3701:1-38-01 **Definitions.**

(A) As used in this chapter and all other rules promulgated pursuant to Chapter 3748. of the Revised Code:

(1) "A_1" means the maximum activity of special form radioactive material permitted in a type A package. These values are listed in rule 3701:1-50-25 of the Administrative Code, or may be derived in accordance with the procedure prescribed in rule 3701:1-50-25 of the Administrative Code.

(2) "A_2" means the maximum activity of radioactive material, other than special form, low specific activity and surface contaminated object material, permitted in a type A package. These values are listed in rule 3701:1-50-25 of the Administrative Code, or may be derived in accordance with the procedure prescribed in rule 3701:1-50-25 of the Administrative Code.

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

(4) "Accelerator or charged particle accelerator" means any of a class of radiation generating equipment designed to electronically accelerate atomic or sub-atomic particles for subsequent bombardment of targets.

(5) "Accelerator-produced radioactive material" means any material made radioactive by a particle accelerator.

~~(5)~~(6) "Activity" means the rate of disintegration or transformation or decay of radioactive material. The units of activity are the becquerel, or Bq, and the curie, or Ci.

~~(6)~~(7) "Address of use" means the building or buildings that are identified on the license or registration and where the source of radiation may be received, used, prepared, or stored, except for temporary job sites.

~~(7)~~(8) "Administrative controls" means mechanisms used to protect health and minimize damage to life and property through the use of written policies, procedures, instructions, training, observation of work practices, and related compliance audits.

~~(8)~~(9) "Administrative monetary penalty" means a monetary penalty assessed by the director under section 3748.05 of the Revised Code and in compliance with rules adopted thereunder, to emphasize the need for lasting remedial action and to deter future violations.

~~(9)~~(10) "Adult" means an individual eighteen or more years of age.

~~(10)~~(11) "Agreement state" means any state with which the United States nuclear regulatory commission or the atomic energy commission has entered into an effective agreement under subsection 274B of the Atomic Energy Act. Non-agreement state means any other state.

~~(11)~~(12) "Airborne radioactive material" means radioactive material dispersed in the air in the form of dusts, fumes, particulates, mists, vapors, or gases.

~~(12)~~(13) "Airborne radioactivity area" means a room, enclosure, or area in which airborne radioactive materials, composed wholly or partly of licensed material, exist in concentrations:

(a) In excess of the derived air concentrations (DACs) specified in appendix C to rule 3701:1-38-12 of the Administrative Code, or

(b) To such a degree 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 per cent of the annual limit on intake or twelve DAC-hours.

~~(13)~~(14) "Air-purifying respirator" means a respirator with an air-purifying filter, cartridge, or canister that removes specific air contaminants by passing ambient air through the air-purifying element.

~~(14)~~(15) "ALARA" or "as low as is reasonably achievable" means every reasonable effort to maintain exposures to radiation as far below the dose limits 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 benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials and registered activities in the public interest.

~~(15)~~(16) "Alert" means events may occur, are in progress, or have occurred that could lead to a release of radioactive material but that the release is not expected to require a response by off-site response organizations to protect persons off-site.

~~(16)~~(17) "Annual limit on intake" or "ALI" means 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 sievert (five rem) or a committed dose equivalent of 0.5 sievert (fifty rem) to any individual organ or tissue. ALI values for intake by

ingestion and by inhalation of selected radionuclides are given in appendix C to rule 3701:1-38-12 of the Administrative Code.

~~(17)~~(18) "Annually" means either

(a) At intervals not to exceed one year; or

(b) Once per year, at about the same time each year, plus or minus one month.

~~(18)~~(19) "Area of use" means a portion of an address of use that has been set aside for the purpose of receiving, preparing, using, or storing sources of radiation.

~~(19)~~(20) "Assigned protection factor" or "APF" means the expected workplace level of respiratory 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.

~~(20)~~(21) "Atmosphere-supplying respirator" means a respirator that supplies the respirator user with breathing air from a source independent of the ambient atmosphere, and includes supplied air respirators, or SARs, and self-contained breathing apparatus, or SCBA, units.

~~(21)~~(22) "Atomic energy commission" or "AEC" means the federal agency created by the Atomic Energy Act of 1954, as amended, and was the predecessor agency to the current United States nuclear regulatory commission created by the Energy Reorganization Act of 1974.

~~(22)~~(23) "Background radiation" means radiation from cosmic sources; naturally occurring radioactive materials, including radon, except as a decay product of source or special nuclear material, and global fallout as it exists in the environment from the testing of nuclear explosive devices or from past nuclear accidents such as Chernobyl that contribute to background radiation and are not under the control of the licensee. "Background radiation" does not include radiation from radioactive materials regulated by the department.

~~(23)~~(24) "Becquerel" or "Bq" means the SI unit of activity. One becquerel is equal to one disintegration per second.

~~(24)~~(25) "Bioassay" or "radiobioassay" 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.

~~(25)~~(26) "Byproduct material" means

(a) 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 materials; ~~or~~

(b) The tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content, including discrete surface wastes resulting from solution extraction processes. Underground ore bodies depleted by such solution extraction do not constitute byproduct material within the definition~~.~~;

(c)

(i) Any discrete source of radium-226 that is produced, extracted, or converted after extraction, for use for a commercial, medical, or research activity; or

(ii) Any material that:

(a) Has been made radioactive by use of a particle accelerator; and

(b) Is produced, extracted, or converted after extraction, for use for a commercial, medical, or research activity; and

(d) Any discrete source of naturally occurring radioactive material, other than source material, that:

(i) The United States nuclear regulatory commission, in consultation with the administrator of the environmental protection agency, the secretary of energy, the secretary of homeland security, and the head of any other appropriate federal agency, determines would pose a threat similar to the threat posed by a discrete source of radium-226 to the public health and safety or the common defense and security; and

(ii) Is extracted, or converted after extraction, for use in a commercial, medical, or research activity.

~~(26)~~(27) "Chelating agent" means a chemical compound or mixture that enhances the removal of radioactive material from the body, water or similar applications. Typical chelating agents include amine polycarboxylic acids such as EDTA or DTPA; hydroxy-carboxylic acids; and polycarboxylic acids such as citric acid, carbolic acid, and gluconic acid.

~~(27)~~(28) "Chiropractor" means an individual licensed by the state of Ohio to practice chiropractic medicine pursuant to Chapter 4734. of the Revised Code.

~~(28)~~(29) "Class" or "lung class" or "inhalation class" means a classification scheme for inhaled material according to its rate of clearance from the pulmonary region of 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 ten days, for class W, weeks, from ten to one hundred days, and for class Y, years, of greater than one hundred days.

~~(29)~~(30) "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.

~~(30)~~(31) "Commencement of construction" means any clearing of land, excavation, or other substantial action that would adversely affect the natural environment of a site but does not include changes desirable for the temporary use of the land for public recreational uses, necessary borings to determine site characteristics or other preconstruction monitoring to establish background information related to the suitability of a site or to the protection of environmental values.

~~(31)~~(32) "Committed dose equivalent" or "$H_{T,50}$" 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 fifty year period following the intake.

~~(32)~~(33) "Committed effective dose equivalent" or "$H_{E,50}$" means the sum of the products of the weighting factors applicable to each of the body organs or tissues, W_T, that are irradiated and the committed dose equivalent to each of these organs or tissues ($H_{E,50} = \mathrm{Sigma} W_T H_{T,50}$).

(34) "Consortium" means an association of medical use licensees and a PET radionuclide production facility in the same geographical area that jointly own or share in the operation and maintenance cost of the PET radionuclide production facility that produces PET radionuclides for use in producing radioactive drugs within the consortium for noncommercial distributions among its associated members for medical use. The PET radionuclide production facility within the consortium must be located at an educational institution or a medical facility.

~~(33)~~(35) "Constraint" or "dose constraint" means a value above which specified licensee actions are required.

~~(34)~~(36) "Controlled area" means an area, outside of a restricted area but inside the site boundary, access to which can be limited by the licensee or registrant for any reason.

~~(35)~~(37) "Critical group" means the group of individuals reasonably expected to receive the greatest exposure to residual radioactivity for any applicable set of circumstances.

~~(36)~~(38) "Curie" or "Ci" means a unit of activity. One curie equals 3.7 x 10^{10} disintegrations per second equals 3.7 x 10^{10} becquerels equals 2.22 x 10^{12} disintegrations per minute.

(39) "Cyclotron" means a particle accelerator in which the charged particles travel in an outward spiral or circular path. A cyclotron accelerates charged particles at energies usually in excess of ten megaelectron volts and is commonly used for production of short half-life radionuclides for medical use.

~~(37)~~(40) "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.

~~(38)~~(41) "Decommission" means to safely remove any licensed operation from service and reduce residual radioactivity to a level that permits release of the licensee's property for unrestricted use and termination of the license. Termination of a license under conditions other than unrestricted use is not permitted by Chapter 3748. of the Revised Code.

~~(39)~~(42) "Dedicated check source" means a radioactive source that is used to assure the consistent performance of a radiation detection or measurement device over several months or years.

~~(40)~~(43) "Deep dose equivalent" or "H_d" applies to external whole body exposure, and means the dose equivalent at a tissue depth of one centimeter, one thousand milligram per square centimeter.

~~(41)~~(44) "Demand respirator" means an atmosphere-supplying respirator that admits breathing air to the facepiece only when a negative pressure is created inside the facepiece by inhalation.

~~(42)~~(45) "Dentist" means an individual licensed by the state of Ohio to practice dentistry under Chapter 4715. of the Revised Code.

~~(43)~~(46) "Department" means the Ohio department of health.

~~(44)~~(47) "Depleted uranium" means the source material uranium in which the isotope uranium-235 is less than 0.711 weight per cent of the total uranium present. Depleted uranium does not include special nuclear material.

~~(45)~~(48) "Derived air concentration" or "DAC" means the concentration of a given radionuclide in air which, if breathed by the reference man for a working year of two thousand hours under conditions of light work, results in an intake of one ALI. The condition of light work is inhaling 1.2 cubic meters of air per hour for two thousand hours in a year. DAC values are given in appendix C to rule 3701:1-38-12 of the Administrative Code.

~~(46)~~(49) "Derived air concentration-hour or DAC-hour" means the product of the concentration of radioactive material in air, which is 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 two thousand DAC-hours to represent one ALI, equivalent to a committed effective dose equivalent of 0.05 Sv (five rem).

~~(47)~~(50) "Direct reading dosimeter" means a device that measures radiation dose that does not require another device to read the measured radiation dose. Examples of direct reading dosimeters include pocket dosimeters and electronic dosimeters.

~~(48)~~(51) "Director" means the director of health or a designee or authorized representative of the director.

~~(49)~~(52) "Discipline" means a branch of knowledge or of teaching.

(53) "Discrete source" means a radionuclide that has been processed so that its concentration within a material has been purposely increased for use for commercial, medical, or research activities.

~~(50)~~(54) "Disposable respirator" means a respirator for which maintenance is not intended and that is designed to be discarded after excessive breathing resistance, sorbent exhaustion, physical damage, or end-of service-life renders it unsuitable for use. Examples of this type of respirator are a disposable half-mask respirator or a disposable escape-only self-contained breathing apparatus.

~~(51)~~(55) "Dose" or "radiation dose" is a generic term that means absorbed dose, dose equivalent, effective dose equivalent, committed effective dose equivalent, or total effective dose equivalent as defined in other paragraphs of this rule.

~~(52)~~(56) "Dose equivalent" or "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 and rem.

~~(53)~~(57) "Dose limits" or "limits" means the permissible upper bounds of radiation doses established in accordance with these regulations but excludes background radiation and medical exposure.

~~(54)~~(58) "Dosimetry processor" means a person that processes and evaluates individual monitoring devices in order to determine the radiation dose delivered to the monitoring devices.

~~(55)~~(59) "Effective dose equivalent" or "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$W_T H_T$).

~~(56)~~(60) "Embryo" or "fetus" means the developing human organism from conception until time of birth.

~~(57)~~(61) "Engineering controls" means mechanisms used to protect health and minimize damage to life and property through engineering specifications, design, and construction of the product or facility including all of the security and safety features. This includes, but is not limited to, auxiliary security and safety features such as additional external shielding, barriers, and operational interlocks with associated processes.

~~(58)~~(62) "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 or registered radiation generating equipment. This includes entry or exit portals of sufficient size to permit human entry, irrespective of their intended use.

~~(59)~~(63) "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.

~~(60)~~(64) "Exposure" means being exposed to sources of ionizing radiation.

~~(61)~~(65) "External dose" means that portion of the dose equivalent received from radiation sources outside the body.

~~(62)~~(66) "Extremity" means hand, elbow, arm below the elbow, foot, knee, or leg below the knee.

~~(63)~~(67) "Eye dose equivalent" means the same as lens dose equivalent.

~~(64)~~(68) "Facility" means all buildings, equipment, structures and other stationary items that, in addition to the meaning defined in division (H) of section 3748.01 of the Revised Code, are:

(a) Located on a single site or on contiguous or adjacent sites and are operated by the same person and have common corporate or business interests; or

(b) Portions of a building or structure which are operated by the same person and have common corporate or business interests.

~~(65)~~(69) "Filtering facepiece" or "dust mask" means a negative pressure particulate respirator with a filter as an integral part of the facepiece or with the entire facepiece composed of the filtering medium, not equipped with elastomeric sealing surfaces and adjustable straps.

~~(66)~~(70) "Fissile material" means the radionuclides uranium-233, uranium-235, plutonium-239, and plutonium-241, or any combination of these radionuclides. Fissile material means the fissile nuclides themselves, not material containing fissile nuclides. Unirradiated natural uranium and depleted uranium and natural uranium or depleted uranium that has been irradiated in thermal reactors only, are not included in this definition. Certain exclusions from fissile material controls are provided in rule 3701:1-50-13 of the Administrative Code.

~~(67)~~(71) "Fit factor" means 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.

~~(68)~~(72) "Fit test" means the use of a protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual.

~~(69)~~(73) "Generally applicable environmental radiation standards" means standards issued by the United States environmental protection agency 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.

~~(70)~~(74) "Gray" or "Gy" means the SI unit of absorbed dose. One gray is equal to an absorbed dose of one joule per kilogram (one hundred rads).

~~(71)~~(75) "Handler" means a facility that handles sources of radiation unless possession is solely for the purpose of transportation.

~~(72)~~(76) "Hazardous waste" means those wastes designated as hazardous by rule 3745-51-03 of the Administrative Code.

~~(73)~~(77) "Helmet" means a rigid respiratory inlet covering that also provides head protection against impact and penetration.

~~(74)~~(78) "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 one millisievert (0.1 rem) in

one hour at thirty centimeters from the radiation source or thirty centimeters from any surface that the radiation penetrates.

~~(75)~~(79) "Hood" means a respiratory inlet covering that completely covers the head and neck and may also cover portions of the shoulders and torso.

~~(76)~~(80) "Individual" means any human being.

~~(77)~~(81) "Individual monitoring" means

(a) The assessment of dose equivalent by the use of devices designed to be worn by an individual;

(b) The assessment of committed effective dose equivalent by bioassay or by determination of the time-weighted air concentrations to which an individual has been exposed, i.e. DAC-hours; or

(c) The assessment of dose equivalent by the use of survey data.

~~(78)~~(82) "Individual monitoring devices" means devices designed to be worn by a single individual for the assessment of dose equivalent such as film badges; thermoluminescent dosimeters; optically stimulated luminescent dosimeters; pocket ionization chambers; and personal air sampling devices.

~~(79)~~(83) "Industrial radiography" means the examination of the structure of materials by nondestructive methods, utilizing sealed sources of radioactive material or radiation-generating equipment.

~~(80)~~(84) "Internal dose" means that portion of the dose equivalent received from radioactive material taken into the body.

~~(81)~~(85) "Irradiator" means a facility that uses radioactive sealed sources for the irradiation of objects or materials and in which radiation dose rates exceeding five grays (five hundred rads) per hour exist at one meter from the sealed radioactive source in air or water, as applicable for the irradiator type, but does not include irradiators in which both the sealed source and the area subject to irradiation are contained within a device and are not accessible to personnel.

~~(82)~~(86) "Lens dose equivalent" or "eye dose equivalent" 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; i.e. three hundred milligrams per square centimeter.

~~(83)~~(87) "License" means a license issued by the nuclear regulatory commission, the director, or another agreement state in accordance with rules adopted by those organizations.

~~(84)~~(88) "Licensee" means a person to whom a license is issued.

~~(85)~~(89) "Licensed activity" means an activity authorized by a radioactive material license which is essential to achieving the purpose for which the license was issued or amended.

~~(86)~~(90) "Licensed material" means radioactive material received, possessed, used, transferred or disposed of under a general or specific license.

~~(87)~~(91) "Loose-fitting facepiece" means a respiratory inlet covering that is designed to form a partial seal with the face.

~~(88)~~(92) "Lost or missing licensed source of radiation" means a licensed source of radiation whose location is unknown. It includes material that has been shipped but has not reached its destination and whose location cannot be readily traced in the transportation system.

~~(89)~~(93) "Low-level radioactive waste" or "LLRW," also "low-level waste," or "LLW" means radioactive waste which is not high-level radioactive waste, spent nuclear fuel, NARM, or byproduct material as defined in section 11 E. (2) of the Atomic Energy Act of 1954, as amended, but is radioactive material that the United States nuclear regulatory commission classifies as low-level radioactive waste.

~~(90)~~(94) "Low specific activity material" or "LSA" means radioactive material with limited specific activity which is nonfissile or is excepted under rule 3701:1-50-13 of the Administrative Code, and which satisfies the descriptions and limits set forth below. Shielding materials surrounding the LSA material may not be considered in determining the estimated average specific activity of the package contents. LSA must be in one of three groups:

(a) LSA - I.

(i) Uranium and thorium ores, concentrates of uranium and thorium ores, and other ores containing naturally occurring radioactive radionuclides which are not intended to be processed for the use of these radionuclides;

(ii) Solid unirradiated natural uranium or depleted uranium or natural thorium or their solid or liquid compounds or mixtures;

(iii) Radioactive material for which the A_2 value is unlimited; or

(iv) Other radioactive material in which the activity is distributed throughout and the estimated average specific activity does not exceed thirty times the value for exempt material activity concentration

determined in accordance with rule 3701:1-50-25 of the Administrative Code.

(b) LSA-II.

(i) Water with tritium concentration up to 0.8 terabecquerels per liter (twenty curies per liter); or

(ii) Other material in which the activity is distributed throughout and the average specific activity does not exceed (0.0001 x A_2) per gram for solids and gases, and (0.00001 x A_2) for liquids.

(c) LSA-III. Solids (e.g., consolidated wastes, activated materials), excluding powders, that satisfy the requirements of 10 C.F.R. 71.77 (as published in the January 1, 2006, Code of Federal Regulations), in which:

(i) The radioactive material is distributed throughout a solid or a collection of solid objects, or is essentially uniformly distributed in a solid compact binding agent (such as concrete, bitumen, ceramic, etc.);

(ii) The radioactive material is relatively insoluble, or it is intrinsically contained in a relatively insoluble material, so that even under loss of packaging, the loss of radioactive material per package by leaching, when placed in water for seven days, would not exceed (0.1 x A_2); and

(iii) The estimated average specific activity of the solid does not exceed (0.002 x A_2) per gram.

