).

R12-1-1414. Operation and Use of Tanning Equipment

A. There shall be present during operating hours at least one operator knowledgeable in the correct operation of the tanning devices used at the facility and able to inform and assist each user in the proper use of the tanning devices.

B. Prior to use of a tanning device by any individual, the operator shall:

1. Provide sanitized, protective, sunlamp eye wear and directions for its proper use;
2. Demonstrate the use of physical aids, as appropriate, to maintain proper exposure distance as recommended by the manufacturer of the tanning device;
3. Set the timer.

C. The operator shall limit each individual to the manufacturer's maximum recommended exposure time for the tanning device.

D. The interior temperature of a tanning device shall be controlled such that it does not exceed 38° C (100° F).

E. Prior to the first use of a tanning facility in each calendar year, each user shall be required to read a copy of the warning specified in Section R12-1-1415. The user shall sign a statement that the information has been read and understood. For illiterate or visually handicapped persons, the warning statement shall be read by the operator in the presence of a witness. Both the witness and the operator shall sign the statement.

F. A record shall be kept by the operator of each user's total number of tanning visits and tanning times.

G. Each operator shall be trained and records of training retained in the facility. Training shall include:

1. The requirements of this Section,
2. Procedures for correct operation of the facility,
3. Manufacturer's procedures for operation and maintenance of tanning equipment,
4. Recognition of injury or overexposure,
5. Emergency procedures in case of injury.

H. A list of operators trained in accordance with R12-1-1414(G) shall be posted at the facility.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Amended effective January 2, 1996 (Supp. 96-1).

R12-1-1415. Warning Signs and Statements for Tanning Facilities

A. A warning sign shall be posted in the area where a tanning device is used or where each user must pass before entering a tanning device.

B. The sign shall be clearly visible and unobstructed by any barrier or other item.

C. The sign shall read as follows:

****

DANGER - ULTRAVIOLET RADIATION

1. Follow instructions.
2. Avoid overexposure. As with natural sunlight, exposure can cause eye and skin injury and allergic reactions. Repeated exposure may cause premature aging of the skin, dryness, wrinkling, and skin cancer.
3. Wear protective eye wear.

FAILURE TO USE PROTECTIVE EYE WEAR MAY RESULT IN SEVERE BURNS OR LONG TERM INJURY TO THE EYES.

4. Medications or cosmetics may increase your sensitivity to the ultraviolet radiation. Consult a physician before using a sunlamp if you are using medications or have a history of skin problems or believe you are especially sensitive to sunlight.
5. If you do not tan in the sun, you are unlikely to tan from use of this device.

****

D. The lettering on each warning sign shall be at least 10 millimeters high for all words shown in capital letters and at least 5 millimeters high for all lower case letters.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Section heading amended effective January 2, 1996 (Supp. 96-1).

R12-1-1416. Reporting of injuries in tanning facilities

A. The licensee shall report any eye injury, skin burn, fall injury if the fall occurs within the tanning device or while entering or exiting the device, laceration or infection possibly transmitted by use of the tanning device.

B. The report shall be forwarded to the Agency within 10 working days of its occurrence or the date the registrant gained knowledge thereof.

C. The report shall include:
1. The name of the user,
2. Name and location of the tanning facility,
3. A description of nature of the injury,
4. The name and address of the health care provider treating the user, if any, and
5. Any other information the licensee may consider relevant to the incident.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2).

R12-1-1417. High intensity mercury vapor discharge (HID) lamps

A. Unless otherwise approved by the Agency, each facility using HID lamps shall meet the following requirements:
1. For indoor facilities, HID lamps shall be:
   a. Self-extinguishing lamps bearing the letter “T” on the label, or
   b. Non-self-extinguishing lamps, bearing the letter “R” on the label, provided that the lamp is installed within a totally enclosed protective shield which protects the lamp from damage.
2. For outdoor facilities, HID lamps shall be:
   a. Self-extinguishing lamps bearing the letter “T” on the label,
   b. Non-self-extinguishing lamps, provided that the lamp is installed within a totally enclosed protective shield which protects the lamp from damage, or
   c. Exempted by the Agency as a result of the licensee providing sufficient information to the Agency to enable the Agency to determine that precautions taken to minimize the exposure to ultraviolet radiation with wavelengths less than 320 nanometers are at least as effective as the requirements of subsections (a) and (b) above.
   d. Street lighting and security lighting fixtures permanently mounted 18 feet (5.5 meters) or higher above ground level are exempted from the requirements of this subsection.

B. A written report of any injury due to overexposure to ultraviolet light from a HID lamp shall be forward to the Agency by the owner of the facility within 10 working days of its occurrence or of the date that the licensee gained knowledge thereof. The report shall include:
1. The names of all individuals known to have been injured,
2. The name and location of the facility,
3. The name and address of the health care providers treating the injuries, if any,
4. The type of lamp involved (“T” or “R”), lamp model designation and manufacturer,
5. Any other information the licensee may consider relevant to the incident.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2).

R12-1-1418. Reserved

R12-1-1419. Reserved

R12-1-1420. Reserved

R12-1-1421. Laser Safety Requirements, Surveys, and Records

A. These requirements, including special requirements for testing, maintenance, and modification, shall apply to laser products in their intended mode of operation only. During manufacture and research and development activities, when some engineering controls may be inappropriate, the LSO shall specify alternate requirements to obtain equivalent laser safety protection.

B. The licensee shall appoint a laser safety officer and shall establish and maintain an effective program of laser radiation safety.

C. Each licensee shall make or cause to be made such laser radiation protection surveys as may be necessary to comply with R12-1-1433 initially prior to routine operation, upon system modifications, and routinely at intervals not to exceed six months. Surveys shall include but not be limited to:
1. A determination that all laser protective devices are labeled correctly and functioning within the design speci-

fications and are proper for the type and class of lasers in use;
2. A determination that all warning devices are functioning within their design specifications;
3. A determination that each laser-controlled area is properly identified, access is controlled, and the area is posted with accurate warning signs in accordance with R12-1-1427.
4. A reevaluation of potential hazards from surfaces which may be associated with Class III and Class IV beam paths.
5. Additional surveys required to evaluate the laser and collateral radiation hazard incident to the use of lasers.

D. The licensee shall retain records of:
1. Results of all physical surveys made to determine compliance with this Article;
2. Records indicating any restriction in operating procedures necessary to prevent unnecessary or excessive exposure to laser or collateral radiation;
3. Records relating to any incident for which reporting to the Agency is required pursuant to R12-1-1436;
4. Results of medical surveillance to determine extent of injury resulting from exposure to laser or collateral radiation;
5. Inventory to account for all sources of radiation possessed by the licensee.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Amended effective January 2, 1996 (Supp. 96-2).

R12-1-1422. General Requirements for All Laser Facilities

A. Each laser product shall have a protective housing which prevents human access during operation to laser and collateral radiation that exceeds the limits of Class I and paragraphs (A) and (B) of Table X in R12-1-1426, wherever and whenever such human access is not necessary in order for the product to perform its intended function. Wherever and whenever humans are able to access laser radiation levels that exceed the limits of Class I or the accessible emission limits from 21 CFR 1040.10, 1993 edition, published April 1, 1993, by the Office of the Federal Register, National Archives and Records Administration, incorporated by reference and on file with the Department and the Office of the Secretary of State, containing no future editions or amendments, these levels shall not exceed the limits of the lowest laser class necessary to perform the intended function.

B. A safety interlock, which shall ensure that radiation is not accessible above MPE limits, shall be provided for any portion of the protective housing which, by design, can be removed or displaced without the use of tools during normal operation or maintenance and, thereby, allow access to radiation above MPE limits.
1. Adjustment during operation, service, testing, or maintenance of a laser containing interlocks shall not cause the interlocks to become inoperative or the radiation to exceed MPE limits outside protective housing except where a laser-controlled area as specified in R12-1-1433 is established.
2. For pulsed lasers, interlocks shall be designed so as to prevent firing of the laser.
3. For Class IIIb and IV continuous wave (cw) lasers, the interlocks shall turn off the power supply or interrupt the beam.
4. An interlock shall not allow automatic accessibility of radiation emission above MPE limits when the interlock is closed.
5. If failure of a single interlock would allow:
   a. Human access to levels of laser radiation in excess of the radiant power accessible emission limit of Class IIIa laser radiation; or
   b. Laser radiation in excess of the accessible emission limit of Class II to be emitted directly through the opening created by removal or displacement of that portion of the protective housing; then, either multiple safety interlocks or a means to preclude removal or displacement of the interlocked portion of the protective housing upon such failure shall be provided.