~~(91)~~(95) "Management" means the chief executive officer or other individual having the authority to manage, direct, or administer the licensee's activities, or those persons' delegate or delegates.

~~(92)~~(96) "Medical institution" means an organization in which more than one medical discipline is practiced.

~~(93)~~(97) "Medical use" means the intentional internal or external administration of radioactive material or the radiation therefrom to patients or human research subjects under the supervision of an authorized user.

~~(94)~~(98) "Member of the public" means any individual except when that individual is receiving an occupational dose.

~~(95)~~(99) "Minor" means an individual less than eighteen years of age.

~~(96)~~(100) "Monitoring" or "radiation monitoring" or "radiation protection monitoring" means the measurement of radiation levels, concentrations, surface

area concentrations or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposures and doses.

~~(97)~~(101) "NARM" or "naturally occurring or accelerator-produced radioactive material" means naturally-occurring or accelerator-produced radioactive material, including naturally occurring material that is technologically enhanced, and those nuclides that are generated in a charged particle accelerator, but does not include source material, byproduct material, or special nuclear material.

~~(98)~~(102) "NARM licensing state" means any state with regulations equivalent to the suggested state regulations for control of radiation relating to, and an effective program for, the regulatory control of NARM and which has been granted final designation by the conference of radiation control program directors, inc.

~~(99)~~(103) "Negative pressure respirator" or "tight fitting respirator" means a respirator in which the air pressure inside the facepiece is negative during inhalation with respect to the ambient air pressure outside the respirator.

~~(100)~~(104) "Nonstochastic effect" or "deterministic effect" means health effects, 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.

~~(101)~~(105) "NORM" or "naturally occurring radioactive material" means any nuclide that is radioactive in its natural physical state, but does not include source material, byproduct material, or special nuclear material.

~~(102)~~(106) "Normal form radioactive material" means radioactive material that has not been demonstrated to qualify as special form radioactive material.

~~(103)~~(107) "Nuclear regulatory commission" means the federal agency established by Title II of the Energy Reorganization Act of 1974, as amended, comprising the members of the commission and all offices, employees, and representatives authorized to act in any case or matter related to licensing and related regulatory function previously assigned to the AEC by the Atomic Energy Act of 1954, as amended.

~~(104)~~(108) "Occupational dose" means the dose received by an individual in the course of employment in which the individual's assigned duties involve exposure to radiation or radioactive material from licensed and unlicensed sources of radiation, whether in the possession of the licensee or other person. Occupational dose does not include doses received from background radiation, from any medical administration the individual has received, from exposures to individuals administered radioactive materials and released in accordance with rule 3701:1-58-30 of the Administrative Code or equivalent United States

nuclear regulatory commission or agreement state regulations, from voluntary participation in medical research programs, or as a member of the public.

~~(105)~~(109) "Package" means the packaging together with its radioactive contents as presented for transport.

(a) Fissile material package or type AF package, type BF package, type B(U)F package, or type B(M)F package means a fissile material packaging together with its fissile material contents.

(b) Type A package means a type A packaging together with its radioactive contents. A type A package is defined and must comply with the United States department of transportation regulations in 49 C.F.R. 173 (as published in the October 1, 2005, Code of Federal Regulations).

(c) Type B package means a type B packaging together with its radioactive contents. On approval, a type B package design is designated by the United States nuclear regulatory commission as B(U) unless the package has a maximum normal operating pressure of more than seven hundred kilopascals (one hundred pounds per square inch) gauge or a pressure relief device that would allow the release of radioactive material to the environment under the tests specified in 10 C.F.R. 71.73 (hypothetical accident conditions) (as published in the January 1, 2006, Code of Federal Regulations), in which case it will receive a designation B(M). B(U) refers to the need for unilateral approval of international shipments; B(M) refers to the need for multilateral approval of international shipments. There is no distinction made in how packages with these designations may be used in domestic transportation. To determine their distinction for international transportation, see United States department of transportation regulations in 49 C.F.R. 173 (as published in the October 1, 2005 Code of Federal Regulations). A type B package approved before September 6, 1983, was designated only as type B. Limitations on its use are specified in 10 C.F.R. 71.19 (as published in the January 1, 2006, Code of Federal Regulations).

~~(106)~~(110) "Packaging" means the assembly of components necessary to ensure compliance with the packaging requirements of rule 49 C.F.R. 173 Subpart I (as published in the October 1, 2005, Code of Federal Regulations). It may consist of one or more receptacles, absorbent materials, spacing structures, thermal insulation, radiation shielding, and devices for cooling or absorbing mechanical shocks. The vehicle, tie-down system and auxiliary equipment may be designated as part of the packaging.

(111) "Particle 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 one megaelectron volt. For purposes of this definition, "accelerator" is an equivalent term.

~~(107)~~(112) "Person" means any individual, corporation, association, business enterprise, or other legal entity either public or private and any legal successor, representative, agent, or agency of that individual, corporation, association, business enterprise, or other legal entity. Person also includes the United States, states, political subdivisions of states, and any department, agency, or instrumentality of the United States or a state, except the U.S. department of energy or the U.S. nuclear regulatory commission where the state regulation of radioactive material by either of those agencies is prohibited by federal law.

~~(108)~~(113) "Personnel dosimeter", means a device that measures radiation dose that is processed and evaluated by an accredited "National Voluntary Laboratory Accreditation Program" (NVLAP) processor. Examples of personnel dosimeters include film badges, thermo-luminescent dosimeters (TLD), and optically stimulated luminescence (OSL) dosimeters.

~~(109)~~(114) "Pharmacist" means a person who is licensed by the state of Ohio to practice pharmacy pursuant to Chapter 4731. of the Revised Code.

~~(110)~~(115) "Physician" means a person who is licensed pursuant to Chapter 4731. of the Revised Code to practice medicine or surgery or osteopathic medicine or surgery.

~~(111)~~(116) "Planned special exposure" means an infrequent exposure to radiation, separate from and in addition to the annual dose limits.

~~(112)~~(117) "Podiatrist" means an individual licensed by the state of Ohio to practice podiatry pursuant to Chapter 4731. of the Revised Code.

~~(113)~~(118) "Positive pressure respirator" means a respirator in which the pressure inside the respiratory inlet covering exceeds the ambient air pressure outside the respirator.

(119) "Positron Emission Tomography (PET) radionuclide production facility" means a facility operating a cyclotron or accelerator for the purpose of producing PET radionuclides.

~~(114)~~(120) "Powered air-purifying respirator" or "PAPR" means an air-purifying respirator that uses a blower to force the ambient air through air purifying elements to the inlet covering.

~~(115)~~(121) "Pressure demand respirator" means a positive pressure atmosphere supplying respirator that admits breathing air to the facepiece when the positive pressure is reduced inside the facepiece by inhalation.

~~(116)~~(122) "Public dose" means the dose received by a member of the public from exposure to radiation and/or radioactive material released by the licensee, or to any other source of radiation under the control of a licensee or registrant. Public dose does not include occupational dose or doses received from background radiation, from any medical administration the individual has received, from exposures to individuals administered radioactive materials and released in accordance with rule 3701:1-58-30 of the Administrative Code or equivalent United States nuclear regulatory commission or agreement state regulations, or from voluntary participation in medical research programs.

~~(117)~~(123) "Pyrophoric material" means any liquid that ignites spontaneously in dry or moist air at or below 54.4 degrees celsius (one hundred thirty degrees fahrenheit). A pyrophoric solid is 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 as to create a serious transportation, handling, or disposal hazard. Included are spontaneously combustible and water-reactive materials.

~~(118)~~(124) "Qualitative fit test" or "QLFT" means a pass/fail fit test to assess the adequacy of respirator fit that relies on the individual's response to the test agent.

~~(119)~~(125) "Quality factor" or "Q" means the modifying factor, as listed in paragraphs (A) and (B) of rule 3701:1-38-11 of the Administrative Code, that is used to derive dose equivalent from absorbed dose.

~~(120)~~(126) "Quantitative fit test" or "QNFT" means an assessment of the adequacy of respirator fit by numerically measuring the amount of leakage into the respirator.

~~(121)~~(127) "Quarter" or "quarterly" means a period of time equal to one-fourth of the year observed by the licensee or registrant, approximately thirteen consecutive weeks, providing that the beginning of the first quarter in a year coincides with the starting date of the year and that no day is omitted or duplicated in consecutive quarters.

~~(122)~~(128) "Rad" means the special unit of radiation absorbed dose. One rad is equal to an absorbed dose of one hundred ergs per gram, or 0.01 joule per kilogram, or 0.01 gray.

~~(123)~~(129) "Radiation" or "ionizing radiation" means alpha particles, beta particles, gamma rays, x-rays, neutrons, high speed electrons, high speed protons, and other particles capable of producing ions. Radiation does not include nonionizing radiation, such as radio or microwaves, or visible, infrared or ultraviolet light.

~~(124)~~(130) "Radiation area" means an area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.05 millisievert (0.005 rem) in one hour at thirty centimeters from the source of radiation or from any surface that the radiation penetrates.

~~(125)~~(131) "Radiation-generating equipment" or "RGE" means any manufactured product or device, or component of such a product or device, or any machine or system that during operation can generate or emit radiation, except those that emit radiation only from radioactive material. "Radiation-generating equipment" does not include either of the following:

(a) Diathermy machines;

(b) Microwave ovens, including food service microwave ovens used for commercial and industrial uses, television receivers, electric lamps, and other household appliances and products that generate very low levels of radiation.

~~(126)~~(132) "Radiation Safety Officer" or "RSO" means an individual designated by the licensee who has the knowledge and responsibility for the overall radiation safety program at the facility, to include the implementation of the daily radiation safety operations and compliance with the rules.

~~(127)~~(133) "Radioactive material" means any solid, liquid or gaseous material that emits ionizing radiation spontaneously. "Radioactive material" includes accelerator-produced and naturally occurring radioactive materials and byproduct, source, and special nuclear material.

~~(128)~~(134) "Radioactive waste" means waste containing regulated radioactive material.

~~(129)~~(135) "Radioactivity" means the transformation of unstable atoms by the emission of radiation.

~~(130)~~(136) "Radiography" means the same as industrial radiography.

~~(131)~~(137) "Reference man" means a hypothetical aggregation of human physical and physiological characteristics arrived at 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.

~~(132)~~(138) "Registrant" means a person required by Chapter 3748. of the Revised Code to register radiation-generating equipment with the director.

~~(133)~~(139) "Rem" means the special unit of any of the quantities expressed as dose equivalent. The dose equivalent in rem is equal to the absorbed dose in rads multiplied by the quality factor (one rem = 0.01 Sv).

~~(134)~~(140) "Research and development" means

(a) Theoretical analysis, exploration, or experimentation; or

(b) 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 sources of radiation to human beings.

~~(135)~~(141) "Residual radioactivity" means radioactivity in structures, materials, soils, groundwater, and other media at a site resulting from activities under the 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 remaining at the site as a result of routine or accidental releases of radioactive material at the site and previous burials at the site, even if those burials were made in accordance with the provisions of 10 C.F.R. 20 (as published in the January 1, 2006, Code of Federal Regulations).

~~(136)~~(142) "Respiratory protective equipment or device" means an apparatus, such as a respirator, used to reduce the individual's intake of airborne radioactive materials.

~~(137)~~(143) "Restricted area" means an area access to which is limited by the licensee or registrant for the purpose of protecting individuals against undue risks from exposure to sources of radiation. Restricted area does not include areas used as residential quarters, but separate rooms in a residential building may be set apart as a restricted area.

~~(138)~~(144) "Roentgen" means the amount of gamma or x-rays required to produce ions resulting in a charge of 0.000258 coulombs per kilogram of air under standard conditions.

~~(139)~~(145) "Sanitary sewerage" means a system of public sewers for carrying off wastewater and refuse, but excluding sewage treatment facilities, septic tanks, and leach fields owned or operated by the licensee.

~~(140)~~(146) "Sealed source" means radioactive material that is encased in a manner designed to prevent leakage or escape of the radioactive material.

~~(141)~~(147) "Sealed source and device registry" means the national registry that contains all the registration certificates, generated by both the United States nuclear regulatory commission and the agreement states, that summarize the radiation safety information for the sealed sources and devices and describe the licensing and use conditions approved for the product.

~~(142)~~(148) "Seismic area" means any area where the probability of a horizontal acceleration in rock of more than 0.3 times the acceleration of gravity in two hundred fifty years is greater than ten per cent, as designated by the United States geological survey.

~~(143)~~(149) "Self-contained breathing apparatus" or "SCBA" means an atmosphere-supplying respirator for which the breathing air source is designed to be carried by the user.

~~(144)~~(150) "Shallow dose equivalent" or "H_S" means the external exposure of the skin of the whole body or the skin of an extremity, is taken as the dose equivalent at a tissue depth of 0.007 centimeter, or seven milligrams per square centimeter.

~~(145)~~(151) "Sievert" or "Sv" means the SI unit of any of the quantities expressed as dose equivalent. The dose equivalent in sieverts is equal to the absorbed dose in grays multiplied by the quality factor. One sievert equals one hundred rem.

~~(146)~~(152) "Site area emergency" means events may occur, are in progress, or have occurred that could lead to a significant release of radioactive material and that could require a response by off-site response organizations to protect persons off-site.

~~(147)~~(153) "Site boundary" means that line beyond which the land or property is not owned, leased, or otherwise controlled by the licensee or registrant.

~~(148)~~(154) "Site closure and stabilization" means those actions that are taken upon completion of operations that prepare a disposal site for custodial care and that assure that the disposal site will remain stable and will not need ongoing active maintenance.

~~(149)~~(155) "Source material" means uranium, thorium, or any combination thereof in any physical or chemical form, or any ores that contain by weight at least one-twentieth of one per cent (0.05 per cent) of uranium, thorium, or any combination thereof. Source material does not include special nuclear material.

~~(150)~~(156) "Sources of radiation" means radioactive material or radiation generating equipment.

~~(151)~~(157) "Special form radioactive material" means radioactive material that satisfies the following conditions:

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

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

(c) It satisfies the test requirements specified by the United States nuclear regulatory commission in 10 C.F.R. 71.75 (as published in the January 1, 2006, Code of Federal Regulations). A special form encapsulation designed in accordance with the United States nuclear regulatory commission requirements identified in 10 C.F.R. 71.4, in effect on June 30, 1983, and constructed prior to July 1, 1985, and a special form encapsulation designed in accordance with the requirements of 10 C.F.R. 71.4 in effect on March 31, 1996, and constructed before April 1, 1998, may continue to be used. Any other special form encapsulation must meet the specifications of this definition.

~~(152)~~(158) "Special nuclear material" means either of the following:

(a) Plutonium, uranium-233, uranium enriched in the isotope 233, or in the isotope 235, and any other material that the United States nuclear regulatory commission determines to be special nuclear material, but does not include source material pursuant to section 51 of the "Atomic Energy Act of 1954," 68 Stat 919, 42 USCA 2071.

(b) Any material artificially enriched by any of the foregoing but does not include source material.

~~(153)~~(159) "Special nuclear material in quantities not sufficient to form a critical mass" means uranium enriched in the isotope uranium-235 in quantities not exceeding three hundred fifty grams of contained uranium-235; uranium-233 in quantities not exceeding two hundred grams; plutonium in quantities not exceeding two hundred 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 unity. For example, the following quantities in combination would not exceed the limitation and are within the formula:

~~(154)~~(160) "Stochastic effect" means health effects that occur randomly and for which the probability of the effect occurring, rather than its severity, is assumed

to be a linear function of dose without threshold. Hereditary effects and cancer incidence are examples of stochastic effects.

~~(155)~~(161) "Supplied-air respirator" or "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.

~~(156)~~(162) "Surface contaminated object" or "SCO" means a solid object that is not itself classed as radioactive material, but which has radioactive material distributed on any of its surfaces. SCO must be in one of two groups with surface activity not exceeding the following limits:

(a) SCO-I: a solid object on which:

(i) The non-fixed contamination on the accessible surface averaged over three hundred square centimeters, or the area of the surface if less than three hundred square centimeters, does not exceed four becquerels per square centimeter (10^{-4} microcurie per square centimeter) for beta and gamma and low toxicity alpha emitters, or 0.4 becquerels per square centimeter 10^{-5} microcurie per square centimeter) for all other alpha emitters;

(ii) The fixed contamination on the accessible surface averaged over three hundred square centimeters, or the area of the surface if less than three hundred square centimeters, does not exceed forty thousand becquerels per square centimeter (one microcurie per square centimeter) for beta and gamma and low toxicity alpha emitters, or four thousand becquerels per square centimeter (0.1 microcurie per square centimeter) for all other alpha emitters; and

(iii) The non-fixed contamination plus the fixed contamination on the inaccessible surface averaged over three hundred square centimeters, or the area of the surface if less than three hundred square centimeters, does not exceed forty thousand becquerels per square centimeter (one microcurie per square centimeter) for beta and gamma and low toxicity alpha emitters, or four thousand becquerels per square centimeter (0.1 microcurie per square centimeter) for all other alpha emitters.

(b) SCO-II: a solid object on which the limits for SCO-I are exceeded and on which:

(i) The non-fixed contamination on the accessible surface averaged over three hundred square centimeters, or the area of the surface if less than three hundred square centimeter, does not exceed four hundred becquerels per square centimeter (10^{-2} microcurie per square centimeter) for beta and gamma and low toxicity alpha emitters, or

forty becquerels per square centimeter (10^{-3} microcurie per square centimeter) for all other alpha emitters;

(ii) The fixed contamination on the accessible surface averaged over three hundred square centimeters, or the area of the surface if less than three hundred square centimeters, does not exceed eight hundred thousand becquerels per square centimeter (twenty microcuries per square centimeter) for beta and gamma and low toxicity alpha emitters, or eighty thousand becquerels per square centimeter (two microcuries per square centimeter) for all other alpha emitters; and

(iii) The non-fixed contamination plus the fixed contamination on the inaccessible surface averaged over three hundred square centimeters, or the area of the surface if less than three hundred square centimeters, does not exceed eight hundred thousand becquerels per square centimeter (twenty microcuries per square centimeter) for beta and gamma and low toxicity alpha emitters, or eighty thousand becquerels per square centimeter (two microcuries per square centimeter) for all other alpha emitters.

~~(157)~~(163) "Survey" means an evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal or presence of radioactive material or other sources of radiation. When appropriate, such an evaluation includes a physical survey of the location of radioactive material, or the sources of radiation and measurements or calculations of levels of radiation, or concentrations or quantities of radioactive material present.

~~(158)~~(164) "Tight-fitting facepiece" means a respiratory inlet covering that forms a complete seal with the face.

~~(159)~~(165) "Total effective dose equivalent" or "TEDE" means the sum of the effective dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

~~(160)~~(166) "Transport index" means the dimensionless number, rounded up to the next tenth, placed on the label of a package, to designate the degree of control to be exercised by the carrier during transportation. The transport index is the number determined by multiplying the maximum radiation level in millisievert per hour at one meter (3.3 feet) from the external surface of the package by one hundred, which is equivalent to the maximum radiation level in millirem per hour at one meter (3.3 feet).