C. All viewing ports, viewing optics, or display screens included as an integral part of an enclosed laser or laser system shall incorporate a suitable means to attenuate the laser and collateral radiation transmitted through the port to less than the MPE and the accessible emission limits for collateral radiation from 21 CFR 1040.10, 1993 edition, published April 1, 1993, by the Office of the Federal Register, National Archives and Records Administration, incorporated by reference and on file with the Department and the Office of the Secretary of State, and this incorporation by reference contains no future editions or amendments, under any conditions of operation of the laser. The laser safety officer shall determine the potential for increased hazard that the use of optical system, such as lenses, telescopes, and microscopes, may cause to the eye or the skin, and specify administrative procedures and the use of controls such as interlocks or filters.

D. Each Class III or IV laser product shall provide visual or audible indication during the emission of accessible laser radiation in excess of the limits of Class I.
1. For Class IIIb, except those which allow access only to less than 5 milliwatts peak visible laser radiation, and Class IV lasers, the indication shall be sufficiently prior to emission of such radiation to allow appropriate action to avoid exposure.
2. Any visual indicator shall be clearly visible through protective eye wear designed specifically for the wavelength of the emitted laser radiation.
3. If the laser and laser energy source are housed separately and can be operated at a separation distance of greater than 2 meters, both laser and laser energy source shall incorporate visual or audible indicators.
4. The visual indicators shall be positioned so that viewing does not require human access to laser radiation in excess of the MPE.

E. In addition to the contents of signs, symbols, and labels prescribed in R12-1-1427, R12-1-1428 and R12-1-1429, each licensee shall provide near the signs, symbols, and labels any additional information which is necessary to minimize exposure to laser or collateral radiation within a facility.

F. Any restrictions in operating procedures required to ensure compliance with this Article shall be legibly posted at a position clearly visible to the laser operator.

Editor's Note: The table referenced in subsection (A) was repealed effective January 2, 1996.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Amended effective January 2, 1996 (Supp. 96-1).

R12-1-1423. Prohibitions

A. No individual shall be permitted to look directly into a laser beam, directly at specular reflections of a laser beam, or align a laser by eye while looking along the axis of a beam when the

intensity of such beams or reflections exceeds the MPE limits in this Article.

B. The licensee shall not permit any individual to enter a laser-controlled area when skin exposure in excess of the MPE limits is likely unless the licensee provides and requires the use of protective clothing, gloves and shields.

C. Laser products emitting spatially scanned laser radiation shall not, as a result of scan failure or any other failure causing a change in angular velocity or amplitude, permit human access to laser radiation in excess of the accessible emission limits applicable to the class of the product.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2).

R12-1-1424. Repealed

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Repealed effective January 2, 1996 (Supp. 96-1).

R12-1-1425. Laser Product Classification

A. Each laser product or installation shall be classified on the basis of that combination of emission level, emission duration, and wavelength of accessible laser radiation emitted over the full range of operational capability which results, any time during the useful life of such product or installation, in accordance with the requirements of the federal performance standards for light-emitting products contained in 21 CFR 1040.10.

B. The modification of any laser product or installation, which affects any aspect of performance or intended functions of such product or installations, shall require reclassification and relabeling in accordance with 21 CFR 1040.10.

C. Any laser system that is incorporated into a laser product subject to the requirements of this Article and that is capable, without modification, of producing laser radiation when removed from such laser product, shall itself be considered a laser product and shall be separately subject to the applicable requirements of this Article for laser products in its class. It shall be classified on the basis of accessible emission of laser radiation when so removed.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Amended effective January 2, 1996 (Supp. 96-1).

R12-1-1426. Maximum Permissible Exposure Limits to Laser and Collateral Radiations

A. No licensee shall use, or permit the use of, any laser products or installation which allows human exposure in excess of the MPE limits in ANSI Z136.1-1993, American National Standard for Safe Use of Lasers, 1993 edition, published by the Laser Institute of America, incorporated by reference and on file with the Department and the Office of the Secretary of State, containing no future editions or amendments, and accessible emission limits in 21 CFR 1040.10, 1993 edition, published April 1, 1993, by the Office of the Federal Register, National Archives and Records Administration, incorporated by reference and on file with the Department and the Office of the Secretary of State. This incorporation by reference contains no future editions or amendments.

B. Maximum permissible exposure limits to the eye for intrabeam viewing shall not exceed those shown in ANSI Z136.1-1993, American National Standard for Safe Use of Lasers, 1993 edition, published by the Laser Institute of America, incorporated by reference and on file with the Department and the Office of the Secretary of State. This incorporation by reference contains no future editions or amendments.

C. Maximum permissible exposure to the eye for extended source viewing shall not exceed the limits shown in ANSI Z136.1-1993, American National Standard for Safe Use of Lasers, 1993 edition, published by the Laser Institute of America, incorporated by reference and on file with the Department and the Office of the Secretary of State. This incorporation by reference contains no future editions or amendments.

D. Skin exposure to laser radiation shall not exceed the MPE limits shown in ANSI Z136.1-1993, American National Standard for Safe Use of Lasers, 1993 edition, published by the Laser Institute of America, incorporated by reference and on file with the Department and the Office of the Secretary of State. This incorporation by reference contains no future editions or amendments.

E. Exposure to collateral radiation shall not exceed the limits in 21 CFR 1040.10, 1993 edition, published April 1, 1993, by the Office of the Federal Register, National Archives and Records Administration, incorporated by reference and on file with the Department and the Office of the Secretary of State. This incorporation by reference contains no future editions or amendments.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Amended effective January 2, 1996 (Supp. 96-1).

R12-1-1427. Requirements for Laser Caution Signs, Symbols, and Labels

A. Except as otherwise authorized by the Agency, signs, symbols, and labels prescribed by this Section shall use the design and colors specified in ANSI Z136.1-1993, American National Standard for Safe Use of Lasers, 1993 edition, published by the Laser Institute of America, incorporated by reference and on file with the Department and the Office of the Secretary of State. This incorporation by reference contains no future editions or amendments.

B. The word "invisible" shall immediately precede the word "radiation" on labels and signs required by this Section for wavelengths of laser and collateral radiation that are outside of the range of 400 to 710 nanometers.

C. The words "visible and invisible" shall immediately precede the word "radiation" on labels and signs required by this Section for wavelengths of laser and collateral radiation that are both within and outside the range of 400 to 710 nanometers.

D. All labels placed on lasers or signs posted to laser facilities shall be positioned so as to make unnecessary, during reading, human exposure to laser or collateral radiation in excess of the MPE and AEL.

E. Labels and signs required by this Section shall be clearly visible, legible, and permanently attached to the laser or facility.

F. Each laser shall have a label permanently and legibly affixed which identifies, in accordance with the requirements in 21 CFR 1040, 1993 edition, published April 1, 1993, by the Office of the Federal Register, National Archives and Records Administration, incorporated by reference and on file with the Department and the Office of the Secretary of State, containing no future editions or amendments, the classification of the laser.

G. Each Class III and IV laser shall state, at position 2 on the required warning logotype, the maximum output of laser radiation, the pulse duration when appropriate, and the laser medium or emitted wavelength.

H. Class III and IV lasers, except lasers used in the practice of medicine, shall have a label in close proximity to each aperture through which is emitted accessible laser or collateral radiation in excess of the MPE limits specified in R12-1-1426, with the following wording as applicable:

1. "AVOID EXPOSURE - Laser radiation is emitted from this aperture," if the radiation emitted through such aperture is laser radiation.
2. "AVOID EXPOSURE - Hazardous electromagnetic radiation is emitted from this aperture," if the radiation emitted through such aperture is collateral radiation.
3. "AVOID EXPOSURE - Hazardous x-rays are emitted from this aperture," if the radiation emitted through such aperture is collateral x-ray radiation.

I. Each non-interlocked or defeatably interlocked portion of the protective housing or enclosure which is designed to be displaced or removed during normal operation, maintenance, or servicing, and which thereby would permit human access to laser or collateral radiation, shall be labeled as follows:
1. For laser radiation in excess of the accessible emission limits of Class I or Class II, as applicable, but not in excess of the accessible emission limits of Class III, the wording: "DANGER - Laser radiation when open, AVOID DIRECT EXPOSURE TO THE BEAM."
2. For laser radiation in excess of the accessible emission limits of Class III, the wording: "DANGER - laser radiation when open, AVOID EYE OR SKIN EXPOSURE TO DIRECT OR SCATTERED RADIATION."
3. For collateral radiation in excess of the accessible emission limits:
   a. If the limits for collateral laser radiation are exceeded, the wording: "CAUTION - Hazardous Electromagnetic Radiation when open"; and
   b. If the limits for collateral x-ray radiation are exceeded, the wording: "CAUTION - Hazardous X-ray Radiation."
4. For protective housing or enclosures which provide a defeatable interlock, the words "and interlock defeated" shall be included in the labels specified above.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Amended effective January 2, 1996 (Supp. 96-1).

R12-1-1428. Repealed

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Repealed effective January 2, 1996 (Supp. 96-1).

R12-1-1429. Posting of Laser Facilities
Facilities shall be posted in a manner consistent with ANSI Z136.1-1993, American National Standard for Safe Use of Lasers, 1993 edition, published by the Laser Institute of America, incorporated by reference and on file with the Department and the Office of the Secretary of State, containing no future editions or amendments, or as otherwise approved in writing by the Agency.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Amended effective January 2, 1996 (Supp. 96-1).

R12-1-1430. Repealed

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Repealed effective January 2, 1996 (Supp. 96-1).

R12-1-1431. Repealed

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Repealed effective January 2, 1996 (Supp. 96-1).

R12-1-1432. Repealed

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Repealed effective January 2, 1996 (Supp. 96-1).

R12-1-1433. Laser-controlled Areas

A. With a Class IIIb or Class IV laser, except those Class IIIb lasers which allow access only to less than 5 milliwatts visible peak power, a laser-controlled area shall be established when exposure to the laser radiation in excess of the MPE or AEL in R12-1-1426 is possible. The controlled area shall meet the requirements of subsections (B) through (D) for Class IIIb lasers and the requirements of subsections (B) through (H) for Class IV lasers.

B. The area shall be the responsibility of the laser safety officer.

C. The area shall be posted as required by R12-1-1427.

D. Access to the laser-controlled area shall be only by permission of the laser safety officer or a trained, designated representative.

E. For Class IV indoor controlled areas, latches, interlocks, or other appropriate means shall be used to prevent unexpected entry into laser-controlled areas.
1. Such measures shall be designed to allow both rapid egress by the laser personnel at all times and admittance to the laser-controlled area in an emergency condition.
2. For emergency conditions, a control-disconnect switch, panic button, or equivalent device shall be available for deactivating the laser.

F. For Class IV indoor controlled areas, during tests requiring continuous operation, the individual in charge of the controlled area shall be permitted to momentarily override the safety interlocks to allow access to other authorized personnel if it is clearly evident that there is no optical radiation hazard at the point of entry and if the necessary protective devices are being worn by the entering personnel.

G. For Class IV indoor controlled areas, optical paths such as windows from an indoor facility shall be controlled in such a manner as to reduce the transmitted values of the laser radiation to levels at or below appropriate ocular MPE and AEL in R12-1-1426. When the laser beam must exit the indoor controlled area (as in the case of exterior atmospheric beam paths), the operator shall be responsible for ensuring that the beam path is limited to controlled air space or controlled ground space when the beam irradiance or radiant exposure is above the appropriate MPE and AEL.

H. In cases where removal of panels or protective covers or overriding of interlocks becomes necessary, such as for service, testing, or maintenance, accessible laser-controlled areas shall be established. The laser safety office or a designated representative shall ensure that the necessary laser safety requirements for all potentially exposed individuals shall be established.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Amended effective January 2, 1996 (Supp. 96-1).

R12-1-1434. Laser safety officer duties
The Laser Safety officer shall administer the laser radiation protection program and shall:
1. Assure that maintenance and service for Class IIIb and Class IV lasers shall be performed only by technicians trained to provide such service by either the manufacturer's service organization or the institution's staff;
2. Approve written service and maintenance operating procedures;

3. Investigate, document and report all incidents and accidents as required by R12-1-1436;
4. Select protective eye wear as required pursuant to R12-1-1435, along with any other appropriate protective equipment;
5. For health care facilities, establish authorization and operating procedures, including preoperative and postoperative checklists, for use by operating room personnel;
6. Assure the training of authorized personnel in the assessment and control of laser hazards;
7. Select proper signs and warning posters as required by R12-1-1427;
8. Perform laser radiation protection surveys as required by R12-1-1424 and R12-1-1441;
9. Classify or verify classification of laser and laser systems used under the LSO's jurisdiction;
10. Be responsible for hazard evaluation of laser use areas, treatment areas, and laser control areas, as described in R12-1-1428(E).

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2).

R12-1-1435. Protective Eye Wear for Use in Laser Facilities

A. Protective eye wear, as specified by the laser safety officer, shall be worn:
1. By all individuals with access to Class IV levels of laser radiation.
2. When required by the laser safety officer, by all individuals with access to Class IIIb levels of laser radiation.

B. Protective eye wear shall:
1. Be legibly and permanently labeled indicating the optical density at the wavelengths for which each such device affords adequate protection,
2. Be maintained in proper condition to assure the protective properties are retained,
3. Be inspected at intervals not to exceed six months to ensure integrity of the protective properties,
4. Be removed from service should the device be determined to be in a condition resulting in decreased protection.

C. Records of maintenance, inspections and removal from service shall be retained for five years.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Section heading amended effective January 2, 1996 (Supp. 96-1).

R12-1-1436. Reporting of Laser Incidents

A. The licensee shall be responsible for the reporting to the Agency any incident involving known or suspected exposure to laser or collateral radiation, from a source possessed by the licensee, in excess of the MPE limits in R12-1-1426, Tables VII through X.

B. The Agency shall be notified within 24 hours by telephone of any incident which has caused or may have caused:
1. The permanent loss of sight in either eye; or
2. Third-degree burns of the skin involving more than 5 percent of the body surface as estimated by the rule of nines.

C. Each licensee shall notify the Agency by telephone within 5 working days of any incident which has or may have caused:
1. Second-degree burns of the skin larger than 1 inch (2.54 centimeter) in greatest diameter; or
2. Any third-degree burns of the skin; or
3. An eye injury with potential loss of sight.

D. Each licensee shall make a report in writing within 30 days to the Agency of:
1. Each exposure of an individual to laser and collateral radiation in excess of the MPE limits.
2. Any incident of which notification is required by subsection (B) or (C).

E. Each report required by subsection (D) shall describe the extent of exposure of individuals to laser or collateral radiation, including:
1. Estimates of each individual's exposure;
2. Levels of laser or collateral radiation involved;
3. The cause of the exposure; and
4. Corrective steps taken or planned to be taken to assure against a recurrence.

Editor's Note: The tables referenced in subsection (A) were repealed effective January 2, 1996.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Amended effective January 2, 1996 (Supp. 96-1).

R12-1-1437. Additional Requirements for Special Lasers and Applications

Installations operating laser systems with unenclosed beam path shall:
1. Conduct an evaluation of the expected beam path and the potential hazards from incidental reflective surfaces which may be encountered before operating the laser. Incidental reflective surfaces shall be excluded from the beam path at all points where the laser radiation exceeds MPE limits.
2. The stability of the laser platform shall be evaluated to determine the constraints that shall be placed upon the beam traverse and the extent of the range of control.
3. No laser shall be operated or made ready for operation until the area along all points of the beam path where the laser radiation will exceed the MPE is clear of individuals, unless the individuals are wearing appropriate protective devices.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Amended effective January 2, 1996 (Supp. 96-1).

R12-1-1438. Repealed

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Repealed effective January 2, 1996 (Supp. 96-1).

R12-1-1439. Additional Requirements for Medical Laser Applications

A. Each Class III and Class IV medical laser product shall incorporate the means for measurement of the level of laser radiation intended for human irradiation, with an error in measurement of no greater than ± 20%, when calibrated in accordance with the laser product manufacturer's calibration procedure.

B. Medical lasers used for human irradiation shall be calibrated in accordance with the manufacturer's specified calibration procedure, at intervals not to exceed those specified by the manufacturer.

C. The licensee shall ensure that medical lasers shall not be used for human irradiation unless all applicable requirements of this Article are met.

D. In institutions where a number of different practitioners may use Class IIIb and Class IV lasers, a laser safety committee shall be formed to govern laser activity, establish use criteria, and approve operating procedures.