~~(161)~~(167) "Type A quantity" means a quantity of radioactive material, the aggregate radioactivity of which does not exceed A_1 for special form radioactive material, or A_2 for normal form radioactive material, where A_1 and A_2 are given in rule 3701:1-50-25 of the Administrative Code.

~~(162)~~(168) "Type B quantity" means a quantity of radioactive material greater than a type A quantity.

~~(163)~~(169) "Type B package" is defined under "Package."

~~(164)~~(170) "United States department of energy" means the department of energy established by the Department of Energy Organization Act, PL 95-91, August 4, 1977, 91 Stat. 565, 42 U.S.C. 7101 et seq., to the extent that the department of energy or its duly authorized representatives, exercises functions formerly vested in the United States atomic energy commission, its chairman, members, officers and components and transferred to the United States energy research and development administration and to the administrator thereof pursuant to Sections 104(b), (c) and (d) of the Energy Reorganization Act of 1974 (PL 93-438, 88 Stat. 1233 at 1237, 42 U.S.C. 5814) and retransferred to the secretary of energy pursuant to Section 301(a) of the Department of Energy Organization Act (PL 95-91, 91 Stat. 565 at 577-578, 42 U.S.C. 7151).

~~(165)~~(171) "Unrestricted area" or "uncontrolled area" means any area, access to which is neither restricted nor controlled by the licensee or registrant.

~~(166)~~(172) "User seal check" or "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.

~~(167)~~(173) "Very 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 an absorbed dose in excess of five gray (five hundred rad) in one hour at one meter from a source of radiation or from any surface that the radiation penetrates. At very high doses received at high dose rates, units of absorbed dose, gray and rad, are appropriate, rather than units of dose equivalent, sievert and rem.

~~(168)~~(174) "Veterinarian" means an individual licensed by the state of Ohio to practice veterinary medicine pursuant to Chapter 4741. of the Revised Code.

(175) "Waste" means those low-level radioactive wastes containing source, special nuclear, or byproduct material that are acceptable for disposal in a land disposal facility. For the purposes of this definition, low-level radioactive waste means radioactive waste not classified as high-level radioactive waste, transuranic waste, spent nuclear fuel, or byproduct material as defined in paragraphs (A)(26)(b), (A)(26)(c), and (A)(26)(d) of this rule.

~~(169)~~(176) "Week" means seven consecutive days starting on Sunday.

~~(170)~~(177) "Weighting factor - W_T" for an organ or tissue, (T), is 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:

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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 on a case-by-case basis until such time as specific guidance is issued.

~~(171)~~(178) "Whole body" means for purposes of external exposure, head; trunk, including male gonads; arms above the elbow; legs above the knee.

~~(172)~~(179) "Worker" means an individual engaged in activities licensed or registered by the department and controlled by a licensee or registrant, but does not include the licensee or registrant.

~~(173)~~(180) "Working level" or "WL" means any combination of short-lived radon decay products (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) in one liter of air that will result in the ultimate emission of 1.3 x 10^5 million electron volts alpha particle energy.

~~(174)~~(181) "Working level month" or "WLM" means a cumulative exposure to one working level for one hundred seventy hours. (Two thousand working hours per year/twelve months per year equals approximately one hundred seventy hours per month.)

~~(175)~~(182) "Year" means the period of time beginning in January used to determine compliance with the provisions of this rule. 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.

(B) The terms set out in paragraph (A) of this rule may be redefined in other chapters as promulgated pursuant to Chapter 3748. of the Revised Code as used in that chapter only.

Appendix C

Annual Limits on Intake (ALIs) and Derived Air Concentrations (DACs) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sewerage

Atomic No.	Nuclide	Class	Table I. Occupational Values			Table II. Effluent Concentrations		Table III. Releases to Sewers
			Oral Ingestion ALI (µCi)	Inhalation ALI (µCi)	DAC (µCi)	Air (µCi/mL)	Water (µCi/mL)	Monthly Average Conc. (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 a/: 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 Be-7	1E+3 LLI wall (1E+3)	2E+2	6E-8	2E-10	-	-
				-	-	-	2E-5	2E-4
		Y, see Be-7	-	1E+1	6E-9	2E-11	-	-
6	Carbon-11	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
7	Nitrogen-13 b/	Submersion a/	-	-	4E-6	2E-8	-	-
8	Oxygen-15 b/	Submersion a/	-	-	4E-6	2E-8	-	-
9	Flourine-18 b/	D, fluorides of H, Li, Na, K, Rb, Cs, and Fr	5E+4 St wall (5E+4)	7E+4	3E-5	1E-7	-	-
				-	-	-	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	-	-

Atomic No.	Nuclide	Class	Table I. Occupational Values			Table II. Effluent Concentrations		Table III. Releases to Sewers
			Oral Ingestion ALI (µCi)	Inhalation ALI (µCi)	DAC (µCi)	Air (µCi/mL)	Water (µCi/mL)	Monthly Average Conc. (µCi/mL)
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 LLI wall (3E+3)	3E+3 -	1E-6 -	4E-9 -	- 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 b/	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 W, oxides, hydroxides, carbides, halides, and nitrates Y, SrTi0	3E+2 - -	1E+1 3E+1 6E+0	5E-9 1E-8 2E-9	2E-11 4E-11 8E-12	4E-6 - -	4E-5 - -
22	Titanium-45	D, see Ti-44 W, see Ti-44 Y, see Ti-44	9E+3 - -	3E+4 4E+4 3E+4	1E-5 1E-5 1E-5	3E-8 5E-8 4E-8	1E-4 - -	1E-3 - -
23	Vanadium-47 b/	D, all compounds except those given for W W, oxides, hydroxides, carbides, and halides	3E+4 St wall (3E+4) -	8E+4 1E+5	3E-5 4E-5	1E-7 1E-7	- 4E-4 -	- 4E-3 -
23	Vanadium-48	D, see V-47 W, see V-47	6E+2 -	1E+3 6E+2	5E-7 3E-7	2E-9 9E-10	9E-6 -	9E-5 -
23	Vanadium-49	D, see V-47 W, see V-47	7E+4 LLI wall (9E+4) -	3E+4 Bone surf (3E+4) 2E+4	1E-5 8E-6	- 5E-8 2E-8	- 1E-3 -	- 1E-2 -
24	Chromium-48	D, all compounds except those given for W and Y W, halides and nitrates Y, oxides and hydroxides	6E+3 - -	1E+4 7E+3 7E+3	5E-6 3E-6 3E-6	2E-8 1E-8 1E-8	8E-5 - -	8E-4 - -
24	Chromium-49 b/	D, see Cr-48 W, see Cr-48 Y, see Cr-48	3E+4 - -	8E+4 1E+5 9E+4	4E-5 4E-5 4E-5	1E-7 1E-7 1E-7	4E-4 - -	4E-3 - -
24	Chromium-51	D, see Cr-48 W, see Cr-48 Y, see Cr-48	4E+4 - -	5E+4 2E+4 2E+4	2E-5 1E-5 8E-6	6E-8 3E-8 3E-8	5E-4 - -	5E-3 - -
25	Manganese-51 b/	D, all compounds except those given for W W, oxides, hydroxides, halides, and nitrates	2E+4 -	5E+4 6E+4	2E-5 3E-5	7E-8 8E-8	3E-4 -	3E-3 -
25	Manganese-52m b/	D, see Mn-51 W, see Mn-51	3E+4 St wall (4E+4) -	9E+4 1E+5	4E-5 1 4E-5	E-7 1E-7	- 5E-4 -	- 5E-3 -
25	Manganese-52	D, see Mn-51 W, see Mn-51	7E+2 -	1E+3 9E+2	5E-7 4E-7	2E-9 1E-9	1E-5 -	1E-4 -
25	Manganese-53	D, see Mn-51 W, see Mn-51	5E+4 - -	1E+4 Bone surf (2E+4) 1E+4	5E-6 - 5E-6	- 3E-8 2E-8	7E-4 - -	7E-3 - -

Atomic No.	Nuclide	Class	Table I. Occupational Values			Table II. Effluent Concentrations		Table III. Releases to Sewers
			Oral Ingestion ALI (µCi)	Inhalation ALI (µCi)	DAC (µCi)	Air (µCi/mL)	Water (µCi/mL)	Monthly Average Conc. (µCi/mL)
28	Nickel-63	D, see Ni-56	9E+3	2E+3	7E-7	2E-9	1E-4	1E-3
		W, see Ni-56	-	3E+3	1E-6	4E-9	-	-
		Vapor	-	8E+2	3E-7	1E-9	-	-
28	Nickel-65	D, see Ni-56	8E+3	2E+4	1E-5	3E-8	1E-4	1E-3
		W, see Ni-56	-	3E+4	1E-5	4E-8	-	-
		Vapor	-	2E+4	7E-6	2E-8	-	-
28	Nickel-66	D, see Ni-56	4E+2 LLI wall (5E+2)	2E+3 -	7E-7 -	2E-9 -	- 6E-6	- 6E-5
		W, see Ni-56	-	6E+2	3E-7	9E-10	-	-
		Vapor	-	3E+3	1E-6	4E-9	-	-
29	Copper-60 b/	D, all compounds except those given for W and Y	3E+4 St wall (3E+4)	9E+4 -	4E-5 -	1E-7 -	- 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 Cu-60	1E+4	3E+4	1E-5	4E-8	2E-4	2E-3
		W, see Cu-60	-	4E+4	2E-5	6E-8	-	-
		Y, see Cu-60	-	4E+4	1E-5	5E-8	-	-
29	Copper-64	D, see Cu-60	1E+4	3E+4	1E-5	4E-8	2E-4	2E-3
		W, see Cu-60	-	2E+4	1E-5	3E-8	-	-
		Y, see Cu-60	-	2E+4	9E-6	3E-8	-	-
29	Copper-67	D, see Cu-60	5E+3	8E+3	3E-6	1E-8	6E-5	6E-4
		W, see Cu-60	-	5E+3	2E-6	7E-9	-	-
		Y, see Cu-60	-	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 b/	Y, all compounds	2E+4 St wall (3E+4)	7E+4 -	3E-5 -	9E-8 -	- 3E-4	- 3E-3
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 b/	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 b/	D, all compounds except those given for W	5E+4 St wall (6E+4)	2E+5 -	7E-5 -	2E-7 -	- 9E-4	- 9E-3
		W, oxides, hydroxides, carbides, halides, and nitrates	-	2E+5	8E-5	3E-7	-	-
31	Gallium-66	D, see Ga-65	1E+3	4E+3	1E-6	5E-9	1E-5	1E-4
		W, see Ga-65	-	3E+3	1E-6	4E-9	-	-
31	Gallium-67	D, see Ga-65	7E+3	1E+4	6E-6	2E-8	1E-4	1E-3
		W, see Ga-65	-	1E+4	4E-6	1E-8	-	-
31	Gallium-68 b/	D, see Ga-65	2E+4	4E+4	2E-5	6E-8	2E-4	2E-3
		W, see Ga-65	-	5E+4	2E-5	7E-8	-	-
31	Gallium-70 b/	D, see Ga-65	5E+4 St wall (7E+4)	2E+5 -	7E-5 -	2E-7 -	- 1E-3	- 1E-2
		W, see Ga-65	-	2E+5	8E-5	3E-7	-	-
31	Gallium-72	D, see Ga-65	1E+3	4E+3	1E-6	5E-9	2E-5	2E-4
		W, see Ga-65	-	3E+3	1E-6	4E-9	-	-

Atomic No.	Nuclide	Class	Table I. Occupational Values			Table II. Effluent Concentrations		Table III. Releases to Sewers
			Oral Ingestion ALI (µCi)	Inhalation ALI (µCi)	DAC (µCi)	Air (µCi/mL)	Water (µCi/mL)	Monthly Average Conc. (µCi/mL)
34	Selenium-83 b/	D, see Se-70	4E+4	1E+5	5E-5	2E-7	4E-4	4E-3
		W, see Se-70	3E+4	1E+5	5E-5	2E-7	-	-
35	Bromine-74m b/	D, bromides of H, Li, Na, K, Rb, Cs, and Fr	1E+4 St wall (2E+4)	4E+4 -	2E-5 -	5E-8 -	- 3E-4	- 3E-3
		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 b/	D, see Br-75m	2E+4 St wall (4E+4)	7E+4 -	3E-5 -	1E-7 -	- 5E-4	- 5E-3
		W, see Br-75m	-	8E+4	4E-5	1E-7	-	-
35	Bromine-75 b/	D, see Br-75m	3E+4 St wall (4E+4)	5E+4 -	2E-5 -	7E-8 -	- 5E-4	- 5E-3
		W, see Br-75m	-	5E+4	2E-5	7E-8	-	-
35	Bromine-76	D, see Br-75m	4E+3	5E+3	2E-6	7E-9	5E-5	5E-4
		W, see Br-75m	-	4E+3	2E-6	6E-9	-	-
35	Bromine-77	D, see Br-75m	2E+4	2E+4	1E-5	3E-8	2E-4	2E-3
		W, see Br-75m	-	2E+4	8E-6	3E-8	-	-
35	Bromine-80m	D, see Br-75m	2E+4	2E+4	7E-6	2E-8	3E-4	3E-3
		W, see Br-75m	-	1E+4	6E-6	2E-8	-	-
35	Bromine-80 b/	D, see Br-75m	5E+4 St wall (9E+4)	2E+5 -	8E-5 -	3E-7 -	- 1E-3	- 1E-2
		W, see Br-75m	-	2E+5	9E-5	3E-7	-	-
35	Bromine-82	D, see Br-75m	3E+3	4E+3	2E-6	6E-9	4E-5	4E-4
		W, see Br-75m	-	4E+3	2E-6	5E-9	-	-
35	Bromine-83	D, see Br-75m	5E+4 St wall (7E+4)	6E+4 -	3E-5 -	9E-8 -	- 9E-4	- 9E-3
		W, see Br-75m	-	6E+4	3E-5	9E-8	-	-
35	Bromine-84 b/	D, see Br-75m	2E+4 St wall (3E+4)	6E+4 -	2E-5 -	8E-8 -	- 4E-4	- 4E-3
		W, see Br-75m	-	6E+4	3E-5	9E-8	-	-
36	Krypton-74 b/	Submersion a/	-	-	3E-6	1E-8	-	-
36	Krypton-76	Submersion a/	-	-	9E-6	4E-8	-	-
36	Krypton-77 b/	Submersion a/	-	-	4E-6	2E-8	-	-
36	Krypton-79	Submersion a/	-	-	2E-5	7E-8	-	-
36	Krypton-81	Submersion a/	-	-	7E-4	3E-6	-	-
36	Krypton-83m b/	Submersion a/	-	-	1E-2	5E-5	-	-
36	Krypton-85m	Submersion a/	-	-	2E-5	1E-7	-	-
36	Krypton-85	Submersion a/	-	-	1E-4	7E-7	-	-
36	Krypton-87 b/	Submersion a/	-	-	5E-6	2E-8	-	-
36	Krypton-88	Submersion a/	-	-	2E-6	9E-9	-	-
37	Rubidium-79 b/	D, all compounds	4E+4 St wall (6E+4)	1E+5 -	5E-5 -	2E-7 -	- 8E-4	- 8E-3
37	Rubidium-81m b/	D, all compounds	2E+5 St wall (3E+5)	3E+5 -	1E-4 -	5E-7 -	- 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

Atomic No.	Nuclide	Class	Table I. Occupational Values			Table II. Effluent Concentrations		Table III. Releases to Sewers
			Oral Ingestion ALI (µCi)	Inhalation ALI (µCi)	DAC (µCi)	Air (µCi/mL)	Water (µCi/mL)	Monthly Average Conc. (µCi/mL)
39	Yttrium-91	W, see Y-86m	5E+2 LLI wall (6E+2)	2E+2 -	7E-8 -	2E-10 -	- 8E-6	- 8E-5
		Y, see Y-86m	-	1E+2	5E-8	2E-10	-	-
39	Yttrium-92	W, see Y-86m	3E+3	9E+3	4E-6	1E-8	4E-5	4E-4
		Y, see Y-86m	-	8E+3	3E-6	1E-8	-	-
39	Yttrium-93	W, see Y-86m	1E+3	3E+3	1E-6	4E-9	2E-5	2E-4
		Y, see Y-86m	-	2E+3	1E-6	3E-9	-	-
39	Yttrium-94 b/	W, see Y-86m	2E+4 St wall (3E+4)	8E+4 -	3E-5 -	1E-7 -	- 4E-4	- 4E-3
		Y, see Y-86m	-	8E+4	3E-5	1E-7	-	-
39	Yttrium-95 b/	W, see Y-86m	4E+4 St wall (5E+4)	2E+5 -	6E-5 -	2E-7 -	- 7E-4	- 7E-3
		Y, see Y-86m	-	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 Zr-86	4E+3	2E+2	9E-8	3E-10	5E-5	5E-4
		W, see Zr-86	-	5E+2	2E-7	7E-10	-	-
		Y, see Zr-86	-	3E+2	1E-7	4E-10	-	-
40	Zirconium-89	D, see Zr-86	2E+3	4E+3	1E-6	5E-9	2E-5	2E-4
		W, see Zr-86	-	2E+3	1E-6	3E-9	-	-
		Y, see Zr-86	-	2E+3	1E-6	3E-9	-	-
40	Zirconium-93	D, see Zr-86	1E+3 Bone surf (3E+3)	6E+0 Bone surf (2E+1)	3E-9 -	- 2E-11	- 4E-5	- 4E-4
		W, see Zr-86	- -	2E+1 Bone surf (6E+1)	1E-8 -	- 9E-11	- -	- -
		Y, see Zr-86	- -	6E+1 Bone surf (7E+1)	2E-8 -	- 9E-11	- -	- -
40	Zirconium-95	D, see Zr-86	1E+3 -	1E+2 Bone surf (3E+2)	5E-8 -	- 4E-10	2E-5 -	2E-4 -
		W, see Zr-86	-	4E+2	2E-7	5E-10	-	-
		Y, see Zr-86	-	3E+2	1E-7	4E-10	-	-
40	Zirconium-97	D, see Zr-86	6E+2	2E+3	8E-7	3E-9	9E-6	9E-5
		W, see Zr-86	-	1E+3	6E-7	2E-9	-	-
		Y, see Zr-86	-	1E+3	5E-7	2E-9	-	-
41	Niobium-88 b/	W, all compounds except those given for Y	5E+4 St wall (7E+4)	2E+5 -	9E-5 -	3E-7 -	- 1E-3	- 1E-2
		Y, oxides and hydroxides	-	2E+5	9E-5	3E-7	-	-
41	Niobium-89 b/ (66 min)	W, see Nb-88	1E+4	4E+4	2E-5	6E-8	1E-4	1E-3
		Y, see Nb-88	-	4E+4	2E-5	5E-8	-	-
41	Niobium-89 (122 min)	W, see Nb-88	5E+3	2E+4	8E-6	3E-8	7E-5	7E-4
		Y, see Nb-88	-	2E+4	6E-6	2E-8	-	-

Atomic No.	Nuclide	Class	Table I. Occupational Values			Table II. Effluent Concentrations		Table III. Releases to Sewers
			Oral Ingestion ALI (µCi)	Inhalation ALI (µCi)	DAC (µCi)	Air (µCi/mL)	Water (µCi/mL)	Monthly Average Conc. (µCi/mL)
43	Technetium-96	D, see Tc-93m	2E+3	3E+3	1E-6	5E-9	3E-5	3E-4
		W, see Tc-93m	-	2E+3	9E-7	3E-9	-	-
43	Technetium-97m	D, see Tc-93m	5E+3	7E+3 St wall (7E+3)	3E-6	- 1E-8	6E-5 -	6E-4 -
		W, see Tc-93m	-	1E+3	5E-7	2E-9	-	-
43	Technetium-97	D, see Tc-93m	4E+4	5E+4	2E-5	7E-8	5E-4	5E-3
		W, see Tc-93m	-	6E+3	2E-6	8E-9	-	-
43	Technetium-98	D, see Tc-93m	1E+3	2E+3	7E-7	2E-9	1E-5	1E-4
		W, see Tc-93m	-	3E+2	1E-7	4E-10	-	-
43	Tchnetium-99m	D, see Tc-93m	8E+4	2E+5	6E-5	2E-7	1E-3	1E-2
		W, see Tc-93m	-	2E+5	1E-4	3E-7	-	-
43	Technetium-99	D, see Tc-93m	4E+3	5E+3 St wall (6E+3)	2E-6	- 8E-9	6E-5 -	6E-4 -
		W, see Tc-93m	-	7E+2	3E-7	9E-10	-	-
43	Technetium-101 b/	D, see Tc-93m	9E+4 St wall (1E+5)	3E+5 -	1E-4 -	5E-7 -	- 2E-3	- 2E-2
		W, see Tc-93m	-	4E+5	2E-4	5E-7	-	-
43	Technetium-104 b/	D, see Tc-93m	2E+4 St wall (3E+4)	7E+4 -	3E-5 -	1E-7 -	- 4E-4	- 4E-3
		W, see Tc-93m	-	9E+4	4E-5	1E-7	-	-
44	Ruthenium-94 b/	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 Ru-94	8E+3	2E+4	8E-6	3E-8	1E-4	1E-3
		W, see Ru-94	-	1E+4	5E-6	2E-8	-	-
		Y, see Ru-94	-	1E+4	5E-6	2E-8	-	-
44	Ruthenium-103	D, see Ru-94	2E+3	2E+3	7E-7	2E-9	3E-5	3E-4
		W, see Ru-94	-	1E+3	4E-7	1E-9	-	-
		Y, see Ru-94	-	6E+2	3E-7	9E-10	-	-
44	Ruthenium-105	D, see Ru-94	5E+3	1E+4	6E-6	2E-8	7E-5	7E-4
		W, see Ru-94	-	1E+4	6E-6	2E-8	-	-
		Y, see Ru-94	-	1E+4	5E-6	2E-8	-	-
44	Ruthenium-106	D, see Ru-94	2E+2 LLI wall (2E+2)	9E+1 -	4E-8 -	1E-10 -	- 3E-6	- 3E-5
		W, see Ru-94	-	5E+1	2E-8	8E-11	-	-
		Y, see Ru-94	-	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 Rh-99m	2E+3	3E+3	1E-6	4E-9	3E-5	3E-4
		W, see Rh-99m	-	2E+3	9E-7	3E-9	-	-
		Y, see Rh-99m	-	2E+3	8E-7	3E-9	-	-

Atomic No.	Nuclide	Class	Table I. Occupational Values			Table II. Effluent Concentrations		Table III. Releases to Sewers
			Oral Ingestion ALI (µCi)	Inhalation ALI (µCi)	DAC (µCi)	Air (µCi/mL)	Water (µCi/mL)	Monthly Average Conc. (µCi/mL)
46	Palladium-107	D, see Pd-100	3E+4 LLI wall (4E+4)	2E+4 Kidneys (2E+4)	9E-6 -	- 3E-8	- 5E-4	- 5E-3
		W, see Pd-100	-	7E+3	3E-6	1E-8	-	-
		Y, see Pd-100	-	4E+2	2E-7	6E-10	-	-
46	Palladium-109	D, see Pd-100	2E+3	6E+3	3E-6	9E-9	3E-5	3E-4
		W, see Pd-100	-	5E+3	2E-6	8E-9	-	-
		Y, see Pd-100	-	5E+3	2E-6	6E-9	-	-
47	Silver-102 b/	D, all compounds except those given for W and Y	5E+4 St wall (6E+4)	2E+5 -	8E-5 -	2E-7 -	- 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 b/	D, see Ag-102	4E+4	1E+5	4E-5	1E-7	5E-4	5E-3
		W, see Ag-102	-	1E+5	5E-5	2E-7	-	-
		Y, see Ag-102	-	1E+5	5E-5	2E-7	-	-
47	Silver-104m b/	D, see Ag-102	3E+4	9E+4	4E-5	1E-7	4E-4	4E-3
		W, see Ag-102	-	1E+5	5E-5	2E-7	-	-
		Y, see Ag-102	-	1E+5	5E-5	2E-7	-	-
47	Silver-104 b/	D, see Ag-102	2E+4	7E+4	3E-5	1E-7	3E-4	3E-3
		W, see Ag-102	-	1E+5	6E-5	2E-7	-	-
		Y, see Ag-102	-	1E+5	6E-5	2E-7	-	-
47	Silver-105	D, see Ag-102	3E+3	1E+3	4E-7	1E-9	4E-5	4E-4
		W, see Ag-102	-	2E+3	7E-7	2E-9	-	-
		Y, see Ag-102	-	2E+3	7E-7	2E-9	-	-
47	Silver-106m	D, see Ag-102	8E+2	7E+2	3E-7	1E-9	1E-5	1E-4
		W, see Ag-102	-	9E+2	4E-7	1E-9	-	-
		Y, see Ag-102	-	9E+2	4E-7	1E-9	-	-
47	Silver-106 b/	D, see Ag-102	6E+4 St wall (6E+4)	2E+5 -	8E-5 -	3E-7 -	- 9E-4	- 9E-3
		W, see Ag-102	-	2E+5	9E-5	3E-7	-	-
		Y, see Ag-102	-	2E+5	8E-5	3E-7	-	-
47	Silver-108m	D, see Ag-102	6E+2	2E+2	8E-8	3E-10	9E-6	9E-5
		W, see Ag-102	-	3E+2	1E-7	4E-10	-	-
		Y, see Ag-102	-	2E+1	1E-8	3E-11	-	-
47	Silver-110m	D, see Ag-102	5E+2	1E+2	5E-8	2E-10	6E-6	6E-5
		W, see Ag-102	-	2E+2	8E-8	3E-10	-	-
		Y, see Ag-102	-	9E+1	4E-8	1E-10	-	-
47	Silver-111	D, see Ag-102	9E+2 LLI wall (1E+3)	2E+3 Liver (2E+3)	6E-7 -	- 2E-9	- 2E-5	- 2E-4
		W, see Ag-102	-	9E+2	4E-7	1E-9	-	-
		Y, see Ag-102	-	9E+2	4E-7	1E-9	-	-
47	Silver-112	D, see Ag-102	3E+3	8E+3	3E-6	1E-8	4E-5	4E-4
		W, see Ag-102	-	1E+4	4E-6	1E-8	-	-
		Y, see Ag-102	-	9E+3	4E-6	1E-8	-	-

Atomic No.	Nuclide	Class	Table I. Occupational Values			Table II. Effluent Concentrations		Table III. Releases to Sewers
			Oral Ingestion ALI (µCi)	Inhalation ALI (µCi)	DAC (µCi)	Air (µCi/mL)	Water (µCi/mL)	Monthly Average Conc. (µCi/mL)
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 b/ (69.1 min)	D, see In-109	2E+4	4E+4	2E-5	6E-8	2E-4	2E-3
		W, see In-109	-	6E+4	2E-5	8E-8	-	-
49	Indium-110 (4.9 h)	D, see In-109	5E+3	2E+4	7E-6	2E-8	7E-5	7E-4
		W, see In-109	-	2E+4	8E-6	3E-8	-	-
49	Indium-111	D, see In-109	4E+3	6E+3	3E-6	9E-9	6E-5	6E-4
		W, see In-109	-	6E+3	3E-6	9E-9	-	-
49	Indium-112 b/	D, see In-109	2E+5	6E+5	3E-4	9E-7	2E-3	2E-2
		W, see In-109	-	7E+5	3E-4	1E-6	-	-
49	Indium-113m b/	D, see In-109	5E+4	1E+5	6E-5	2E-7	7E-4	7E-3
		W, see In-109	-	2E+5	8E-5	3E-7	-	-
49	Indium-114m	D, see In-109	3E+2 LLI wall (4E+2)	6E+1	3E-8	9E-11	-	-
				-	-	-	5E-6	5E-5
		W, see In-109	-	1E+2	4E-8	1E-10	-	-
49	Indium-115m	D, see In-109	1E+4	4E+4	2E-5	6E-8	2E-4	2E-3
		W, see In-109	-	5E+4	2E-5	7E-8	-	-
49	Indium-115	D, see In-109	4E+1	1E+0	6E-10	2E-12	5E-7	5E-6
		W, see In-109	-	5E+0	2E-9	8E-12	-	-
49	Indium-116m b/	D, see In-109	2E+4	8E+4	3E-5	1E-7	3E-4	3E-3
		W, see In-109	-	1E+5	5E-5	2E-7	-	-
49	Indium-117m b/	D, see In-109	1E+4	3E+4	1E-5	5E-8	2E-4	2E-3
		W, see In-109	-	4E+4	2E-5	6E-8	-	-
49	Indium-117 b/	D, see In-109	6E+4	2E+5	7E-5	2E-7	8E-4	8E-3
		W, see In-109	-	2E+5	9E-5	3E-7	-	-
49	Indium-119m b/	D, see In-109	4E+4 St wall (5E+4)	1E+5	5E-5	2E-7	-	-
				-	-	-	7E-4	7E-3
		W, see In-109	-	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 b/	D, see Sn-110	7E+4	2E+5	9E-5	3E-7	1E-3	1E-2
		W, see Sn-110	-	3E+5	1E-4	4E-7	-	-
50	Tin-113	D, see Sn-110	2E+3 LLI wall (2E+3)	1E+3	5E-7	2E-9	-	-
				-	-	-	3E-5	3E-4
		W, see Sn-110	-	5E+2	2E-7	8E-10	-	-
50	Tin-117m	D, see Sn-110	2E+3 LLI wall (2E+3)	1E+3 Bone surf (2E+3)	5E-7	-	-	-
					-	3E-9	3E-5	3E-4
		W, see Sn-110	-	1E+3	6E-7	2E-9	-	-
50	Tin-119m	D, see Sn-110	3E+3 LLI wall (4E+3)	2E+3	1E-6	3E-9	-	-
				-	-	-	6E-5	6E-4
		W, see Sn-110	-	1E+3	4E-7	1E-9	-	-

Atomic No.	Nuclide	Class	Table I. Occupational Values			Table II. Effluent Concentrations		Table III. Releases to Sewers
			Oral Ingestion ALI (µCi)	Inhalation ALI (µCi)	DAC (µCi)	Air (µCi/mL)	Water (µCi/mL)	Monthly Average Conc. (µCi/mL)
51	Antimony-125	D, see Sb-115	2E+3	2E+3	1E-6	3E-9	3E-5	3E-4
		W, see Sb-115	-	5E+2	2E-7	7E-10	-	-
51	Antimony-126m b/	D, see Sb-115	5E+4 St wall (7E+4)	2E+5 -	8E-5 -	3E-7 -	- 9E-4	- 9E-3
		W, see Sb-115	-	2E+5	8E-5	3E-7	-	-
51	Antimony-126	D, see Sb-115	6E+2	1E+3	5E-7	2E-9	7E-6	7E-5
		W, see Sb-115	5E+2	5E+2	2E-7	7E-10	-	-
51	Antimony-127	D, see Sb-115	8E+2 LLI wall (8E+2)	2E+3 -	9E-7 -	3E-9 -	- 1E-5	- 1E-4
		W, see Sb-115	7E+2	9E+2	4E-7	1E-9	-	-
51	Antimony-128 b/ (10.4 min)	D, see Sb-115	8E+4 St wall (1E+5)	4E+5 -	2E-4 -	5E-7 -	- 1E-3	- 1E-2
		W, see Sb-115	-	4E+5	2E-4	6E-7	-	-
51	Antimony-128 (9.01 h)	D, see Sb-115	1E+3	4E+3	2E-6	6E-9	2E-5	2E-4
		W, see Sb-115	-	3E+3	1E-6	5E-9	-	-
51	Antimony-129	D, see Sb-115	3E+3	9E+3	4E-6	1E-8	4E-5	4E-4
		W, see Sb-115	-	9E+3	4E-6	1E-8	-	-
51	Antimony-130 b/	D, see Sb-115	2E+4	6E+4	3E-5	9E-8	3E-4	3E-3
		W, see Sb-115	-	8E+4	3E-5	1E-7	-	-
51	Antimony-131 b/	D, see Sb-115	1E+4 Thyroid (2E+4)	2E+4 Thyroid (4E+4)	1E-5 -	- 6E-8	- 2E-4	- 2E-3
		W, see Sb-115	- -	2E+4 Thyroid (4E+4)	1E-5 -	- 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 Te-116	5E+2 Bone surf (7E+2)	2E+2 Bone surf (4E+2)	8E-8 -	- 5E-10	- 1E-5	- 1E-4
		W, see Te-116	-	4E+2	2E-7	6E-10	-	-
52	Tellurium-121	D, see Te-116	3E+3	4E+3	2E-6	6E-9	4E-5	4E-4
		W, see Te-116	-	3E+3	1E-6	4E-9	-	-
52	Tellurium-123m	D, see Te-116	6E+2 Bone surf (1E+3)	2E+2 Bone surf (5E+2)	9E-8 -	- 8E-10	- 1E-5	- 1E-4
		W, see Te-116	-	5E+2	2E-7	8E-10	-	-
52	Tellurium-123	D, see Te-116	5E+2 Bone surf (1E+3)	2E+2 Bone surf (5E+2)	8E-8 -	- 7E-10	- 2E-5	- 2E-4
		W, see Te-116	- -	4E+2 Bone surf (1E+3)	2E-7 -	- 2E-9	- -	- -
52	Tellurium-125m	D, see Te-116	1E+3 Bone surf (1E+3)	4E+2 Bone surf (1E+3)	2E-7 -	- 1E-9	- 2E-5	- 2E-4
		W, see Te-116	-	7E+2	3E-7	1E-9	-	-
52	Tellurium-127m	D, see Te-116	6E+2 -	3E+2 Bone surf (4E+2)	1E-7 -	- 6E-10	9E-6 -	9E-5 -
		W, see Te-116	-	3E+2	1E-7	4E-10	-	-

Atomic No.	Nuclide	Class	Table I. Occupational Values			Table II. Effluent Concentrations		Table III. Releases to Sewers
			Oral Ingestion ALI (µCi)	Inhalation ALI (µCi)	DAC (µCi)	Air (µCi/mL)	Water (µCi/mL)	Monthly Average Conc. (µCi/mL)
53	Iodine-128 b/	D, all compounds	4E+4 St wall (6E+4)	1E+5 -	5E-5 -	2E-7 -	- 8E-4	- 8E-3
53	Iodine-129	D, all compounds	5E+0 Thyroid (2E+1)	9E+0 Thyroid (3E+1)	4E-9 -	- 4E-11	- 2E-7	- 2E-6
53	Iodine-130	D, all compounds	4E+2 Thyroid (1E+3)	7E+2 Thyroid (2E+3)	3E-7 -	- 3E-9	- 2E-5	- 2E-4
53	Iodine-131	D, all compounds	3E+1 Thyroid (9E+1)	5E+1 Thyroid (2E+2)	2E-8 -	- 2E-10	- 1E-6	- 1E-5
53	Iodine-132m b/	D, all compounds	4E+3 Thyroid (1E+4)	8E+3 Thyroid (2E+4)	4E-6 -	- 3E-8	- 1E-4	- 1E-3
53	Iodine-132	D, all compounds	4E+3 Thyroid (9E+3)	8E+3 Thyroid (1E+4)	3E-6 -	- 2E-8	- 1E-4	- 1E-3
53	Iodine-133	D, all compounds	1E+2 Thyroid (5E+2)	3E+2 Thyroid (9E+2)	1E-7 -	- 1E-9	- 7E-6	- 7E-5
53	Iodine-134 b/	D, all compounds	2E+4 Thyroid (3E+4)	5E+4 -	2E-5 -	6E-8 -	- 4E-4	- 4E-3
53	Iodine-135	D, all compounds	8E+2 Thyroid (3E+3)	2E+3 Thyroid (4E+3)	7E-7 -	- 6E-9	- 3E-5	- 3E-4
54	Xenon-120 b/	Submersion a/	-	-	1E-5	4E-8	-	-
54	Xenon-121 b/	Submersion a/	-	-	2E-6	1E-8	-	-
54	Xenon-122	Submersion a/	-	-	7E-5	3E-7	-	-
54	Xenon-123	Submersion a/	-	-	6E-6	3E-8	-	-
54	Xenon-125	Submersion a/	-	-	2E-5	7E-8	-	-
54	Xenon-127	Submersion a/	-	-	1E-5	6E-8	-	-
54	Xenon-129m	Submersion a/	-	-	2E-4	9E-7	-	-
54	Xenon-131m	Submersion a/	-	-	4E-4	2E-6	-	-
54	Xenon-133m	Submersion a/	-	-	1E-4	6E-7	-	-
54	Xenon-133	Submersion a/	-	-	1E-4	5E-7	-	-
54	Xenon-135m b/	Submersion a/	-	-	9E-6	4E-8	-	-
54	Xenon-135	Submersion a/	-	-	1E-5	7E-8	-	-
54	Xenon-138 b/	Submersion a/	-	-	4E-6	2E-8	-	-
55	Cesium-125 b/	D, all compounds	5E+4 St wall (9E+4)	1E+5 -	6E-5 -	2E-7 -	- 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 b/	D, all compounds	6E+4 St wall (1E+5)	2E+5 -	8E-5 -	3E-7 -	- 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 St wall (1E+5)	1E+5 -	6E-5 -	2E-7 -	- 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 b/	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 b/	D, all compounds	2E+4 St wall (3E+4)	6E+4 -	2E-5 -	8E-8 -	- 4E-4	- 4E-3
56	Barium-126 b/	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 b/	D, all compounds	4E+5 St wall (5E+5)	1E+6 -	6E-4 -	2E-6 -	- 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 LLI wall (3E+3)	9E+3 -	4E-6 -	1E-8 -	- 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