1. Membership on the committee shall include at least a representative of the Nursing staff, the Laser Safety Officer, a representative of institution management, and a representative of each medical discipline that utilizes the lasers.
2. The committee shall review actions by the Laser Safety Officer in hazard evaluation and the monitoring and control of laser hazards.
3. Users, and those ancillary personnel who may operate or assist in the operation of the lasers under the direction of the users, shall be approved by the committee.

E. For Class IIIb and IV lasers, the switch which controls patient exposure shall have a guard mechanism to prevent inadvertent exposure.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Amended effective January 2, 1996 (Supp. 96-1).

R12-1-1440. Laser Light Shows

A. Prior to the performance of a laser light show, the licensee shall provide to the Agency documentation that a variance has been obtained in accordance with 21 CFR 1040.10, 1993 edition, published April 1, 1993, by the Office of the Federal Register, National Archives and Records Administration, incorporated by reference and on file with the Department and the Office of the Secretary of State, containing no future editions or amendments, to conduct the show.

B. The licensee shall notify the Agency in writing, at least two days in advance of the proposed laser light show, and shall include the following information:
1. The location, time, and date of the light show;
2. Sketches showing the location of the laser, operators, performers, laser beam path, viewing screens, walls, mirror balls, and other reflective or diffuse surfaces which may be struck by the laser beam;
3. Scanning beam patterns, scan velocity, and frequency in occupied areas;
4. Physical surveys and calculations made to ensure compliance with this Article.

C. The licensee shall also supply such additional information as may be required by the Agency for the evaluation of the safety of the proposed performance.

D. Prior to the performance of an outdoor laser light show, the licensee shall notify the Federal Aviation Administration of the proposed show.

E. Laser radiation emissions outside the spectral range 400 to 700 nanometers shall not exceed Class I accessible emission limits.

F. Levels of laser and collateral radiation, where the audience is located, and where operators, performers, and employees are located if the radiation is intended to be viewed by them, shall not exceed Class I accessible emission limits.

G. Operators, performers, and employees shall be able to perform their functions without being exposed to laser or collateral radiation exceeding Class II accessible emission limits when the radiation is not intended to be viewed by them.

H. Areas where levels of laser radiation exceed the Class II accessible emission limit shall be identified by posting of warning signs and through use of barriers or guards to prevent individuals from entering these areas.

I. Scanning devices shall not, as a result of scan failure or any other failure causing a change in either angular velocity or amplitude, permit audience exposure to laser radiation in excess of the accessible emission limits for a Class I laser product.

J. Where a mirror ball is used with a scanning laser, the conditions of subsections (E) and (F) shall be met with the mirror ball stationary or during any failure mode resulting in a change in rotational speed of the mirror ball.

K. Laser light shows shall be at all times under the direct and personal supervision of the laser operator except in cases where the maximum laser power output level is less than 5 milliwatts (all spectral lines), and the laser beam path is located at all times at least 6 meters above any surface upon which an individual in the audience is permitted to stand, and at any point less than 2.5 meters in lateral separation from any position where an individual in the audience is permitted during the performance.

L. Laser radiation levels shall not exceed the accessible emission limits for Class II laser products at any point less than 3 meters above any surface upon which any individual in the audience is permitted to stand and 2.5 meters in lateral separation from any position where an individual in the audience is permitted, unless physical barriers are present which prevent human access to such levels.

M. The maximum laser power output shall be limited to a level sufficient to produce the desired effect.

N. When laser output power must be limited to less than available power in order to satisfy the requirements of this Article, the laser output power shall be adjusted, measured, and recorded prior to the performance of the laser light show.

O. All safety devices and procedures necessary to comply with this Article shall be functionally tested and evaluated after setup and prior to the performance of laser light show to ensure compliance.

P. The laser system, when not in use, shall be secured against unauthorized operation or tampering.

Q. Laser alignment procedures shall be performed with the laser output power reduced to the lowest practicable level, and protective eye wear shall be worn where necessary to prevent exposure to radiation levels exceeding MPE. Only persons required to perform the alignment shall be present during such procedures.

R. The licensee shall ensure that no laser light show is conducted except as specifically authorized in a variance issued in accordance with 21 CFR 1040.10, 1993 edition, published April 1, 1993, by the Office of the Federal Register, National Archives and Records Administration, incorporated by reference and on file with the Department and the Office of the Secretary of State, containing no future editions or amendments, and applicable requirements of this Article.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Amended effective January 2, 1996 (Supp. 96-1).

R12-1-1441. Measurements and Calculations to Determine MPE Limits for Lasers

Measurements to determine MPE limits shall be made in a manner consistent with the procedures contained in ANSI Z136.1-1993, American National Standard for Safe Use of Lasers, 1993 edition, published by the Laser Institute of America, incorporated by reference and on file with the Department and the Office of the Secretary of State, containing no future editions or amendments, or as otherwise approved by the Agency.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Amended effective January 2, 1996 (Supp. 96-1).

R12-1-1442. Repealed

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Repealed effective January 2, 1996 (Supp. 96-1).

R12-1-1443. Laser Compliance Measurement Instruments
Each determination requiring a measurement for compliance with this Article shall use instrumentation which is calibrated and designed for use with the laser that is to be tested. The date of calibration, accuracy of calibration, wavelength range, and power or energy of calibration shall be specified on a legible, clearly visible label attached to the instrument.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Section heading amended effective January 2, 1996 (Supp. 96-1).

R12-1-1444. Laser Classification Measurements
Measurement of accessible emission for classification shall be made:

1. Under those operational conditions and procedures which maximize the accessible emission levels including start-up stabilized operation, and shutdown of the laser or facility;
2. With all controls and adjustments listed in the operating and service instructions adjusted for the appropriate maximum accessible emission level of laser radiation which is not expected to be detrimental to the functional integrity of the laser or enclosure;
3. At points in space to which human access is possible for a given laser configuration. If operations may include removal of portions of the protective housing or enclosure and defeat of safety interlocks, measurements shall be made at points accessible in that configuration;
4. With the measuring instrument detector so positioned and so oriented with respect to the laser as to result in the maximum detection of radiation by the instrument; and
5. For a laser other than a laser system, with the laser coupled to that type of laser energy source specified as compatible by the laser fabricator and which produces the maximum emission of accessible laser radiation from that laser.
6. Accessible emission levels for classification of laser and collateral radiation shall be based upon the following measurements:
   a. For laser products intended to be used in a locale where the emitted laser radiation is unlikely to be viewed with optical instruments, the radiant power in watts or radiant energy in joules detectable through a circular aperture stop having a diameter of 7 millimeters, except for scanned laser radiation, and within a circular solid angle of acceptance of 1 millisteradian with collimating optics of 5 diopters or less.
   b. The irradiance in watts per square centimeter or radiant exposure in joules per square centimeter equivalent to the radiant power or radiant energy detectable through a circular aperture stop having a diameter of 7 millimeters and, for irradiance, within a circular solid angle of acceptance of 1 millisteradian with collimating optic of 5 diopters or less, divided by the area of the aperture stop in square centimeters.
   c. The radiance in watts per square centimeter per steradian or integrated radiance in joules per square centimeter per steradian equivalent to the radiant power or radiant energy detectable through a circular aperture stop having a diameter of 7 millimeters with a circular solid angle of acceptance of 10 microsteradian with collimating optics of 5 diopters or less, divided by that solid angle and by the area of the aperture stop in square centimeters.
   d. Accessible emission levels of scanned laser radiation shall be based upon the measurement of radiation detectable through a stationary circular aperture stop having a 7 millimeter diameter and within the circular solid angle of acceptance with collimating optics applicable under subsections (a), (b) and (c). The direction of the solid angle of acceptance shall change as needed to maximize detectable radiation, with an angular speed of up to 5 radians per second. A 50 millimeter diameter aperture stop with the same collimating optics and acceptance angle will be used for all other laser products.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Section heading amended effective January 2, 1996 (Supp. 96-1).

Appendix A. Radiofrequency Devices
Radiofrequency Devices Include But Are Not Limited To:
Dielectric Heaters And Sealers
Industrial Microwave Ovens And Dryers
Medical Diathermy Units
Asher - Etcher Machines
Radar
Radio And Television Transmitters
R.f. Activated Alarm Systems
Microwave Relay Links
Sputter Machines
R.f. Welding Equipment
R.f. Activated Lasers
Medical Surgical Coagulators
Edge Gluers

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2).