Atomic No.	Nuclide	Class	Table I. Occupational Values			Table II. Effluent Concentrations		Table III. Releases to Sewers
			Oral Ingestion ALI (µCi)	Inhalation ALI (µCi)	DAC (µCi)	Air (µCi/mL)	Water (µCi/mL)	Monthly Average Conc. (µCi/mL)
58	Cerium-144	W, see Ce-134	2E+2 LLI wall (3E+2)	3E+1	1E-8	4E-11	-	-
		Y, see Ce-134	-	1E+1	6E-9	2E-11	3E-6	3E-5
59	Praseodymium-136 b/	W, all compounds except those given for Y	5E+4 St wall (7E+4)	2E+5	1E-4	3E-7	-	-
		Y, oxides, hydroxides, carbides, and fluorides	-	2E+5	9E-5	3E-7	1E-3	1E-2
59	Praseodymium-137 b/	W, see Pr-136	4E+4	2E+5	6E-5	2E-7	5E-4	5E-3
		Y, see Pr-136	-	1E+5	6E-5	2E-7	-	-
59	Praseodymium-138m	W, see Pr-136	1E+4	5E+4	2E-5	8E-8	1E-4	1E-3
		Y, see Pr-136	-	4E+4	2E-5	6E-8	-	-
59	Praseodymium-139	W, see Pr-136	4E+4	1E+5	5E-5	2E-7	6E-4	6E-3
		Y, see Pr-136	-	1E+5	5E-5	2E-7	-	-
59	Praseodymium-142m b/	W, see Pr-136	8E+4	2E+5	7E-5	2E-7	1E-3	1E-2
		Y, see Pr-136	-	1E+5	6E-5	2E-7	-	-
59	Praseodymium-142	W, see Pr-136	1E+3	2E+3	9E-7	3E-9	1E-5	1E-4
		Y, see Pr-136	-	2E+3	8E-7	3E-9	-	-
59	Praseodymium-143	W, see Pr-136	9E+2 LLI wall (1E+3)	8E+2	3E-7	1E-9	-	-
		Y, see Pr-136	-	7E+2	3E-7	9E-10	2E-5	2E-4
59	Praseodymium-144 b/	W, see Pr-136	3E+4 St wall (4E+4)	1E+5	5E-5	2E-7	-	-
		Y, see Pr-136	-	1E+5	5E-5	2E-7	6E-4	6E-3
59	Praseodymium-145	W, see Pr-136	3E+3	9E+3	4E-6	1E-8	4E-5	4E-4
		Y, see Pr-136	-	8E+3	3E-6	1E-8	-	-
59	Praseodymium-147 b/	W, see Pr-136	5E+4 St wall (8E+4)	2E+5	8E-5	3E-7	-	-
		Y, see Pr-136	-	2E+5	8E-5	3E-7	1E-3	1E-2
60	Neodymium-136 b/	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 Nd-136	2E+3	6E+3	3E-6	9E-9	3E-5	3E-4
		Y, see Nd-136	-	5E+3	2E-6	7E-9	-	-
60	Neodymium-139m	W, see Nd-136	5E+3	2E+4	7E-6	2E-8	7E-5	7E-4
		Y, see Nd-136	-	1E+4	6E-6	2E-8	-	-
60	Neodymium-139 b/	W, see Nd-136	9E+4	3E+5	1E-4	5E-7	1E-3	1E-2
		Y, see Nd-136	-	3E+5	1E-4	4E-7	-	-
60	Neodymium-141	W, see Nd-136	2E+5	7E+5	3E-4	1E-6	2E-3	2E-2
		Y, see Nd-136	-	6E+5	3E-4	9E-7	-	-
60	Neodymium-147	W, see Nd-136	1E+3 LLI wall (1E+3)	9E+2	4E-7	1E-9	-	-
		Y, see Nd-136	-	8E+2	4E-7	1E-9	2E-5	2E-4
60	Neodymium-149 b/	W, see Nd-136	1E+4	3E+4	1E-5	4E-8	1E-4	1E-3
		Y, see Nd-136	-	2E+4	1E-5	3E-8	-	-
60	Neodymium-151 b/	W, see Nd-136	7E+4	2E+5	8E-5	3E-7	9E-4	9E-3
		Y, see Nd-136	-	2E+5	8E-5	3E-7	-	-

Atomic No.	Nuclide	Class	Table I. Occupational Values			Table II. Effluent Concentrations		Table III. Releases to Sewers
			Oral Ingestion ALI (µCi)	Inhalation ALI (µCi)	DAC (µCi)	Air (µCi/mL)	Water (µCi/mL)	Monthly Average Conc. (µCi/mL)
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 Bone surf (1E+2)	4E-8 -	- 2E-10	5E-5 -	5E-4 -
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 b/	W, all compounds	2E+4	6E+4	2E-5	8E-8	3E-4	3E-4
64	Gadolinium-145 b/	D, all compounds except those given for W W, oxides, hydroxides, and fluorides	5E+4 St wall -	2E+5 2E+5	6E-5 7E-5	2E-7 2E-7	- -	- -
64	Gadolinium-146	D, see Gd-145 W, see Gd-145	1E+3 -	1E+2 3E+2	5E-8 1E-7	2E-10 4E-10	2E-5 -	2E-4 -
64	Gadolinium-147	D, see Gd-145 W, see Gd-145	2E+3 -	4E+3 4E+3	2E-6 1E-6	6E-9 5E-9	3E-5 -	3E-4 -
64	Gadolinium-148	D, see Gd-145 W, see Gd-145	1E+1 Bone surf (2E+1) - -	8E-3 Bone surf (2E-2) 3E-2 Bone surf (6E-2)	3E-12 - 1E-11 -	- 2E-14 - 8E-14	- 3E-7 - -	- 3E-6 - -
64	Gadolinium-149	D, see Gd-145 W, see Gd-145	3E+3 -	2E+3 2E+3	9E-7 1E-6	3E-9 3E-9	4E-5 -	4E-4 -
64	Gadolinium-151	D, see Gd-145 W, see Gd-145	6E+3 - -	4E+2 Bone surf (6E+2) 1E+3	2E-7 - 5E-7	- 9E-10 2E-9	9E-5 - -	9E-4 - -
64	Gadolinium-152	D, see Gd-145 W, see Gd-145	2E+1 Bone surf (3E+1) - -	1E-2 Bone surf (2E-2) 4E-2 Bone surf (8E-2)	4E-12 - 2E-11 -	- 3E-14 - 1E-13	- 4E-7 - -	- 4E-6 - -
64	Gadolinium- 153	D, see Gd-145 W, see Gd-145	5E+3 - -	1E+2 Bone surf (2E+2) 6E+2	6E-8 - 2E-7	- 3E-10 8E-10	6E-5 - -	6E-4 - -
64	Gadolinium-159	D, see Gd-145 W, see Gd-145	3E+3 -	8E+3 6E+3	3E-6 2E-6	1E-8 8E-9	4E-5 -	4E-4 -
65	Terbium-147 b/	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 LLI wall (5E+4)	3E+2 Bone surf (6E+2)	1E-7 -	- 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 LLI wall (2E+3)	2E+3 -	7E-7 -	2E-9 -	- 3E-5	- 3E-4
66	Dysprosium-155	W, all compounds	9E+3	3E+4	1E-5	4E-8	1E-4	1E-3

Atomic No.	Nuclide	Class	Table I. Occupational Values			Table II. Effluent Concentrations		Table III. Releases to Sewers
			Oral Ingestion ALI (µCi)	Inhalation ALI (µCi)	DAC (µCi)	Air (µCi/mL)	Water (µCi/mL)	Monthly Average Conc. (µCi/mL)
70	Ytterbium-177 b/	W, see Yb-162	2E+4	5E+4	2E-5	7E-8	2E-4	2E-3
		Y, see Yb-162	-	5E+4	2E-5	6E-8	-	-
70	Ytterbium-178 b/	W, see Yb-162	1E+4	4E+4	2E-5	6E-8	2E-4	2E-3
		Y, see Yb-162	-	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 Lu-169	1E+3	2E+3	9E-7	3E-9	2E-5	2E-4
		Y, see Lu-169	-	2E+3	8E-7	3E-9	-	-
71	Lutetium-171	W, see Lu-169	2E+3	2E+3	8E-7	3E-9	3E-5	3E- 4
		Y, see Lu-169	-	2E+3	8E-7	3E-9	-	-
71	Lutetium-172	W, see Lu-169	1E+3	1E+3	5E-7	2E-9	1E-5	1E-4
		Y, see Lu-169	-	1E+3	5E-7	2E-9	-	-
71	Lutetium-173	W, see Lu-169	5E+3	3E+2 Bone surf	1E-7	-	7E-5	7E-4
			-	(5E+2)	-	6E-10	-	-
		Y, see Lu-169	-	3E+2	1E-7	4E-10	-	-
71	Lutetium-174m	W, see Lu-169	2E+3 LLI wall	2E+2 Bone surf	1E-7	-	-	-
			(3E+3)	(3E+2)	-	5E-10	4E-5	4E-4
		Y, see Lu-169	-	2E+2	9E-8	3E-10	-	-
71	Lutetium-174	W, see Lu-169	5E+3	1E+2 Bone surf	5E-8	-	7E-5	7E-4
			-	(2E+2)	-	3E-10	-	-
		Y, see Lu-169	-	2E+2	6E-8	2E-10	-	-
71	Lutetium-176m	W, see Lu-169	8E+3	3E+4	1E-5	3E-8	1E-4	1E-3
		Y, see Lu-169	-	2E+4	9E-6	3E-8	-	-
71	Lutetium-176	W, see Lu-169	7E+2	5E+0 Bone surf	2E-9	-	1E-5	1E-4
			-	(1E+1)	-	2E-11	-	-
		Y, see Lu-169	-	8E+0	3E-9	1E-11	-	-
71	Lutetium-177m	W, see Lu-169	7E+2	1E+2 Bone surf	5E-8	-	1E-5	1E-4
			-	(1E+2)	-	2E-10	-	-
		Y, see Lu-169	-	8E+1	3E-8	1E-10	-	-
71	Lutetium-177	W, see Lu-169	2E+3 LLI wall	2E+3	9E-7	3E-9	-	-
			(3E+3)	-	-	-	4E-5	4E-4
		Y, see Lu-169	-	2E+3	9E-7	3E-9	-	-
71	Lutetium-178m b/	W, see Lu-169	5E+4 St wall	2E+5	8E-5	3E-7	-	-
			(6E+4)	-	-	-	8E-4	8E-3
		Y, see Lu-169	-	2E+5	7E-5	2E-7	-	-
71	Lutetium-178 b/	W, see Lu-169	4E+4 St wall	1E+5	5E-5	2E-7	-	-
			(4E+4)	-	-	-	6E-4	6E-3
		Y, see Lu-169	-	1E+5	5E-5	2E-7	-	-
71	Lutetium-179	W, see Lu-169	6E+3	2E+4	8E-6	3E-8	9E-5	9E-4
		Y, see Lu-169	-	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	-	-

Atomic No.	Nuclide	Class	Table I. Occupational Values			Table II. Effluent Concentrations		Table III. Releases to Sewers
			Oral Ingestion ALI (µCi)	Inhalation ALI (µCi)	DAC (µCi)	Air (µCi/mL)	Water (µCi/mL)	Monthly Average Conc. (µCi/mL)
73	Tantalum-177	W, see Ta-172	1E+4	2E+4	8E-6	3E-8	2E-4	2E-3
		Y, see Ta-172	-	2E+4	7E-6	2E-8	-	-
73	Tantalum-178	W, see Ta-172	2E+4	9E+4	4E-5	1E-7	2E-4	2E-3
		Y, see Ta-172	-	7E+4	3E-5	1E-7	-	-
73	Tantalum-179	W, see Ta-172	2E+4	5E+3	2E-6	8E-9	3E-4	3E-3
		Y, see Ta-172	-	9E+2	4E-7	1E-9	-	-
73	Tantalum-180m	W, see Ta-172	2E+4	7E+4	3E-5	9E-8	3E-4	3E-3
		Y, see Ta-172	-	6E+4	2E-5	8E-8	-	-
73	Tantalum-180	W, see Ta-172	1E+3	4E+2	2E-7	6E-10	2E-5	2E-4
		Y, see Ta-172	-	2E+1	1E-8	3E-11	-	-
73	Tantalum-182m b/	W, see Ta-172	2E+5 St wall (2E+5)	5E+5 -	2E-4 -	8E-7 -	- 3E-3	- 3E-2
		Y, see Ta-172	-	4E+5	2E-4	6E-7	-	-
73	Tantalum-182	W, see Ta-172	8E+2	3E+2	1E-7	5E-10	1E-5	1E-4
		Y, see Ta-172	-	1E+2	6E-8	2E-10	-	-
73	Tantalum-183	W, see Ta-172	9E+2 LLI wall (1E+3)	1E+3 -	5E-7 -	2E-9 -	- 2E-5	- 2E-4
		Y, see Ta-172	-	1E+3	4E-7	1E-9	-	-
73	Tantalum-184	W, see Ta-172	2E+3	5E+3	2E-6	8E-9	3E-5	3E-4
		Y, see Ta-172	-	5E+3	2E-6	7E-9	-	-
73	Tantalum-185 b/	W, see Ta-172	3E+4	7E+4	3E-5	1E-7	4E-4	4E-3
		Y, see Ta-172	-	6E+4	3E-5	9E-8	-	-
73	Tantalum-186 b/	W, see Ta-172	5E+4 St wall (7E+4)	2E+5 -	1E-4 -	3E-7 -	- 1E-3	- 1E-2
		Y, see Ta-172	-	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 b/	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 LLI wall (3E+3)	7E+3 -	3E-6 -	9E-9 -	- 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 LLI wall (5E+2)	1E+3 -	5E-7 -	2E-9 -	- 7E-6	- 7E-5
75	Rhenium-177 b/	D, all compounds except those given for W	9E+4 St wall (1E+5)	3E+5 -	1E-4 -	4E-7 -	- 2E-3	- 2E-2
		W, oxides, hydroxides, and nitrates	-	4E+5	1E-4	5E-7	-	-
75	Rhenium-178 b/	D, see Re-177	7E+4 St wall (1E+5)	3E+5 -	1E-4 -	4E-7 -	- 1E-3	- 1E-2
		W, see Re-177	-	3E+5	1E-4	4E-7	-	-
75	Rhenium-181	D, see Re-177	5E+3	9E+3	4E-6	1E-8	7E-5	7E-4
		W, see Re-177	-	9E+3	4E-6	1E-8	-	-
75	Rhenium-182 (12.7 h)	D, see Re-177	7E+3	1E+4	5E-6	2E-8	9E-5	9E-4
		W, see Re-177	-	2E+4	6E-6	2E-8	-	-
75	Rhenium-182 (64.0 h)	D, see Re-177	1E+3	2E+3	1E-6	3E-9	2E-5	2E-4
		W, see Re-177	-	2E+3	9E-7	3E-9	-	-

Atomic No.	Nuclide	Class	Table I. Occupational Values			Table II. Effluent Concentrations		Table III. Releases to Sewers
			Oral Ingestion ALI (µCi)	Inhalation ALI (µCi)	DAC (µCi)	Air (µCi/mL)	Water (µCi/mL)	Monthly Average Conc. (µCi/mL)
76	Osmium-194	D, see Os-180	4E+2 LLI wall (6E+2)	4E+1 -	2E-8 -	6E-11 -	- 8E-6	- 8E-5
		W, see Os-180	-	6E+1	2E-8	8E-11	-	-
		Y, see Os-180	-	8E+0	3E-9	1E-11	-	-
77	Iridium-182 b/	D, all compounds except those given for W and Y	4E+4 St wall (4E+4)	1E+5 -	6E-5 -	2E-7 -	- 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 Ir-182	8E+3	2E+4	1E-5	3E-8	1E-4	1E-3
		W, see Ir-182	-	3E+4	1E-5	5E-8	-	-
		Y, see Ir-182	-	3E+4	1E-5	4E-8	-	-
77	Iridium-185	D, see Ir-182	5E+3	1E+4	5E-6	2E-8	7E-5	7E-4
		W, see Ir-182	-	1E+4	5E-6	2E-8	-	-
		Y, see Ir-182	-	1E+4	4E-6	1E-8	-	-
77	Iridium-186	D, see Ir-182	2E+3	8E+3	3E-6	1E-8	3E-5	3E-4
		W, see Ir-182	-	6E+3	3E-6	9E-9	-	-
		Y, see Ir-182	-	6E+3	2E-6	8E-9	-	-
77	Iridium-187	D, see Ir-182	1E+4	3E+4	1E-5	5E-8	1E-4	1E-3
		W, see Ir-182	-	3E+4	1E-5	4E-8	-	-
		Y, see Ir-182	-	3E+4	1E-5	4E-8	-	-
77	Iridium-188	D, see Ir-182	2E+3	5E+3	2E-6	6E-9	3E-5	3E-4
		W, see Ir-182	-	4E+3	1E-6	5E-9	-	-
		Y, see Ir-182	-	3E+3	1E-6	5E-9	-	-
77	Iridium-189	D, see Ir-182	5E+3 LLI wall (5E+3)	5E+3 -	2E-6 -	7E-9 -	- 7E-5	- 7E-4
		W, see Ir-182	-	4E+3	2E-6	5E-9	-	-
		Y, see Ir-182	-	4E+3	1E-6	5E-9	-	-
77	Iridium-190m b/	D, see Ir-182	2E+5	2E+5	8E-5	3E-7	2E-3	2E-2
		W, see Ir-182	-	2E+5	9E-5	3E-7	-	-
		Y, see Ir-182	-	2E+5	8E-5	3E-7	-	-
77	Iridium-190	D, see Ir-182	1E+3	9E+2	4E-7	1E-9	1E-5	1E-4
		W, see Ir-182	-	1E+3	4E-7	1E-9	-	-
		Y, see Ir-182	-	9E+2	4E-7	1E-9	-	-
77	Iridium-192m	D, see Ir-182	3E+3	9E+1	4E-8	1E-10	4E-5	4E-4
		W, see Ir-182	-	2E+2	9E-8	3E-10	-	-
		Y, see Ir-182	-	2E+1	6E-9	2E-11	-	-
77	Iridium-192	D, see Ir-182	9E+2	3E+2	1E-7	4E-10	1E-5	1E-4
		W, see Ir-182	-	4E+2	2E-7	6E-10	-	-
		Y, see Ir-182	-	2E+2	9E-8	3E-10	-	-
77	Iridium-194m	D, see Ir-182	6E+2	9E+1	4E-8	1E-10	9E-6	9E-5
		W, see Ir-182	-	2E+2	7E-8	2E-10	-	-
		Y, see Ir-182	-	1E+2	4E-8	1E-10	-	-

Atomic No.	Nuclide	Class	Table I. Occupational Values			Table II. Effluent Concentrations		Table III. Releases to Sewers
			Oral Ingestion ALI (µCi)	Inhalation ALI (µCi)	DAC (µCi)	Air (µCi/mL)	Water (µCi/mL)	Monthly Average Conc. (µCi/mL)
79	Gold-200 b/	D, see Au-193	3E+4	6E+4	3E-5	9E-8	4E-4	4E-3
		W, see Au-193	-	8E+4	3E-5	1E-7	-	-
		Y, see Au-193	-	7E+4	3E-5	1E-7	-	-
79	Gold-201 b/	D, see Au-193	7E+4 St wall (9E+4)	2E+5 -	9E-5 -	3E-7 -	- 1E-3	- 1E-2
		W, see Au-193	-	2E+5	1E-4	3E-7	-	-
		Y, see Au-193	-	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 Hg-193m	2E+4	4E+4	2E-5	6E-8	2E-4	2E-3
		W, see Hg-193m	-	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 Hg-193m	8E+2	4E+1	2E-8	6E-11	1E-5	1E-4
		W, see Hg-193m	-	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 Hg-193m	2E+3	5E+3	2E-6	7E-9	3E-5	3E-4
		W, see Hg-193m	-	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 Hg-193m	1E+4	4E+4	1E-5	5E-8	2E-4	2E-3
		W, see Hg-193m	-	3E+4	1E-5	5E-8	-	-
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 Hg-193m	3E+3	7E+3	3E-6	1E-8	4E-5	4E-4
		W, see Hg-193m	-	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 Hg-193m	6E+3	1E+4	5E-6	2E-8	8E-5	8E-4
		W, see Hg-193m	-	9E+3	4E-6	1E-8	-	-
80	Mercury-199m b/	Vapor	-	8E+4	3E-5	1E-7	-	-
		Organic D	6E+4 St wall (1E+5)	2E+5 -	7E-5 -	2E-7 -	- 1E-3	- 1E-2
		D, see Hg-193m	6E+4	1E+5	6E-5	2E-7	8E-4	8E-3
		W, see Hg-193m	-	2E+5	7E-5	2E-7	-	-

Atomic No.	Nuclide	Class	Table I. Occupational Values			Table II. Effluent Concentrations		Table III. Releases to Sewers
			Oral Ingestion ALI (µCi)	Inhalation ALI (µCi)	DAC (µCi)	Air (µCi/mL)	Water (µCi/mL)	Monthly Average Conc. (µCi/mL)
83	Bismuth-212 b/	D, see Bi-200	5E+3	2E+2	1E-7	3E-10	7E-5	7E-4
		W, see Bi-200	-	3E+2	1E-7	4E-10	-	-
83	Bismuth-213 b/	D, see Bi-200	7E+3	3E+2	1E-7	4E-10	1E-4	1E-3
		W, see Bi-200	-	4E+2	1E-7	5E-10	-	-
8388	Bismuth-214 b/	D, see Bi-200	2E+4 St wall (2E+4)	8E+2	3E-7	1E-9	-	-
				-	-	-	3E-4	3E-3
		W, see Bi-200	-	9E-2	4E-7	1E-9	-	-
84	Polonium-203 b/	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 b/	D, see Po-203	2E+4	4E+4	2E-5	5E-8	3E-4	3E-3
		W, see Po-203	-	7E+4	3E-5	1E-7	-	-
84	Polonium-207	D, see Po-203	8E+3	3E+4	1E-5	3E-8	1E-4	1E-3
		W, see Po-203	-	3E+4	1E-5	4E-8	-	-
84	Polonium-210	D, see Po-203	3E+0	6E-1	3E-10	9E-13	4E-8	4E-7
		W, see Po-203	-	6E-1	3E-10	9E-13	-	-
85	Astatine-207 b/	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 WLM)	9E-9 (or 1.0 WL)	3E-11	-	-
86	Radon-222	With daughters removed	-	1E+4	4E-6	1E-8	-	-
		With daughters present	-	1E+2 (or 4 WLM)	3E-8 (or 0.33 WL)	1E-10	-	-
87	Francium-222 b/	D, all compounds	2E+3	5E+2	2E-7	6E-10	3E-5	3E-4
87	Francium-223 b/	D, all compounds	6E+2	8E+2	3E-7	1E-9	8E-6	8E-5
88	Radium-223	W, all compounds	5E+0 Bone surf (9E+0)	7E-1	3E-10	9E-13	-	-
				-	-	-	1E-7	1E-6
88	Radium-224	W, all compounds	8E+0 Bone surf (2E+1)	2E+0	7E-10	2E-12	-	-
				-	-	-	2E-7	2E-6
88	Radium-225	W, all compounds	8E+0 Bone surf (2E+1)	7E-1	3E-10	9E-13	-	-
				-	-	-	2E-7	2E-6
88	Radium-226	W, all compounds	2E+0 Bone surf (5E+0)	6E-1	3E-10	9E-13	-	-
				-	-	-	6E-8	6E-7
88	Radium-227 b/	W, all compounds	2E+4 Bone surf (2E+4)	1E+4 Bone surf (2E+4)	6E-6	-	-	-
					-	3E-8	3E-4	3E-3
88	Radium-228	W, all compounds	2E+0 Bone surf (4E+0)	1E+0	5E-10	2E-12	-	-
				-	-	-	6E-8	6E-7
89	Actinium-224	D, all compounds except those given for W and Y	2E+3 LLI wall (2E+3)	3E+1 Bone surf (4E+1)	1E-8	-	-	-
					-	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	-	-

Atomic No.	Nuclide	Class	Table I. Occupational Values			Table II. Effluent Concentrations		Table III. Releases to Sewers
			Oral Ingestion ALI (µCi)	Inhalation ALI (µCi)	DAC (µCi)	Air (µCi/mL)	Water (µCi/mL)	Monthly Average Conc. (µCi/mL)
90	Thorium-234	W, see Th-226	3E+2 LLI wall (4E+2)	2E+2 -	8E-8 -	3E-10 -	- 5E-6	- 5E-5
		Y, see Th-226	-	2E+2	6E-8	2E-10	-	-
91	Protactinium-227 b/	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 Pa-227	1E+3 -	1E+1 Bone surf (2E+1)	5E-9 -	- 3E-11	2E-5 -	2E-4 -
		Y, see Pa-227	-	1E+1	5E-9	2E-11	-	-
91	Protactinium-230	W, see Pa-227	6E+2 Bone surf (9E+2)	5E+0 -	2E-9 -	7E-12 -	- 1E-5	- 1E-4
		Y, see Pa-227	-	4E+0	1E-9	5E-12	-	-
91	Protactinium-231	W, see Pa-227	2E-1 Bone surf (5E-1)	2E-3 Bone surf (4E-3)	6E-13 -	- 6E-15	- 6E-9	- 6E-8
		Y, see Pa-227	- -	4E-3 Bone surf (6E-3)	2E-12 -	- 8E-15	- -	- -
91	Protactinium-232	W, see Pa-227	1E+3 -	2E+1 Bone surf (6E+1)	9E-9 -	- 8E-11	2E-5 -	2E-4 -
		Y, see Pa-227	- -	6E+1 Bone surf (7E+1)	2E-8 -	- 1E-10	- -	- -
91	Protactinium-233	W, see Pa-227	1E+3 LLI wall (2E+3)	7E+2 -	3E-7 -	1E-9 -	- 2E-5	- 2E-4
		Y, see Pa-227	-	6E+2	2E-7	8E-10	-	-
91	Protactinium-234	W, see Pa-227	2E+3	8E+3	3E-6	1E-8	3E-5	3E-4
		Y, see Pa-227	-	7E+3	3E-6	9E-9	-	-
92	Uranium-230	D, UF_6, UO_2F_2, $UO_2(NO_3)_2$	4E+0 Bone surf (6E+0)	4E-1 Bone surf (6E-1)	2E-10 -	- 8E-13	- 8E-8	- 8E-7
		W, UO_3, UF_4, UCl_4	-	4E-1	1E-10	5E-13	-	-
		Y, UO_2, U_3O_8	-	3E-1	1E-10	4E-13	-	-
92	Uranium-231	D, see U-230	5E+3 LLI wall (4E+3)	8E+3 -	3E-6 -	1E-8 -	- 6E-5	- 6E-4
		W, see U-230	-	6E+3	2E-6	8E-9	-	-
		Y, see U-230	-	5E+3	2E-6	6E-9	-	-
92	Uranium-232	D, see U-230	2E+0 Bone surf (4E+0)	2E-1 Bone surf (4E-1)	9E-11 -	- 6E-13	- 6E-8	- 6E-7
		W, see U-230	-	4E-1	2E-10	5E-13	-	-
		Y, see U-230	-	8E-3	3E-12	1E-14	-	-
92	Uranium-233	D, see U-230	1E+1 Bone surf (2E+1)	1E+0 Bone surf (2E+0)	5E-10 -	- 3E-12	- 3E-7	- 3E-6
		W, see U-230	-	7E-1	3E-10	1E-12	-	-
		Y, see U-230	-	4E-2	2E-11	5E-14	-	-

Atomic No.	Nuclide	Class	Table I. Occupational Values			Table II. Effluent Concentrations		Table III. Releases to Sewers
			Oral Ingestion ALI (µCi)	Inhalation ALI (µCi)	DAC (µCi)	Air (µCi/mL)	Water (µCi/mL)	Monthly Average Conc. (µCi/mL)
93	Neptunium-239	W, all compounds	2E+3 LLI wall (2E+3)	2E+3 -	9E-7 -	3E-9 -	- 2E-5	- 2E-4
93	Neptunium-240 b/	W, all compounds	2E+4	8E+4	3E-5	1E-7	3E-4	3E-3
94	Plutonium-234	W, all compounds except PuO_2 Y, PuO_2	8E+3 -	2E+2 2E+2	9E-8 8E-8	3E-10 3E-10	1E-4 -	1E-3 -
94	Plutonium-235 b/	W, see Pu-234 Y, see Pu-234	9E+5 -	3E+6 3E+6	1E-3 1E-3	4E-6 3E-6	1E-2 -	1E-1 -
94	Plutonium-236	W, see Pu-234 Y, see Pu-234	2E+0 Bone surf (4E+0) -	2E-2 Bone surf (4E-2) 4E-2	8E-12 - 2E-11	- 5E-14 6E-14	- 6E-8 -	- 6E-7 -
94	Plutonium-237	W, see Pu-234 Y, see Pu-234	1E+4 -	3E+3 3E+3	1E-6 1E-6	5E-9 4E-9	2E-4 -	2E-3 -
94	Plutonium-238	W, see Pu-234 Y, see Pu-234	9E-1 Bone surf (2E+0) -	7E-3 Bone surf (1E-2) 2E-2	3E-12 - 8E-12	- 2E-14 2E-14	- 2E-8 -	- 2E-7 -
94	Plutonium-239	W, see Pu-234 Y, see Pu-234 -	8E-1 Bone surf (1E+0) - -	6E-3 Bone surf (1E-2) 2E-2 Bone surf (2E-2)	3E-12 - 7E-12 -	- 2E-14 - 2E-14	- 2E-8 - -	- 2E-7 - -
94	Plutonium-240	W, see Pu-234 Y, see Pu-234 -	8E-1 Bone surf (1E+0) - -	6E-3 Bone surf (1E-2) 2E-2 Bone surf (2E-2)	3E-12 - 7E-12 -	- 2E-14 - 2E-14	- 2E-8 - -	- 2E-7 - -
94	Plutonium-241	W, see Pu-234 Y, see Pu-234 -	4E+1 Bone surf (7E+1) - -	3E-1 Bone surf (6E-1) 8E-1 Bone surf (1E+0)	1E-10 - 3E-10 -	- 8E-13 - 1E-12	- 1E-6 - -	- 1E-5 - -
94	Plutonium-242	W, see Pu-234 Y, see Pu-234 -	8E-1 Bone surf (1E+0) - -	7E-3 Bone surf (1E-2) 2E-2 Bone surf (2E-2)	3E-12 - 7E-12 -	- 2E-14 - 2E-14	- 2E-8 - -	- 2E-7 - -
94	Plutonium-243	W, see Pu-234 Y, see Pu-234	2E+4 -	4E+4 4E+4	2E-5 2E-5	5E-8 5E-8	2E-4 -	2E-3 -
94	Plutonium-244	W, see Pu-234 Y, see Pu-234 -	8E-1 Bone surf (2E+0) - -	7E-3 Bone surf (1E-2) 2E-2 Bone surf (2E-2)	3E-12 - 7E-12 -	- 2E-14 - 2E-14	- 2E-8 - -	- 2E-7 - -
94	Plutonium-245	W, see Pu-234 Y, see Pu-234	2E+3 -	5E+3 4E+3	2E-6 2E-6	6E-9 6E-9	3E-5 -	3E-4 -
94	Plutonium-246	W, see Pu-234 Y, see Pu-234	4E+2 LLI wall (4E+2) -	3E+2 - 3E+2	1E-7 - 1E-7	4E-10 - 4E-10	- 6E-6 -	- 6E-5 -
95	Americium-237 b/	W, all compounds	8E+4	3E+5	1E-4	4E-7	1E-3	1E-2
95	Americium-238 b/	W, all compounds	4E+4 -	3E+3 Bone surf (6E+3)	1E-6 -	- 9E-9	5E-4 -	5E-3 -

Atomic No.	Nuclide	Class	Table I. Occupational Values			Table II. Effluent Concentrations		Table III. Releases to Sewers
			Oral Ingestion ALI (µCi)	Inhalation ALI (µCi)	DAC (µCi)	Air (µCi/mL)	Water (µCi/mL)	Monthly Average Conc. (µCi/mL)
98	Californium-244 b/	W, all compounds except those given for Y	3E+4 St wall (3E+4)	6E+2 -	2E-7 -	8E-10 -	- 4E-4	- 4E-3
		Y, oxides and hydroxides	-	6E+2	2E-7	8E-10	-	-
98	Californium-246	W, see Cf-244	4E+2	9E+0	4E-9	1E-11	5E-6	5E-5
		Y, see Cf-244	-	9E+0	4E-9	1E-11	-	-
98	Californium-248	W, see Cf-244	8E+0 Bone surf (2E+1)	6E-2 Bone surf (1E-1)	3E-11 -	- 2E-13	- 2E-7	- 2E-6
		Y, see Cf-244	-	1E-1	4E-11	1E-13	-	-
98	Californium-249	W, see Cf-244	5E-1 Bone surf (1E+0)	4E-3 Bone surf (9E-3)	2E-12 -	- 1E-14	- 2E-8	- 2E-7
		Y, see Cf-244	- -	1E-2 Bone surf (1E-2)	4E-12 -	- 2E-14	- -	- -
98	Californium-250	W, see Cf-244	1E+0 Bone surf (2E+0)	9E-3 Bone surf (2E-2)	4E-12 -	- 3E-14	- 3E-8	- 3E-7
		Y, see Cf-244	-	3E-2	1E-11	4E-14	-	-
98	Californium-251	W, see Cf-244	5E-1 Bone surf (1E+0)	4E-3 Bone surf (9E-3)	2E-12 -	- 1E-14	- 2E-8	- 2E-7
		Y, see Cf-244	- -	1E-2 Bone surf (1E-2)	4E-12 -	- 2E-14	- -	- -
98	Californium-252	W, see Cf-244	2E+0 Bone surf (5E+0)	2E-2 Bone surf (4E-2)	8E-12 -	- 5E-14	- 7E-8	- 7E-7
		Y, see Cf-244	-	3E-2	1E-11	5E-14	-	-
98	Californium-253	W, see Cf-244	2E+2 Bone surf (4E+2)	2E+0 -	8E-10 -	3E-12 -	- 5E-6	- 5E-5
		Y, see Cf-244	-	2E+0	7E-10	2E-12	-	-
98	Californium-254	W, see Cf-244	2E+0	2E-2	9E-12	3E-14	3E-8	3E-7
		Y, see Cf-244	-	2E-2	7E-12	2E-14	-	-
	Einsteinium-250	W, all compounds	4E+4 -	5E+2 Bone surf (1E+3)	2E-7 -	- 2E-9	6E-4 -	6E-3 -
99	Einsteinium-251	W, all compounds	7E+3 -	9E+2 Bone surf (1E+3)	4E-7 -	- 2E-9	1E-4 -	1E-3 -
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 LLI wall (3E+2)	1E+1 -	4E-9 -	1E-11 -	- 4E-6	- 4E-5
99	Einsteinium-254	W, all compounds	8E+0 Bone surf (2E+1)	7E-2 Bone surf (1E-1)	3E-11 -	- 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 Bone surf (4E+1)	2E-1 Bone surf (2E-1)	7E-11 -	- 3E-13	- 5E-7	- 5E-6
101	Mendelevium-257	W, all compounds	7E+3 -	8E+1 Bone surf (9E+1)	4E-8 -	- 1E-10	1E-4 -	1E-3 -
101	Mendelevium-258	W, all compounds	3E+1 Bone surf (5E+1)	2E-1 Bone surf (3E-1)	1E-10 -	- 5E-13	- 6E-7	- 6E-6

Radionuclide	Table I. Occupational Values			Table II. Effluent Concentrations		Table III. Releases to Sewers
	Oral Ingestion ALI (µCi)	Inhalation ALI (µCi)	DAC (µCi)	Air (µCi/mL)	Water (µCi/mL)	Monthly Average Conc. (µCi/mL)
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, UNat, Cm-242, Cf-248, Es-254, Fm-257, and Md-258 are not present	-	-	-	-	1E-6	1E-5

NOTE 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.*

NOTE 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 this appendix 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:

$$\frac{C_A}{DAC_A} + \frac{C_B}{DAC_B} + \frac{C_C}{DAC_C} < 1$$

3701:1-38-19 Waste disposal.

(A) A licensee shall dispose of licensed radioactive material in accordance with this rule. Licensed material shall be disposed of in one of the following manners:

(1) By transfer to an authorized recipient as provided in this chapter, Chapter 3701:1-40 of the Administrative Code, or to the United States department of energy;

(2) By decay in storage provided that the radionuclide has a half-life of one hundred twenty days or less, or as otherwise permitted by the license;

(3) By release in effluents within the limits set forth in rule 3701:1-38-13 of the Administrative Code; or

(4) As authorized pursuant to paragraphs (B) to (F) of this rule.

(B) A person shall be specifically licensed to receive waste containing licensed material from another person for:

(1) Treatment prior to disposal;

(2) Treatment or disposal by incineration;

(3) Decay in storage;

(4) Disposal at a land disposal facility licensed pursuant to rules 3701:1-54-06 to 3701:1-54-12 of the Administrative Code; or

(5) Storage until transfer to a storage or disposal facility authorized to receive the waste.

(C) A licensee or applicant for a license may apply to the director for approval of proposed disposal procedures that are not otherwise authorized in these rules for the 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, and the proposed manner and conditions of waste disposal;

(2) An analysis and evaluation of pertinent information on the nature of the environment;

(3) The nature and location of other potentially affected facilities; and

(4) An analysis and procedures to ensure that doses are maintained ALARA and within the dose limits in rules 3701:1-38-12 and 3701:1-38-13 of the Administrative Code.

(D) A licensee may discharge licensed material into sanitary sewerage as follows:

(1) The material is readily soluble in water or is a biological material that is readily dispersible in water;

(2) The quantity of licensed or other 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 does not exceed the concentration listed in table III of appendix C to rule 3701:1-38-12 of the Administrative Code; and

(3) If more than one radionuclide is to be released, the following conditions must also be satisfied:

(a) The licensee shall determine the fraction of the limit in table III of appendix C to rule 3701:1-38-12 of the Administrative Code represented by discharges into sanitary sewerage by dividing the actual monthly average concentration of each radionuclide released by the licensee into the sewer by the concentration of that radionuclide listed in table III of appendix C to rule 3701:1-38-12 of the Administrative Code; and

(b) The sum of the fractions for each radionuclide required by paragraph (D)(3)(a) of this rule does not exceed unity.

(4) The total quantity of licensed and other radioactive material that the licensee releases into the sanitary sewerage in a year does not exceed one hundred eighty-five gigabecquerels (five curies) of hydrogen-3, thirty-seven gigabecquerels (one curie) of carbon-14, and thirty-seven gigabecquerels (one curie) of all other radioactive materials combined.

(5) Excreta from an individual undergoing medical diagnosis or therapy with radioactive material is not subject to the limitations contained in paragraph (D) of this rule.