Appendix B. Repealed

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Repealed effective January 2, 1996 (Supp. 96-1). Appendix repealed by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

ARTICLE 15. TRANSPORTATION

R12-1-1501. Requirement for License
A person shall not transport radioactive material or deliver radioactive material to a carrier for transport unless the person is authorized in a general or specific license issued by the Agency or exempt under R12-1-103(A).

Historical Note
New Section made by final rulemaking at 9 A.A.R. 1126, effective May 9, 2003 (Supp. 03-1).

R12-1-1502. Definitions
Terms defined in Article 1 have the same meaning when used in this Article. Federal regulations incorporated by reference in this Article are on file at the Agency and the Office of the Secretary of State.

Historical Note
Adopted effective December 20, 1985 (Supp. 85-6). Amended effective June 13, 1997 (Supp. 97-2).

R12-1-1503. Repealed

Historical Note
Adopted effective December 20, 1985 (Supp. 85-6). Repealed effective June 13, 1997 (Supp. 97-2).

R12-1-1504. Intrastate Transportation and Storage of Radioactive Materials

A. A person shall not transport radioactive materials within this state except as provided in this rule.
1. A general license is issued subject to R12-1-1504(B), (C), (D) and R12-1-1505 to any licensee to transport and store radioactive material incidental to transportation, provided the transportation is incidental to, and is made to further the licensee's operations.
2. A general license is issued by this rule to any common or contract carrier not exempt pursuant to R12-1-103.

B. When transporting or storing radioactive materials, a person shall comply with the regulations of the U.S. Department of Transportation, 49 CFR 171 through 189, 1995 Edition, published October 1, 1995, incorporated by reference and on file with the Agency and the Office of the Secretary of State, to the extent. This incorporation by reference contains no future editions or amendments.

C. Any notification of incidents required by those regulations shall in addition be filed with, or made to, the Agency.

D. Persons who transport and store radioactive material under the general license in this Section are exempt from the requirements of Article 4 and Article 10 of this Chapter with respect to such transport and storage.

Historical Note

Adopted effective December 20, 1985 (Supp. 85-6).
Amended effective June 13, 1997 (Supp. 97-2).

R12-1-1505. Storage of Radioactive Material in Transport

A. A carrier shall not store, for any period in excess of 72 hours, any package that contains radioactive material bearing a Department of Transportation Yellow II or Yellow III label, unless the radioactive material is stored in an area other than, and not adjacent to, any food storage area or area that is normally occupied by an individual.

B. A carrier shall not store a package that contains radioactive material with other hazardous materials, except as authorized by U.S. Department of Transportation regulations in 49 CFR 177.848, 2000 Edition, published October 1, 2000, incorporated by reference and on file with the Agency and the Office of the Secretary of State, containing no future editions or amendments.

C. Whenever a package containing radioactive material is stored in excess of 48 hours, the storage area shall be conspicuously posted according to the requirements of Article 4.

D. When transit is interrupted and storage is required for an extended period, the following requirements apply:
1. When radioactive materials are stored for longer than 48 hours during transit, the carrier shall notify the local fire department and provide the following information:
   a. Warehouse location and carrier name and telephone number;
   b. Radionuclide(s);
   c. Activity per package in curies or becquerels and number of packages;
   d. Form (solid, metallic, liquid, gas);
   e. Flammability (if flammable);
   f. Specific location in warehouse;
   g. Estimated date of departure;
   h. Toxicity (if toxic).
2. If the radioactive material will be, or has been in storage for longer than 90 days, the carrier shall notify the Agency in writing and include the information required in subsection (D)(1).
3. The licensee or carrier shall immediately notify the Department of Public Safety of an accident involving radioactive material.

Historical Note

Adopted effective December 20, 1985 (Supp. 85-6).
Amended effective June 13, 1997 (Supp. 97-2). Amended by final rulemaking at 9 A.A.R. 1126, effective May 9, 2003 (Supp. 03-1).

R12-1-1506. Preparation of Radioactive Material for Transport

A licensee shall not deliver any package that contains radioactive material to a carrier for transport or transport radioactive material, unless the licensee:
1. Complies with the applicable packaging, monitoring, manifesting, marking, and labeling requirements, appropriate to the mode of transport, of the U.S. Department of Transportation, 49 CFR 171 through, 180, 2001 Edition, published October 1, 2001, or 39 CFR 111.1, 2001 Edition, published July 1, 2001. Both incorporated by reference and on file with the Agency and the Office of Secretary of State. This incorporation contains no future editions or amendments; and
2. Establishes procedures for safely opening and closing packages in which radioactive material is transported; and
3. Prior to delivery of a package to a carrier for transport, assures that:
   a. The package is properly closed; and
   b. Any special instructions needed to safely open the package, are made available to the consignee.

Historical Note

Adopted effective December 20, 1985 (Supp. 85-6).
Amended effective June 13, 1997 (Supp. 97-2). Amended by final rulemaking at 9 A.A.R. 1126, effective May 9, 2003 (Supp. 03-1).

R12-1-1507. Packaging Quality Assurance

A. A licensee that transports radioactive material in the course of business or delivers radioactive material to a carrier for transport in a package for which a license, certificate of compliance, or other approval has been issued by the Nuclear Regulatory Commission, or meets the applicable criteria specified in 10 CFR 71, 2001 Edition, published January 1, 2001, incorporated by reference and on file with the Agency and the Office of Secretary of State, shall have, maintain, and execute the quality assurance program specified in 10 CFR 71. This incorporation by reference contains no future editions or amendments.

B. In addition to the requirements in subsection (A) for a quality assurance program, a licensee shall verify by procedures such as checking or inspection, that deficiencies or defective material or equipment relative to the shipment of packages containing radioactive material are promptly identified and corrected.

C. Before the first use of any Type B packaging, a licensee shall obtain approval of its quality assurance program by the Agency.

D. A licensee shall maintain sufficient written records to demonstrate compliance with the quality assurance program. Records of quality assurance pertaining to the use of a Type B package for shipment of radioactive material shall be maintained for three years after the package is used for a shipment.

Historical Note

Adopted effective December 20, 1985 (Supp. 85-6).
Amended effective June 13, 1997 (Supp. 97-2). Amended

by final rulemaking at 9 A.A.R. 1126, effective May 9, 2003 (Supp. 03-1).

R12-1-1508. Advance Notification of Nuclear Waste Transportation

A. Prior to the transport of any nuclear waste, as defined in Article 1, outside of the confines of the licensee's facility or other place of use or storage, or prior to the delivery of any nuclear waste to a carrier for transport, each licensee shall provide advance notification of such transport to the Agency.

B. Each advance notification required in subsection (A) above shall contain the following information:
1. The name, address, and telephone number of the shipper, carrier, and receiver of the shipment;
2. A description of the nuclear waste contained in the shipment as required by 49 CFR 172.202 and 172.203(d), 2001 Edition, published October 1, 2001, incorporated by reference and on file with the Agency and the Office of the Secretary of State. This incorporation by reference contains no future editions or amendments.
3. The point of origin of the shipment and the seven-day period during which departure of the shipment will occur;
4. The seven-day period during which arrival of the shipment at state boundaries will occur;
5. The destination of the shipment, and the seven-day period during which arrival of the shipment will occur; and
6. A point of contact with a telephone number for current shipment information.

C. The licensee shall make the notification required by subsection (A) in writing to the Agency. A notification delivered by mail must be postmarked at least seven days before the beginning of the seven-day period during which departure of the shipment is estimated to occur. The licensee shall maintain a copy of the notification for one year.

D. The licensee shall notify the Agency of any changes in shipment plans, including cancellations, rerouting, or rescheduling, provided pursuant to subsection (A). Such notification shall be by telephoning the Agency. The licensee shall maintain for one year a record of the name of the individual contacted.

Historical Note

Adopted effective December 20, 1985 (Supp. 85-6). Amended effective June 13, 1997 (Supp. 97-2). Amended by final rulemaking at 9 A.A.R. 1126, effective May 9, 2003 (Supp. 03-1).

Appendix A. Repealed

Historical Note

Adopted effective December 20, 1985 (Supp. 85-6). Repealed effective June 13, 1997 (Supp. 97-2).

ARTICLE 16. RESERVED

ARTICLE 17. WIRELINE SERVICE OPERATIONS AND SUBSURFACE TRACER STUDIES

R12-1-1701. Definitions

"Energy compensation source (ECS)" means a small sealed source, with activity that does not exceed 3.7 Mbq (100 microcuries), contained within a logging tool or other tool component.

"Tritium neutron generator target source" means a tritium source contained within a tritium neutron generator tube that produces neutrons for use in well logging applications.

Historical Note

New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-1702. Agreement with Well Owner or Operator

A. A licensee that performs wireline service (well logging) with a sealed source shall enter into a written agreement with the employing well owner or operator that identifies the party responsible for complying with each of the following requirements. The responsible party shall:
1. Make a reasonable effort to recover any sealed source that may be lodged in the well;
2. Not attempt to recover a sealed source in a manner which, in the licensee's opinion, is likely to result in its rupture;
3. Perform the radiation monitoring required in R12-1-1723(A);
4. Decontaminate anyone or anything contaminated with licensed material before releasing personnel or equipment from the site or releasing the site for unrestricted use; and
5. If a source is classified by the Agency as irretrievable after reasonable efforts at recovery, implement the following requirements within 30 days:
   a. Immobilize the irretrievable well logging source and seal it in place with a cement plug;
   b. Provide a means to prevent inadvertent intrusion that could damage the source, unless the site is rendered inaccessible to subsequent drilling operations; and
   c. Mount a permanent identification plaque, constructed of long-lasting material, such as stainless steel, brass, bronze, or Monel, in a conspicuous location adjacent to the well. The responsible party shall ensure that the plaque size is at least 17 cm (7 inches) square and 3 mm (1/8 inch) thick and the following information is written on the plaque:
      i. The word "CAUTION,"
      ii. The radiation symbol (the color requirement in R12-1-428(A) does not apply),
      iii. The date the source was abandoned,
      iv. The name of the well owner or operator that employed the licensee;
      v. The well name and identification number or other designation,
      vi. An identification of each source by radionuclide and quantity of radionuclide,
      vii. The depth of the source and depth to the top of the plug, and
      viii. The following warning, "DO NOT RE-ENTER THIS WELL," and
   d. Notify the Oil and Gas Conservation Commission, Department of Water Resources, or Department of Environmental Quality of the abandoned source, as required by law.

B. A licensee shall maintain a copy of the agreement at the field station during logging operations. The licensee shall retain a copy of the written agreement for three years after completion of the well logging operation.

C. A licensee may apply in accordance with A.R.S. § 30-654(B)(13) for Agency approval, on a case-by-case basis, of proposed procedures to abandon an irretrievable well logging source in a manner not otherwise authorized in subsection (A)(5).

D. A written agreement between the licensee and the well owner or operator is not required if the licensee and the well owner or operator are employed by the same corporation or other business entity. If so, the licensee shall comply with the requirements in subsections (A)(1) through (A)(5).

Historical Note

Adopted effective April 2, 1990 (Supp. 90-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3). Section repealed; new Section

made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-1703. Limits on Levels of Radiation

A person in possession of any source of radiation shall transport the source according to 12 A.A.C. 1, Article 15, and use or store the source in a manner that is consistent with the dose limits in 12 A.A.C. 1, Article 4.

Historical Note

Adopted effective April 2, 1990 (Supp. 90-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-1704. Reserved

R12-1-1705. Reserved

R12-1-1706. Reserved

R12-1-1707. Reserved

R12-1-1708. Reserved

R12-1-1709. Reserved

R12-1-1710. Reserved

R12-1-1711. Reserved

R12-1-1712. Storage Precautions

A. A person storing or transporting a source of radiation shall place the source in an approved storage container, transport container, or both. The container or combination of containers shall have a lock, or tamper-proof seal for calibration sources, to prevent unauthorized removal of the source and exposure to radiation.

B. A person storing or transporting a source of radiation shall store the source in a manner that will minimize danger from explosion or fire.

Historical Note

Adopted effective April 2, 1990 (Supp. 90-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-1713. Transportation precautions

Transport containers shall be physically secured to the transporting vehicle to prevent accidental movement, loss, tampering, or unauthorized removal.

Historical Note

Adopted effective April 2, 1990 (Supp. 90-2).

R12-1-1714. Radiation Survey Instruments

A. A licensee shall maintain at each field station and temporary job site a calibrated and operable radiation survey instrument capable of detecting beta and gamma radiation. The licensee shall ensure that the radiation survey instrument is capable of measuring 1.0 microsievert (0.1 millirem) per hour through 500 microsievert (50 millirem) per hour.

B. A licensee shall ensure that additional calibrated and operable radiation detection instruments are available as needed and that the instruments are sensitive enough to detect the low radiation and contamination levels that could be encountered if a sealed source is ruptured.

C. A licensee shall ensure that the radiation survey instrument required in subsection (A) is calibrated

1. At intervals not to exceed six months and after each instrument servicing;
2. At energies comparable to the energies of the radiation sources used;
3. For linear scale instruments, at two points located approximately 1/3 and 2/3 of full-scale on each scale or for logarithmic scale instruments, at mid-range of each decade, and at two points of at least one decade; and
4. So that accuracy within plus or minus 20 percent of the true radiation level can be demonstrated on each scale.

D. A licensee shall retain calibration records for a period of three years from the date of calibration.

Historical Note

Adopted effective April 2, 1990 (Supp. 90-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-1715. Leak Testing of Sealed Sources

A. A licensee that uses a sealed source shall ensure that the source is tested for leakage according to subsection (C). The licensee shall maintain a record of leak test results in units of Becquerels (Bq) or microcuries, for inspection by the Agency for three years after the leak test is performed.

B. A person authorized under R12-1-417(C) shall wipe a sealed source using a leak test kit or a similar method approved by the Agency, NRC, or another Agreement State. The authorized person shall take the wipe sample from the nearest accessible point to the sealed source where contamination might accumulate, and ensure the wipe sample is analyzed for radioactive contamination. The authorized person shall use a method of analysis capable of detecting the presence of 185 Bq (0.005 microcuries) of radioactive material on the test sample.

C. Test frequency.

1. A licensee shall ensure that each sealed source (except an energy compensation source (ECS)) is tested in accordance with R12-1-417. In the absence of a certificate from a transferor that a test has been performed within six months before transfer, a licensee shall not use the sealed source until it is tested.
2. A licensee shall ensure that each ECS that is not exempt from testing under subsection (E) is tested at intervals that do not exceed three years. In the absence of a certificate from a transferor that a test has been performed within three years before transfer, a licensee shall not use the ECS until it is tested.

D. Removal of leaking source from service.

1. If a test conducted according to this Section reveals the presence of 185 Bq (0.005 microcuries) or more of removable radioactive material, a licensee shall remove the sealed source from service immediately and have it decontaminated, repaired, or disposed of by an Agency, NRC, or Agreement State licensee that is authorized to perform these functions. The licensee shall check the equipment associated with the leaking source for radioactive contamination and, if the equipment is contaminated, have it decontaminated or disposed of by an Agency, NRC, or Agreement State licensee that is authorized to perform the chosen function.
2. A licensee shall submit a report to the Agency, within five days of receiving positive test results. The report shall describe the equipment involved in the leak, the test results, any contamination that resulted from the leaking source, and each corrective action taken up to the date on the report.

E. The following sealed sources are exempt from the periodic leak test requirements in subsections (A) through (D):

1. Hydrogen-3 (tritium) sources;
2. Sources that contain licensed material with a half-life of 30 days or less;
3. Sealed sources that contain licensed material in gaseous form;

4. Sources of beta- or gamma-emitting radioactive material with an activity of 3.7 MBq [100 microcuries] or less; and
5. Sources of alpha- or neutron-emitting radioactive material with an activity of 0.37 MBq [10 microcuries] or less.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Amended effective June 13, 1997 (Supp. 97-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-1716. Inventory
Every six months each licensee or registrant shall conduct an inventory to account for all sources of radiation. Records of inventories shall be retained for three years from the date of the inventory and shall include the quantities and kinds of sources of radiation, the location where sources of radiation are assigned, the date of the inventory, and the name of the individual conducting the inventory.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Amended effective June 13, 1997 (Supp. 97-2).

R12-1-1717. Utilization Records
Each licensee shall maintain records of use for three years from the date of the recorded event, that contain the following information for each source of radiation:
1. Make, model number, and serial number or a description of each source of radiation used;
2. The identity of the well-logging supervisor or the field unit to which the source is assigned;
3. Locations and dates of use; and
4. In the case of tracer materials and radioactive markers, the radionuclide and activity undertaken in a particular well.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-1718. Design and Performance Criteria for Sealed Sources
A. A licensee shall use a sealed source for well logging applications if the sealed source:
1. Is doubly encapsulated;
2. Contains licensed material in a chemical and physical form that is insoluble and nondispersible; and
3. Meets the requirements of subsection (B), (C), or (D).