(E) A licensee may dispose of licensed material by decay in storage. A licensee may hold radioactive material with a physical half-life of one hundred twenty days or less for decay-in-storage before disposal as non-radioactive material provided the licensee does the following:

(1) Monitors the material at the container surface prior to disposal and determines that the radioactivity cannot be distinguished from the background radiation level with an appropriate radiation detection survey meter set on its most sensitive scale and with no interposing shielding;

(2) Removes or obliterates all radiation caution labels and symbols, unless otherwise specified in the license; and

(3) Retains a record of the disposal for three years.

(F) A licensee may treat or dispose of licensed material by incineration only in the form and concentration specified in paragraph (G) of this rule or as specifically approved by the director pursuant to paragraph (C) of this rule.

(G) A licensee may dispose of the following licensed material as if it were not radioactive. The licensee shall maintain records in accordance with paragraph (K) of rule 3701:1-38-20 of the Administrative Code.

(1) 1.85 kilobecquerels (0.05 microcurie) or less, of hydrogen-3 or carbon-14 per gram of medium used for liquid scintillation counting; or

(2) 1.85 kilobecquerels (0.05 microcurie) μ or less, of hydrogen-3 or carbon-14 per gram of animal tissue, averaged over the weight of the entire animal. A licensee shall not dispose of tissue pursuant to this paragraph in a manner that would permit its use either as food for humans or as animal feed.

(H) A licensee shall transfer and dispose of licensed material in accordance with the following:

(1) For transfer of radioactive waste intended for disposal at a licensed radioactive waste disposal facility, establish a manifest tracking system, and supplement existing requirements concerning transfers and recordkeeping for those wastes. Each shipment of radioactive waste designated for disposal at a licensed radioactive waste disposal facility shall be accompanied by a shipment manifest as specified in appendix A to this rule.

(2) Each shipment manifest shall include a certification by the waste generator in accordance with appendix A to this rule.

(3) Each person involved in the transfer of waste for disposal or in the disposal of waste, including the waste generator, waste collector, waste processor, and disposal facility operator, shall comply with the requirements specified in appendix A to this rule.

(I) Nothing in this rule relieves a 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 under this rule.

APPENDIX A

Requirements for transfer of radioactive waste for disposal at land disposal facilities and manifests

I. Manifest

A waste generator, collector, or processor who transports, or offers for transportation, radioactive waste intended for ultimate disposal at a licensed radioactive waste land disposal facility must prepare a Shipment Manifest. Licensees are not required to comply with the manifesting requirements of this part when they ship:

(A) Radioactive waste for processing and expect its return for storage under their license prior to disposal at a licensed land disposal facility;

(B) Radioactive waste that is being returned to the licensee who is the "waste generator" or "generator," as defined in this part; or

(C) Radioactively contaminated material to a "waste processor" that becomes the processor's "residual waste."

For guidance in completing these forms, refer to the instructions that accompany the forms.

Copies of manifests required by this appendix may be legible carbon copies, photocopies, or computer printouts that reproduce the data in the format of the shipment manifest.

This appendix includes information requirements of the United States department of transportation, as codified in 49 C.F.R. 172. Information on hazardous, medical, or other waste, required to meet United States environmental protection agency regulations, as codified in 40 C.F.R. Parts 259, 261 or elsewhere, is not addressed in this section, and must be provided on the required EPA forms. However, the required EPA forms must accompany the Radioactive Waste Shipment Manifest required by this rule.

As used in this appendix, the following definitions apply:

Chelating agent means amine polycarboxylic acids (including but not limited to EDTA and DTPA), hydroxy-carboxylic

acids, and polycarboxylic acids (including but not limited to citric acid, carbolic acid, and glucinic acid).

Chemical description means a description of the principal chemical characteristics of a radioactive waste.

Computer-readable medium means that the Bureau's computer can transfer the information from the medium into its memory.

Consignee means the designated receiver of the shipment of radioactive waste.

Decontamination facility means a facility operating under a nuclear regulatory commission or agreement state license whose principal purpose is decontamination of equipment or materials to accomplish recycle, reuse, or other waste management objectives, and, for purposes of this part, is not considered to be a consignee for radioactive waste shipments.

Disposal container means a container principally used to confine radioactive waste during disposal operations at a land disposal facility (also see "high integrity container"). Note that for some shipments, the disposal container may be the transport package.

EPA identification number means the number received by a transporter following application to the administrator of EPA as required by 40 C.F.R. 263.

Generator means a licensee operating under a nuclear regulatory commission or agreement state license who (1) is a waste generator as defined in this part, or (2) is the licensee to whom waste can be attributed to.

High integrity container (HIC) means a container commonly designed to meet the structural stability requirements of rule 3701:1-54-10 of the Administrative Code 10 C.F.R. 61.56 as referenced by 3701-39-02.1, and to meet United States department of transportation requirements for a Type A package.

Land disposal facility means the land, buildings and structures, and equipment that are intended to be used for the disposal of radioactive waste.

Package means the assembly of components necessary to ensure compliance with the packaging requirements of United States department of transportation regulations, together with its radioactive contents, as presented for transport.

Physical description means the items called for on Radioactive Waste Shipment Manifest form "Container and Waste Description" to describe the radioactive waste.

Radioactive Waste Shipment Manifest means forms provided by the director consistent with

NRC Forms 540 & 540A (Shipping Papers), 541 & 541A (Container and Waste Description), and 542 & 542A (Manifest Index and Regional Compact Tabulation). Licensees need not use originals of these forms as long as any substitute forms are equivalent to the original documentation in respect to content, clarity, size, and location of information. Upon agreement between the shipper and consignee, Shipment Manifest forms "Container and

Waste Description" and "Manifest Index and Regional Compact Tabulation" may be completed, transmitted, and stored in electronic media. The electronic media must have the capability for producing legible, accurate, and

complete records in the format of the shipment manifest.

Residual waste means radioactive waste resulting from processing or decontamination activities that cannot be easily separated into distinct batches attributable to specific waste generators. This waste is attributable to the processor or decontamination facility, as applicable.

Shipment manifest – see Radioactive Waste Shipment Manifest

Shipper means the licensed entity including, but not limited to, the waste generator, waste collector, or waste processor, who offers radioactive waste for transportation, typically consigning this type of waste to a licensed waste collector, waste processor, or land disposal facility operator.

Shipping paper means the Radioactive Waste Shipping Manifest form "Shipping Papers" which includes the information required by the United States department of transportation in 49 C.F.R. Part 172.

Source material has the same meaning as that given in rule 3701:1-38-01 of the Administrative Code. 10 C.F.R. 40.4 as referenced by 3701-39-02.1.

Special nuclear material has the same meaning as that given in rule 3701:1-38-01 of the Administrative Code. 10 C.F.R. 70.4 as referenced by 3701-39-02.1.

Waste collector means an entity, operating under a nuclear regulatory commission or agreement state license, whose principal purpose is to collect and consolidate waste generated by others, and to transfer this waste, without processing or repackaging the collected waste, to another licensed waste collector, licensed waste processor, or licensed land disposal facility.

Waste description means the physical, chemical and radiological description of a radioactive waste as called for on Shipment Manifest form "Container and Waste Description".

Waste generator means an entity, operating under a nuclear regulatory commission or agreement state license, who (1) possesses any material or component that contains radioactivity or is radioactively contaminated for which the licensee foresees no further use, and (2) transfers this material or component to a licensed land disposal facility or to a licensed waste collector or processor for handling or treatment prior to disposal. A licensee performing processing or decontamination services may be a "waste generator" if the transfer of radioactive waste from its facility is defined as "residual waste."

Waste processor means an entity, operating under a nuclear regulatory commission or agreement state license, whose principal purpose is to process, repackage, or otherwise treat radioactive material or waste generated by others prior to eventual transfer of waste to a licensed radioactive waste land disposal facility.

Waste type means a waste within a disposal container having a unique physical description (a specific waste descriptor code or description; or a waste sorbed on or solidified in a specifically defined media).

Information Requirements

A. General Information

The shipper of the radioactive waste, shall provide the following information on the Shipment Manifest:

1. The name, facility address, and telephone number of the licensee shipping the waste;

2. An explicit declaration indicating whether the shipper is acting as a waste generator, collector, processor, or a combination of these identifiers for purposes of the manifested shipment; and

3. The name, address, and telephone number, or the name and EPA identification number for the carrier transporting the waste.

B. Shipment Information

The shipper of the radioactive waste shall provide the following information regarding the waste shipment on the Shipment Manifest:

1. The date of the waste shipment;

2. The total number of packages/disposal containers;

3. The total disposal volume and disposal weight in the shipment;

4. The total radionuclide activity in the shipment;

5. The activity of each of the radionuclides H-3, C-14, Tc-99, and I-129 contained in the shipment; and

6. The total masses of U-233, U-235, and plutonium in special nuclear material, and the total mass of uranium and thorium in source material.

C. Disposal Container and Waste information

The shipper of the radioactive waste shall provide the following information on the Shipment

Manifest regarding the waste and each disposal container of waste in the shipment:

1. An alphabetic or numeric identification that uniquely identifies each disposal container in the shipment;

2. A physical description of the disposal container, including the manufacturer and model of any high integrity container;

3. The volume displaced by the disposal container;

4. The gross weight of the disposal container, including the waste;

5. For waste consigned to a disposal facility, the maximum radiation level at the surface of each disposal container;

6. A physical and chemical description of the waste;

7. The total weight percentage of chelating agent for any waste containing more than 0.1% chelating agent by weight, plus the identity of the principal chelating agent;

8. The approximate volume of waste within a container;

9. The sorbing or solidification media, if any, and the identity of the solidification media vendor and brand name;

10. The identities and activities of individual radionuclides contained in each container, the masses of U-233, U-235, and plutonium in special nuclear material, and the masses of uranium and thorium in source material. For discrete waste types (including but not limited to activated materials, contaminated equipment, mechanical filters, sealed source/devices, and wastes in solidification/stabilization media), the identities and activities of individual radionuclides associated with or contained on these waste types within a disposal container shall be reported;

11. The total radioactivity within each container; and

12. For wastes consigned to a disposal facility, the classification of the waste pursuant to rule 3701:1-54-10 of the Administrative Code. 10 C.F.R. 61.55 as referenced by 3701-39-02.1. Waste not meeting the structural stability requirements of paragraph (B)(9) of rule 3701:1-54-10 of the Administrative Code 10 C.F.R. 61.56(b) as referenced by 3701-39-02.1 must be identified.

D. Uncontainerized Waste information

The shipper of the radioactive waste shall provide the following information on the Shipment

Manifest regarding a waste shipment delivered without a disposal container:

1. The approximate volume and weight of the waste;

2. A physical and chemical description of the waste;

3. The total weight percentage of chelating agent if the chelating agent exceeds 0.1% by weight, plus the identity of the principal chelating agent;

4. For waste consigned to a disposal facility, the classification of the waste pursuant to rule 3701:1-54-10 of the Administrative Code. 10 C.F.R. 61.55 as referenced by 3701-39-02.1. Waste not meeting the structural stability requirements of paragraph (B)(9) of rule 3701:1-54-10 of the Administrative Code 10 C.F.R. 61.56(b) as referenced by 3701-39-02.1 must be identified;

5. The identities and activities of individual radionuclides contained in the waste, the masses of U-233, U-235, and plutonium in special nuclear material, and the masses of uranium and thorium in source material; and

6. For wastes consigned to a disposal facility, the maximum radiation levels at the surface of the waste.

E. Multi-Generator Disposal Container Information

This section applies to disposal containers enclosing mixtures of waste originating from different generators. (Note: The origin of the radioactive waste resulting from a processor's activities may be attributable to one or more

"generators" (including "waste generators") as defined in this appendix). It also applies to mixtures of wastes shipped in an uncontainerized form, for which portions of the mixture within the shipment originate from different generators.

1. For homogeneous mixtures of waste, such as incinerator ash, provide the waste description applicable to the mixture and the volume of the waste attributed to each generator.

2. For heterogeneous mixtures of waste, such as the combined products from a large compactor, identify each generator contributing waste to the disposal container, and, for discrete waste types (including but not limited to, activated materials, contaminated equipment, mechanical filters, sealed source/devices, and wastes in solidification/stabilization media), the identities and activities of individual radionuclides contained on these waste types within the disposal container. For each generator, provide the following:

(a) The volume of waste within the disposal container;

(b) A physical and chemical description of the waste, including the solidification agent, if any;

(c) The total weight percentage of chelating agents for any disposal container containing more than 0.1% chelating agent by weight, plus the identity of the principal chelating agent;

(d) The sorbing or solidification media, if any, and the identity of the solidification media vendor and brand name if the media is claimed to meet stability requirements in paragraph (B)(9) of rule 3701:1-54-10 of the Administrative Code; 10 C.F.R. 61.56(b) as referenced by 3701-39-02.1; and

(e) Radionuclide identities and activities contained in the waste, the masses of U-233, U-235, and plutonium in special nuclear material, and the masses of uranium and thorium in source material if contained in the waste.

II. Certification

An authorized representative of the waste generator, processor, or collector shall certify by signing and dating the shipment manifest that the transported materials are properly classified, described, packaged, marked, and labeled and are in proper condition for transportation according to the applicable regulations of the U.S. DOT, the U.S. nuclear regulatory commission, and the department. A collector in signing the certification is certifying that nothing has been done to the collected waste, which would invalidate the waste generator's certification.

III. Control and Tracking

A. Any licensee who transfers radioactive waste to a land disposal facility or a licensed waste collector shall comply with the requirements in paragraphs A.1 through 9 of this section. Any licensee who transfers waste to a licensed waste processor for waste treatment or repackaging shall comply with the requirements of paragraphs A.4 through 9 of this section. A licensee shall:

1. Prepare all wastes so that the waste is classified according to rule 3701:1-54-10 of the Administrative Code 10 C.F.R. 61.55 as referenced by 3701-39-02.1, and meets the waste characteristics requirements in rule 3701:1-54-10 of the Administrative Code; 10 C.F.R. 61.56 as referenced by 3701-39-02.1;

2. Label each disposal container (or transport package if potential radiation hazards preclude labeling of the individual disposal container) of waste to identify whether it is Class A waste, Class B waste, Class C waste, or greater then

Class C waste, in accordance with rule 3701:1-54-10 of the Administrative Code; 10 C.F.R. 61.55 as referenced by 3701-39-02.1;

3. Conduct a quality assurance program to assure compliance with rule 3701:1-54-10 of the Administrative Code 10 C.F.R. 61.55 and 61.56 as referenced by 3701-39-02.1 (The program must include management evaluation of audits);

4. Prepare the Radioactive Waste Shipment Manifest as required by this appendix;

5. Forward a copy or electronically transfer the Radioactive Waste Shipment Manifest to the intended consignee so that either (I) receipt of the manifest precedes the radioactive waste shipment or (II) the manifest is delivered to the consignee with the waste at the time the waste is transferred to the consignee. Using both (I) and (II) is also acceptable;

6. Include Shipment Manifest form "Shipping Paper" with the shipment regardless of the option chosen in paragraph A.5 of this section;

7. Receive acknowledgement of the receipt of the shipment in the form of a signed copy of Shipment Manifest form "Shipping Paper";

8. Retain a copy of or electronically store the Radioactive Waste Shipment manifest and documentation of acknowledgement of receipt as the record of transfer of licensed material as required by rules 3701:1-40-21, 3701:1-44-23, and 3701:1-56-10 of the Administrative Code; 10 C.F.R. Parts 30, 40, and 70 as referenced by 3701-39-02.1; and

9. For any shipments or any part of a shipment for which acknowledgement of receipt has not been received within the times set forth in this appendix, conduct an investigation in accordance with paragraph E of this appendix.

B. Any waste collector licensee who handles only prepackaged waste shall:

1. Acknowledge receipt of the waste from the shipper within one week of receipt by returning a signed copy of Shipment Manifest form "Shipping Paper";

2. Prepare a new manifest to reflect consolidated shipments that meet the requirements of this appendix. The waste collector shall ensure that, for each container of waste in the shipment, the manifest identifies the generator of that container of waste;

3. Forward a copy or electronically transfer the Radioactive Waste Shipment Manifest to the intended consignee so that either: (I) receipt of the manifest precedes the radioactive waste shipment or (II) the manifest is delivered to the consignee with the waste at the time the waste is transferred to the consignee. Using both (I) and (II) is also acceptable;

4. Include Shipment Manifest form "Shipping Paper" with the shipment regardless of the option chosen in paragraph B.3 of this section;

5. Receive acknowledgement of the receipt of the shipment in the form of a signed copy of Shipment Manifest form "Shipping Paper";

6. Retain a copy of or electronically store the Radioactive Waste Shipment Manifest and documentation of acknowledgement of receipt as the record of transfer of licensed material as required by rules 3701:1-40-21, 3701:1-44-23, and 3701:1-56-10 of the Administrative Code;10 C.F.R. Parts 30, 40, and 70 as referenced by 3701-39-02.1;

7. For any shipments or any part of a shipment for which acknowledgement of receipt has not been received within the times set forth in this appendix, conduct an investigation in accordance with paragraph E of this appendix; and

8. Notify the shipper and the department of health, bureau of radiation protection (phone 614-644-2727) when any shipment, or part of a shipment, has not arrived within 60 days after receipt of an advance manifest, unless notified by the shipper that the shipment has been cancelled.

C. Any licensed waste processor who treats or repackages waste shall:

1. Acknowledge receipt of the waste from the shipper within one week of receipt by returning a signed copy of Shipment Manifest form "Shipping Paper";

2. Prepare a new manifest that meets the requirements of this appendix. Preparation of the new manifest reflects that the processor is responsible for meeting these requirements. For each container of waste in the shipment, the manifest shall identify the waste generators, the preprocessed waste volume, and the other information as required in paragraph i.e. of this appendix;

3. Prepare all wastes so that the waste is classified according to rule 3701:1-54-10 of the Administrative Code 10 C.F.R. 61.55 as referenced by 3701-39-02.1 and meets the waste characteristics requirements in rule 3701:1-54-10 of the Administrative Code; 10 C.F.R. 61.56 as referenced by 3701-39-02.1;

4. Label each package of waste to identify whether it is Class A waste, Class B waste, or Class C waste, in accordance with rule 3701:1-54-10 of the Administrative Code; 10 C.F.R. 61.55 and 61.57 as referenced by 3701-39-02.1;

5. Conduct a quality assurance program to assure compliance with rule 3701:1-54-10 of the Administrative Code 10 C.F.R. 61.55 and 61.56 as referenced by 3701-39-02.1 (The program shall include management evaluation of audits);

6. Forward a copy or electronically transfer the Radioactive Waste Shipment Manifest to the intended consignee so that either: (I) receipt of the manifest precedes the radioactive waste shipment or (II) the manifest is delivered to the consignee with the waste at the time the waste is transferred to the consignee. Using both (I) and (II) is also acceptable;

7. Include Shipment Manifest form "Shipping Paper" with the shipment regardless of the option chosen in paragraph C.6 of this section;

8. Receive acknowledgement of the receipt of the shipment in the form of a signed copy of Shipment Manifest form "Shipping Paper";

9. Retain a copy of or electronically store the Radioactive Waste Shipment Manifest and documentation of acknowledgement of receipt as the record of transfer of licensed material as required by rules 3701:1-40-21, 3701:1-44-23, and 3701:1-56-10 of the Administrative Code;10 C.F.R. Parts 30, 40, and 70 as referenced by 3701-39-02.1;

10. For any shipment or any part of a shipment for which acknowledgement of receipt has not been received within the times set forth in this appendix, conduct an investigation in accordance with paragraph E of this appendix; and

11. Notify the shipper and the department of health, bureau of radiation protection (phone 614-644-2727) when any shipment, or part of a shipment, has not arrived within 60 days after receipt of an advance manifest, unless notified by the shipper that the shipment has been cancelled.