B. For a sealed source manufactured on or before July 14, 1989, a licensee may use a sealed source in well logging applications that meets the requirements of USASI N5.4-1968, Classification of Sealed Radioactive Sources, available from the American National Standards Institute at 25 West 43rd Street, 4th floor, New York, NY 10036, which is incorporated by reference and on file with the Agency, or the requirements in subsection (C) or (D). This incorporation by reference contains no future editions or amendments.

C. For a sealed source manufactured after July 14, 1989, a licensee may use a sealed source in well logging applications that meets the oil-well logging requirements of ANSI/HPS N43.6-1997, Sealed Radioactive Sources--Classification, available from the American National Standards Institute at 25 West 43rd Street, 4th floor, New York, NY 10036, which is incorporated by reference and on file with the Agency. This incorporation by reference contains no future editions or amendments.

D. For a sealed source manufactured after July 14, 1989, a licensee may use a sealed source in well logging applications if the sealed source's prototype has been tested and found to maintain its integrity after each of the following required tests:
1. Temperature. The test source is held at -40× C for 20 minutes and 600× C for one hour, and then subjected to a thermal shock with a temperature drop from 600× C to 20× C within 15 seconds.
2. Impact. A 5 kg steel hammer, 2.5 cm in diameter, is dropped from a height of 1 m onto the test source.
3. Vibration. The test source is subjected to vibration in the 25 Hz to 500 Hz range at 5 g amplitude for 30 minutes.
4. Puncture. A 1 gram hammer with a pin, 0.3 cm in diameter, is dropped from a height of 1 m onto the test source.
5. Pressure. The test source is subjected to an external pressure of 1.695 x 107 pascals (24,600 pounds per square inch absolute).

E. The requirements in subsections (A), (B), (C), and (D) do not apply to a sealed source that contains licensed material in gaseous form.

F. The requirements in subsections (A), (B), (C), and (D) do not apply to an energy compensation source (ECS).

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3). Section repealed; new Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-1719. Labeling
A. A licensee shall mark each source, source holder, or logging tool that contains radioactive material with a durable, legible, and clearly visible marking or label, consisting at minimum of the standard radiation caution symbol, without the conventional color requirement, and the following wording:

DANGER (or: CAUTION)
RADIOACTIVE

This labeling is required for each component transported as a separate piece of equipment regardless of size.

B. A licensee shall permanently attach to each transport container a durable, legible, and a clearly visible label consisting at minimum, of the standard radiation caution symbol and the following wording:

DANGER (or: CAUTION)
RADIOACTIVE
NOTIFY CIVIL AUTHORITIES (or name of company)

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-1720. Inspection and Maintenance
A. At intervals not to exceed six months, each licensee shall conduct a program of inspection and maintenance of holders, logging tools, source handling tools, storage containers, transport containers, and injection tools to assure proper labeling and physical condition. A licensee shall retain records of inspection and maintenance for a period of three years.

B. If an inspection conducted according to subsection (A) reveals damage to labeling or components critical to radiation safety, the licensee shall remove the device from service until repairs have been made.

C. Only persons specifically authorized by the Agency, the U.S. Nuclear Regulatory Commission, or an Agreement State may repair, open, or modify a sealed source that contains radioactive material.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-1721. Training Requirements

A. A licensee shall not permit any individual to act as a logging supervisor as defined in Article 1 until the individual has:
1. Received, in a course recognized by the Agency, the U.S. Nuclear Regulatory Commission, or an Agreement State instruction in the following subjects and demonstrated an understanding of:
   a. The fundamentals of radiation safety
      i. Characteristics of radiation
      ii. Units of radiation dose and quantity of radioactivity
      iii. Significance of radiation dose
         (1) Radiation protection standards
         (2) Biological effects of radiation dose
      iv. Levels of radiation from sources of radiation
      v. Methods of minimizing radiation dose
         (1) Working time
         (2) Working distances
         (3) Shielding
   b. Radiation detection instrumentation to be used
      i. Use of radiation survey instruments
         (1) Operation
         (2) Calibration
         (3) Limitations
      ii. Survey techniques
      iii. Use of personnel monitoring equipment
   c. Equipment to be used
      i. Handling equipment
      ii. Sources of radiation
      iii. Storage and control of equipment
      iv. Operation and control of equipment
   d. The requirements of pertinent federal and state regulations
   e. The licensee's written operating and emergency procedures
   f. The licensee's recordkeeping procedures
2. Received, read, and demonstrated an understanding of the rules contained in this Article and the applicable Sections of Articles 1, 4, 10, and 15 of this Chapter or their equivalent, conditions of appropriate license or certificate of registration, and the licensee's operating and emergency procedures; and
3. Demonstrated competence to use sources of radiation, related handling tools, and radiation survey instruments which will be used on the job.

B. A licensee shall not permit an individual to assist in the handling of sources of radiation until the individual has:
1. Read or received, and demonstrated an understanding of instruction in the licensee's operating and emergency procedures; and
2. Demonstrated competence to use, under the personal supervision of the logging supervisor, the sources of radiation, related handling tools, and radiation survey instruments that will be used on the job.

C. The licensee shall retain employee training records for three years following termination of employment.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Amended effective June 13, 1997 (Supp. 97-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-1722. Operating and Emergency Procedures

Each licensee shall develop operating and emergency procedures on the following subjects:
1. Procedures designed to prevent individuals from being exposed to radiation in excess of the limits in Article 4 of this Chapter. This subject includes:
   a. Use of a sealed source in a well without a surface casing for the purposes of protecting a fresh water aquifer, as appropriate;
   b. Methods employed to minimize exposure from inhalation or ingestion of licensed tracer materials; and
   c. Methods for minimizing exposure of individuals in the event of an accident;
2. Use of remote handling tools for manipulating a radioactive sealed source or tracer;
3. Methods and occasions for conducting a radiation survey;
4. Methods and occasions for locking and securing a source of radiation;
5. Personnel monitoring and the use of personnel monitoring equipment;
6. Transportation of a source to a temporary job site or field station, including packaging and placing the source of radiation in a vehicle, placarding the vehicle, and securing the source of radiation during transportation;
7. Procedure for notifying the Agency if there is an accident;
8. Maintenance of records;
9. Inspection and maintenance of source holders, logging tools, source handling tools, storage containers, transport containers, and injection tools;
10. Procedure required if a sealed source is:
    a. Lost or lodged downhole; or
    b. Ruptured, including safeguards to prevent job site and personnel contamination, inhalation; and ingestion
11. Procedures required for picking up, receiving, and opening packages that contain radioactive material; and
12. Procedures required for site and equipment surveys and decontamination following tracer studies.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-1723. Personnel Monitoring

A. A licensee shall not permit an individual to act as a logging supervisor or logging assistant or assist in handling sources of radiation unless the licensee provides the individual with monitoring devices in accordance with R12-1-419.

B. If the level of exposure to an individual using licensed radioactive material in subsurface tracer studies exceeds exposure limits in Article 4, the licensee shall provide a bioassay for the individual.

C. The licensee shall maintain personnel monitoring records according to R12-1-419(E).

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Amended effective June 13, 1997 (Supp. 97-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3). Amended by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-1724. Radioactive Contamination Control

A. If a licensee detects evidence that a sealed source has ruptured or licensed materials have caused contamination, the licensee

shall immediately initiate the emergency procedures required by R12-1-1722.

B. If contamination results from the use of licensed material in well logging, the licensee shall decontaminate all affected areas, equipment, and personnel.

C. During efforts to recover a source lodged in a well, the licensee shall continuously monitor, with a radiation detection instrument that complies with R12-1-1714 or a logging tool with a radiation detector, the well and any circulating fluids from the well to check for contamination resulting from damage to the source.

Historical Note
New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-1725. Uranium Sinker Bars
A licensee may use a uranium sinker bar for a well logging application only if it is legibly impressed with the words "Caution Radioactive-Depleted Uranium" and "Notify Civil Authorities (or company name) if Found."

Historical Note
New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-1726. Energy Compensation Source

A. A licensee may use an energy compensation source (ECS) in a logging tool, or other tool component, if the ECS contains a quantity of radioactive material that does not exceed 3.7 MBq (100 microcuries).

B. If used in a well with a surface casing, an ECS is subject to all Sections of this Article except R12-1-1702, R12-1-1728, and R12-1-1751.

C. If used in a well logging hole without a surface casing, an ECS is subject to all Sections of this Article.

Historical Note
New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-1727. Neutron Generator Source

A. A licensee may use a tritium neutron generator source to produce neutrons for well logging applications.

B. If the activity of a tritium neutron generator source does not exceed 1.11 TBq (30 Curies) and the source is used in a well with a surface casing, the source is subject to all Sections of this Article except R12-1-1702 and R12-1-1751.

C. If the activity of a neutron generator source is equal to or exceeds 1.11 TBq (30 Curies) or the source is used in a well without a surface casing, the source is subject to all Sections of this Article.

Historical Note
New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-1728. Use of a Sealed Source in a Well Without a Surface Casing
A licensee may use a sealed source in a well without a surface casing if the licensee follows a procedure for reducing the probability that the source will be lodged in the well. The procedure shall be separately approved by the Agency or in a license issued by the Agency, NRC, or another Agreement State.

Historical Note
New Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).

R12-1-1729. Reserved

R12-1-1730. Reserved

R12-1-1731. Security

A. A logging supervisor shall be physically present at a temporary job site whenever licensed material is being handled or is not stored and locked in a vehicle or storage place. The logging supervisor may leave the job site to obtain assistance if a source becomes lodged in a well.

B. During well logging, except when a radiation source is below ground or in a shipping or storage container, the logging supervisor or other individual designated by the logging supervisor shall maintain direct surveillance of the operation to prevent unauthorized entry into a restricted area, as defined in R12-1-102.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-1732. Handling tools
The licensee shall provide and require the use of tools that will assure remote handling of sealed sources other than low-activity calibration sources.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2).

R12-1-1733. Subsurface Tracer Studies

A. Any person who handles radioactive tracer material shall wear protective gloves and other appropriate protective clothing and equipment. Precautions shall be taken to avoid ingestion or inhalation of radioactive material.

B. A licensee shall not inject radioactive material into potable aquifers without authority granted in a radioactive material license issued by the Agency.

C. A licensee shall dispose of tracer study waste contaminated with radioactive material in accordance with R12-1-434.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-1734. Use of a Sealed Source in a Well Without a Surface Casing and Particle Accelerators

A. A licensee or registrant may use a sealed source in a well without a surface casing to protect a fresh water aquifer if the licensee follows the correct procedure for reducing the probability that the source will become lodged in the well.

B. A licensee or registrant shall not begin well logging operations in a well without a surface casing unless the Agency has approved the licensee's procedure for logging in an uncased hole.

C. A licensee or registrant shall not permit above-ground testing of a particle accelerator, designed for use in well-logging, which results in the production of radiation, unless the area or facility affected is controlled or shielded in a manner consistent with applicable requirements in Article 4 of this Chapter.

Historical Note
Adopted effective April 2, 1990 (Supp. 90-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-1735. Reserved

R12-1-1736. Reserved

R12-1-1737. Reserved

R12-1-1738. Reserved

R12-1-1739. Reserved

R12-1-1740. Reserved

R12-1-1741. Radiation Surveys

A. A licensee shall perform and make a record of a radiation survey using instruments or calculations of radiation levels in each area where radioactive material is stored.

B. A licensee shall make and record a radiation survey using instruments or calculations of radiation levels in occupied positions and on the exterior of each vehicle used to transport radioactive material. The survey or calculation shall include each source of radiation or combination of sources to be transported in the vehicle.

C. After removal of the sealed source from the logging tool and before departing the job site, a licensee shall ensure that the logging tool detector is energized, or a survey meter is used to test the logging tool for contamination. The licensee shall record the test for contamination.

D. The licensee shall make and record each survey using an appropriate survey instrument for the radionuclide being used, at the job site or wellhead for each tracer operation, except those using Hydrogen-3, Carbon-14 and Sulfur-35. Each survey shall include measurements of radiation levels before and after each tracer operation.

E. Records of surveys conducted according to subsections (A) through (D) shall include the date of each survey, the identification of each individual making the survey, identification of each survey instrument used, each radiation measurement in millirem or microsievert per hour, and an exact description of the location of the survey. A licensee shall retain records of a survey for three years after completion of the survey.

Historical Note

Adopted effective April 2, 1990 (Supp. 90-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-1742. Documents and Records Required at Field Stations

Each licensee utilizing a field station shall have the following documents and records available for the specific devices and sources used at the field station:

1. Appropriate license or equivalent document;
2. Operating and emergency procedures;
3. Applicable rules;
4. Record of the latest survey instrument calibration required by R12-1-1714;
5. Record of the latest leak test performed according to R12-1-1715;
6. Inventories of sealed sources required by R12-1-1716;
7. Utilization records required by R12-1-1717;
8. Records of inspection and maintenance required by R12-1-1720; and
9. Survey records required by R12-1-1741.

Historical Note

Adopted effective April 2, 1990 (Supp. 90-2). Amended effective June 13, 1997 (Supp. 97-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-1743. Documents and Records Required at Temporary Job Sites

Each licensee that conducts operations at a temporary job site shall have the following documents and records available at that site:

1. Operating and emergency procedures;
2. Survey records required by R12-1-1741 for the period of operation at the site;
3. Evidence of current calibration for the radiation survey instruments in use at the site; and
4. If operating in Arizona under reciprocity, a copy of the current out-of-state license, certificate of registration, or equivalent documents; and Agency authorization to enter the state to perform operations governed by this Article.

Historical Note

Adopted effective April 2, 1990 (Supp. 90-2). Amended effective June 13, 1997 (Supp. 97-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3).

R12-1-1744. Reserved

R12-1-1745. Reserved

R12-1-1746. Reserved

R12-1-1747. Reserved

R12-1-1748. Reserved

R12-1-1749. Reserved

R12-1-1750. Reserved

R12-1-1751. Notification of Incidents and Lost Sources; Abandonment Procedures for Irretrievable Sources

A. If, after making a reasonable effort to recover a sealed source or device that contains radioactive material using methods that are not likely to result in damage or rupture and contamination, a licensee determines that the source or device is lodged in a well, the licensee shall:

1. Immediately notify the Agency by telephone of the circumstances that resulted in the inability to retrieve the source and, if there is no evidence of contamination, obtain the following from the Agency:
   a. A determination that the source is irretrievable and abandonment is necessary because further efforts to recover the source are likely to result in an immediate threat to public health and safety, and
   b. An approval to implement abandonment procedures;
2. Advise the well owner or operator, as applicable, of the abandonment procedures implemented under R12-1-1702(A) and (C); and
3. Either ensure that abandonment procedures are implemented within 30 days after the Agency classifies the source as irretrievable or request an extension of time if unable to complete abandonment procedures.

B. A licensee shall immediately notify the Agency by telephone and subsequently, within 30 days, by confirmatory letter if the licensee knows or has reason to believe that a sealed source has been ruptured or the well has otherwise been contaminated. The letter shall describe the well location, the magnitude and extent of radioactive contamination, the consequences of the rupture, and the efforts planned or initiated to mitigate the consequences.

C. A licensee shall notify the Agency of the theft or loss of any radioactive material, radiation overexposure, excessive levels and concentrations of radiation, and incidents as required by R12-1-443, R12-1-444, and R12-1-445.

D. A licensee shall, within 30 days after a sealed source has been classified as irretrievable, report in writing to the Agency. The licensee shall send a copy of the report to each state or federal agency that issued permits or otherwise approved of the drilling operation. The report shall contain the following information:

1. Date of occurrence;

2. A description of the irretrievable well logging source involved, including the name of the radionuclide and its quantity, and the chemical and physical form of the radionuclide;
3. Surface location and identification of the well;
4. Results of efforts to immobilize and seal the source in place;
5. A brief description of the attempted recovery effort;
6. Depth of the source;
7. Depth of the top of the cement plug;
8. Depth of the well;
9. The reasons why further efforts to recover the source are likely to result in an immediate threat to public health and safety, necessitating abandonment;
10. Information contained on the permanent identification plaque; and
11. State and federal agencies receiving a copy of the report.

Historical Note

Adopted effective April 2, 1990 (Supp. 90-2). Amended effective June 13, 1997 (Supp. 97-2). Amended by final rulemaking at 9 A.A.R. 4302, effective November 14, 2003 (Supp. 03-3). Section repealed; new Section made by final rulemaking at 10 A.A.R. 2122, effective July 3, 2004 (Supp. 04-2).