D. The land disposal facility operator shall:

1. Acknowledge receipt of the waste within one week of receipt by returning, as a minimum, a signed copy of Shipment Manifest form "Shipping Paper" to the shipper.

The shipper to be notified is the licensee who last possessed the waste and transferred the waste to the operator. If any discrepancy exists between materials listed on the Radioactive Waste Shipment Manifest and materials received, copies or electronic transfer of the affected forms must be returned indicating the discrepancy;

2. Maintain copies of all completed manifests and electronically store the information required by rule 3701:1-54-12 of the Administrative Code 10 C.F.R. 61.80(l) as referenced in 3701-39-02.1 until the department terminates the license; and

3. Notify the shipper and the department of health, bureau of radiation protection (phone 614-644-2727) when any shipment, or part of a shipment, has not arrived within sixty days after receipt of an advance manifest, unless notified by the shipper that the shipment has been cancelled.

E. Any shipment or part of a shipment for which acknowledgement is not received within the times set forth in this section must:

1. Be investigated by the shipper if the shipper has not received notification or receipt within twenty days after transfer; and

2. Be traced and reported. The investigation shall include tracing the shipment and filing a report with the department of health, bureau of radiation protection (phone 614-644-2727). Each licensee who conducts a trace investigation shall file a written report with the department of health bureau of radiation protection within two weeks of completion of the investigation.

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3701:1-40-13 **Gas and aerosol detectors containing byproduct ~~or accelerator produced~~ material.**

(A) Except for persons who manufacture, process, produce, or initially transfer for sale or distribution gas and aerosol detectors containing byproduct ~~or accelerator produced~~ material, a person is exempt from license requirements set forth in this chapter or Chapters 3701:1-38, 3701:1-46, 3701:1-48, 3701:1-49, 3701:1-52, and 3701:1-58 of the Administrative Code to the extent that such person receives, possesses, uses, transfers, owns, or acquires byproduct ~~or accelerator produced~~ material, in gas and aerosol detectors designed to protect life or property from fires and airborne hazards, and manufactured, processed, produced, or initially transferred in accordance with a specific license for manufacture and distribution issued pursuant to rule 3701:1-46-27 of the Administrative Code, which license authorizes the initial transfer of the product for use under this rule.

(B) A person who desires to manufacture, process, or produce gas and aerosol detectors containing byproduct ~~or accelerator produced~~ material, or to initially transfer such products for use pursuant to paragraph (A) of this rule, shall apply for a license for manufacture and distribution pursuant to rule 3701:1-46-27 of the Administrative Code, which license states that the product may be initially transferred by the licensee to persons exempt from the regulations pursuant to paragraph (A) of this rule or equivalent regulations of an agreement state~~,~~ ~~NARM licensing state,~~ or the United States nuclear regulatory commission.

3701:1-40-14 **Application for specific licenses.**

(A) An applicant for a license to receive and possess byproduct ~~or accelerator produced~~ material shall apply in accordance with rule 3701:1-38-02 of the Administrative Code and this chapter on a form prescribed by the director. The original application shall be filed with the director. Information contained in previous applications, statements or reports filed with the director may be incorporated by reference, provided that the reference is clear, specific, and has been on file with the department for not more than two licensing periods, and provided that the item being referenced in the document is being referenced without change.

(B) The director may at any time after the filing of the original application require additional information from the applicant in order to determine whether a license should be issued or whether a current license should be modified or revoked.

(C) Each application shall be signed by the applicant or a person duly authorized to act for the applicant. ~~and shall be accompanied by the fee prescribed in rule 3701:1-38-02 of the Administrative Code.~~

(D) An application for a license to receive and possess byproduct ~~or accelerator produced~~ material for the conduct of any activity which the director has determined pursuant to rule 3701:1-40-36 of the Administrative Code ~~could potentially affect the quality of the environment~~ shall be filed at least nine months prior to commencement of construction of the plant or facility in which the activity will be conducted and shall be accompanied by any environmental report required pursuant to rule 3701:1-40-36 of the Administrative Code.

(E) An application for a specific license other than broad scope as defined in rule 3701:1-40-23 of the Administrative Code to use byproduct ~~or accelerator produced~~ material in the form of a sealed source or in a device that contains the sealed source must either:

(1) Identify the source or device by manufacturer and model number as registered in the sealed source and device registry of the United States nuclear regulatory commission in accordance with sealed source and device registry requirements contained in rule 3701:1-46-49 ~~of the Administrative Code~~, or with equivalent requirements from an agreement state~~, NARM licensing state,~~ or the United States nuclear regulatory commission; or

(2) Contain the information specified in sealed source and device registry requirements contained in paragraph (C) of rule 3701:1-46-49 ~~of the Administrative Code~~ so that the department is able to perform the review.

(F) In the case of an application for a license specified in rule 3701:1-40-16 of the Administrative Code, ~~or~~ an application for a specific license specified in Chapters

3701:1-46, 3701:1-48, or 3701:1-58 of the Administrative Code, the applicant shall provide a proposed decommissioning funding plan or a certification of financial assurance for decommissioning.

(G) Requirement for an emergency response plan:

(1) Each application to possess radioactive materials in unsealed form, on foils or plated sources, or sealed in glass in excess of the quantities specified in the appendix to this rule shall contain either:

(a) An evaluation showing that the maximum dose to a person offsite due to a release of radioactive materials would not exceed 0.01 sievert (one rem) TEDE or 0.05 sievert (five rem) to the thyroid; or

(b) An emergency plan for responding to a release of radioactive material.

(2) One or more of the following factors may be used to support an evaluation of the need to submit an emergency plan under this paragraph:

(a) The radioactive material is physically separated so that only a portion of the material could be involved in an accident;

(b) All or part of the radioactive material is not subject to release during an accident because of the way it is stored or packaged;

(c) The release fraction in the respirable size range would be lower than the release fraction specified in the appendix to this rule due to the chemical or physical form of the material;

(d) The solubility of the radioactive material would reduce the dose received;

(e) Facility design or engineered safety features in the facility would cause the release fraction to be lower than the limit specified in the appendix to this rule;

(f) Operating restrictions or procedures would prevent a release fraction as large as that shown in the appendix to this rule; or

(g) Other factors appropriate for the specific facility as determined by the director.

(3) An emergency plan for responding to a release of radioactive material submitted under paragraph (G)(1)(b) of this rule shall include the following information:

(a) A brief description of the licensee's facility and the area near the site.

(b) An identification of each type of possible radioactive material accident which may require protective action.

(c) A classification system for classifying an accident as either an alert or a site area emergency.

(d) Identification of the means of detecting each type of accident in a timely manner.

(e) 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.

(f) A brief description of the methods and equipment to assess releases of byproduct and accelerator produced materials.

(g) A brief description of the responsibilities of the licensee's personnel should an accident occur, including identification of personnel responsible for promptly notifying offsite response organizations and the department, and identification of personnel responsible for developing, maintaining, and updating the plan.

(h) A commitment to, and a brief description of, the means to promptly notify offsite response organizations and request offsite assistance, including medical assistance for the treatment of contaminated injured onsite workers when appropriate. A control point shall be established. The notification and coordination shall be planned so that in the event that some personnel, parts of the facility, or some equipment is not available, that unavailability will not prevent such notification and coordination. The licensee shall also commit to notifying the department immediately after notification of the appropriate offsite response organizations and not later than one hour after the licensee declares an emergency. These reporting requirements do not supersede or release licensees from complying with the requirements of the "Emergency Planning and Community Right-to-Know Act of 1986", Title III, Pub. L. 99-499 or other state or federal reporting requirements.

(i) A brief description of the types of information on facility status, radioactive releases, and recommended protective actions, if necessary, to be given to offsite response organizations and to the department.

(j) 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. The training also shall thoroughly prepare site personnel for their responsibilities in the event of an accident, including training on the emergency scenarios postulated as most probable for the specific site, and the use of team training for such scenarios.

(k) A brief description of the means of restoring the facility to a safe condition after an accident.

(l) Provisions for conducting quarterly communication checks with offsite response organizations and biennial onsite exercises to test response to simulated emergencies. Quarterly communication checks with offsite response organizations must include the check and update of all necessary telephone numbers. The licensee shall invite offsite response organizations to participate in the biennial exercises. Participation of offsite response organizations in biennial exercises, although recommended, is not required. Exercises must 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 not having direct implementation responsibility for the plan. Critiques of exercises must evaluate the appropriateness of the plan, emergency procedures, facilities, equipment, training of personnel, and overall effectiveness of the response. Deficiencies found by the critiques must be corrected.

(m) A certification that the applicant has met all responsibilities under the "Emergency Planning and Community Right-to-Know Act of 1986," Title III, Pub. L. 99-499, if applicable to the applicant's activities at the proposed place of use of the byproduct or accelerator produced material.

(n) The licensee must have and maintain liability coverage for incidents which would activate the plan to cover bodily injury and property damage to third parties caused by incidents which would activate the plan in the amount of at least one million dollars per occurrence with an annual aggregate of at least two million dollars, exclusive of legal defense costs.

(4) The licensee shall allow the offsite response organizations expected to respond in case of an accident sixty days to comment on the licensee's emergency plan before submitting it to the department. The licensee shall provide any comments received within the sixty days to the department with the emergency plan.

(H) Information provided by a licensee or applicant for a license or license renewal that constitutes a "trade secret" as defined in section 1333.61 of the Revised Code is not subject to public disclosure in accordance with sections 1333.61 to 1333.69 of the Revised Code.

(I) An application from a medical facility, or educational institution to produce positron emission tomography (PET) radioactive drugs for noncommercial transfer to licensees in its consortium authorized for medical use in accordance with rules in Chapter 58 of the Administrative Code shall include:

(1) A request for authorization for the production of PET radionuclides or evidence of an existing license issued in accordance with rule 3701:1-38-02 of the Administrative Code for a PET radionuclide production facility within its consortium from which it receives PET radionuclides.

(2) Evidence that the applicant is qualified to produce radioactive drugs for medical use by meeting one of the criteria in paragraph (A)(2) of rule 3701:1-46-43 of the Administrative Code.

(3) Identification of individual(s) authorized to prepare the PET radioactive drugs if the applicant is a pharmacy, and documentation that each individual meets the requirements of an authorized nuclear pharmacist as specified in paragraph (B)(2) of rule 3701:1-46-43 of the Administrative Code.

(4) Information identified in paragraph (A)(3) of rule 3701:1-46-43 of the Administrative Code, on the PET drugs to be non-commercially transferred to members of its consortium.

~~(J) Portable gauging devices shall be licensed using a specific license.~~

~~(J) Devices containing radioactive material meeting the criteria in paragraph (C)(12) of rule 3701:1-46-05 of the Administrative Code shall be licensed using a specific license.~~

Appendix A

Quantities of Radioactive Materials Requiring Consideration of the Need for an Emergency Plan for Responding to a Release

Radionuclide[1]	Release Fraction	Quantity (TBq)	Quantity (Ci)
Actinium-228	0.001	148	4,000
Americium-241	0.001	0.074	2
Americium-242	0.001	0.074	2
Americium-243	0.001	0.074	2
Antimony-124	0.01	148	4,000
Antimony-126	0.01	222	6,000
Barium-133	0.01	370	10,000
Barium-140	0.01	1110	30,000
Bismuth-207	0.01	185	5,000
Bismuth-210	0.01	22.2	600
Cadmium-109	0.01	37	1,000
Cadmium-113	0.01	2.96	80
Calcium-45	0.01	740	20,000
Californium-252	0.001	0.333	9 (20 MG)
Carbon-14 (non-carbon dioxide)	0.01	1850	50,000
Cerium-141	0.01	370	10,000
Cerium-144	0.01	11.1	300
Cesium-134	0.01	74	2,000
Cesium-137	0.01	111	3,000
Chlorine-36	0.5	3.7	100
Chromium-51	0.01	11100	300,000
Cobalt-60	0.001	185	5,000
Copper-64	0.01	7400	200,000
Curium-242	0.001	2.22	60

Appendix A

Radionuclide[1]	Release Fraction	Quantity (TBq)	Quantity (Ci)
Curium-243	0.001	0.111	3
Curium-244	0.001	0.148	4
Curium-245	0.001	0.074	2
Europium-152	0.01	18.5	500
Europium-154	0.01	14.8	400
Europium-155	0.01	111	3,000
Germanium-68	0.01	74	2,000
Gadolinium-153	0.01	185	5,000
Gold-198	0.01	1110	30,000
Hafnium-172	0.01	14.8	400
Hafnium-181	0.01	259	7,000
Holmium-166M	0.01	3.7	100
Hydrogen-3	0.5	740	20,000
Iodine-125	0.5	0.37	10
Iodine-131	0.5	0.37	10
Indium-114M	0.01	37	1,000
Iridium-192	0.001	1480	40,000
Iron-55	0.01	1480	40,000
Iron-59	0.01	259	7,000
Krypton-85	1.0	222000	6,000,000
Lead-210	0.01	0.296	8
Manganese-56	0.01	2220	60,000
Mercury-203	0.01	370	10,000
Molybdenum-99	0.01	1110	30,000
Neptunium-237	0.001	0.074	2
Nickel-63	0.01	740	20,000

Appendix A

Radionuclide[1]	Release Fraction	Quantity (TBq)	Quantity (Ci)
Niobium-94	0.01	11.1	300
Phosphorus-32	0.5	3.7	100
Phosphorus-33	0.5	37	1,000
Polonium-210	0.01	0.37	10
Potassium-42	0.01	333	9,000
Promethium-145	0.01	140	4,000
Promethium-147	0.01	148	4,000
Radium-226	0.001	3.7	100
Ruthenium-106	0.01	7.4	200
Samarium-151	0.01	148	4,000
Scandium-46	0.01	111	3,000
Selenium-75	0.01	370	10,000
Silver-110m	0.01	37	1,000
Sodium-22	0.01	333	9,000
Sodium-24	0.01	370	10,000
Strontium-89	0.01	111	3,000
Strontium-90	0.01	3.33	90
Sulfur-35	0.5	33.3	900
Technetium-99	0.01	370	10,000
Technetium-99m	0.01	14800	400,000
Tellurium-127m	0.01	185	5,000
Tellurium-129m	0.01	185	5,000
Terbium-160	0.01	148	4,000
Thulium-170	0.01	148	4,000
Tin-113	0.01	370	10,000
Tin-123	0.01	111	3,000

Appendix A

Radionuclide[1]	Release Fraction	Quantity (TBq)	Quantity (Ci)
Tin-126	0.01	37	1,000
Titanium-44	0.01	3.7	100
Vanadium-48	0.01	259	7,000
Xenon-133	1.0	33300	900,000
Yttrium-91	0.01	74	2,000
Zinc-65	0.01	185	5,000
Zirconium-93	0.01	14.8	400
Zirconium-95	0.01	185	5,000
Any other beta-gamma emitter	0.01	370	10,000
Mixed fission products	0.01	37	1,000
Mixed corrosion products	0.01	370	10,000
Contaminated equipment beta-gamma	0.001	370	10,000
Irradiated material, any form other than solid noncombustible.	0.01	37	1,000
Irradiated material, solid noncombustible	0.001	370	10,000
Mixed radioactive waste, beta-gamma	0.01	37	1,000
Packaged mixed waste, beta-gamma	0.001	370	10,000
Any other alpha emitter	0.001	0.074	2
Contaminated equipment, alpha	0.0001	0.74	20
Packaged waste, alpha	0.0001	0.74	20
Combinations of radioactive materials listed above[1]			

[1] 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 this appendix exceeds one.

[2] Waste packaged in Type B containers does not require an emergency plan.

(F) Each licensee must notify the department by certified mail within ten business days of the commencement of a voluntary or involuntary bankruptcy petition that has been filed by or against:

(1) The licensee;

(2) An entity, defined in this rule as person, estate, trust, governmental unit, and United States trustee, controlling the licensee or listing the license or licensee as property of the estate; or

(3) An affiliate of the licensee defined in this rule as an entity that directly or indirectly owns, controls, or holds with power to vote, twenty per cent or more of the outstanding voting securities of the debtor, other than an entity that holds such securities:

(a) In a fiduciary or agency capacity without sole discretionary power to vote such securities; or

(b) Solely to secure a debt, if such entity has not in fact exercised such power to vote.

The notification shall specify the bankruptcy court in which the petition for bankruptcy was filed and the date of the filing petition.

(G) The director may, upon application including adequate documentation by a person or by his own initiative, grant such exemptions from the requirements of this chapter or other chapters of the Administrative Code involving radioactive materials promulgated under Chapter 3748. of the Revised Code that are authorized by law and will not result in undue hazard to life or property and are otherwise in the public interest.

(H) Each portable gauge licensee shall use a minimum of two independent physical controls that form tangible barriers to secure portable gauges from unauthorized removal, whenever portable gauges are not under the control and constant surveillance of the licensee.

(I)

(1) Authorization under paragraph (I) of rule 3701:1-40-17 of the Administrative Code to produce positron emission tomography (PET) radioactive drugs for noncommercial transfer to medical use licensees in its consortium does not relieve the licensee from complying with applicable United States federal drug administration, other federal, and state requirements governing radioactive drugs.

*** DRAFT – NOT FOR FILING ***

3701:1-40-16 **Terms and conditions of licenses.**

(A) A license, or any right under a license, shall not be transferred, assigned or in any manner disposed of, either voluntarily or involuntarily, directly or indirectly, through transfer of control of any license to any person, unless the director finds that the transfer is in accordance with this rule and Chapters 3701:1-46, 3701:1-48, 3701:1-49, 3701:1-52, and 3701:1-58 of the Administrative Code. A license or any right contained therein may not be transferred or conveyed without the written authorization of the director. If the director approves the transfer and receives payment of the appropriate licensing fee, a new license will be issued to the transferee.

(B) Each licensee shall confine possession and use of byproduct ~~or accelerator produced~~ material to the locations and purposes authorized in the license. Preparation for shipment and transport of byproduct ~~or accelerator produced~~ material shall be in accordance with Chapter 3701:1-50 of the Administrative Code.

(C) The director may incorporate at the time of issuance, or thereafter by appropriate rule, regulation, or order, such additional requirements or conditions with respect to the licensee's receipt, possession, use and transfer of byproduct ~~or accelerator produced~~ material as the director deems appropriate or necessary in order to protect the environment, protect health, or minimize danger to life or property. The director may require such reports and the keeping of such records, and provide for such inspections of activities under the license as may be necessary to effectuate the purposes of Chapter 3748. of the Revised Code or rules adopted thereunder.

(D) A licensee that is required to submit an emergency plan pursuant to rule 3701:1-40-14 of the Administrative Code shall follow the emergency plan approved by the director. The licensee may amend the approved plan without approval of the director provided that the amendment does not decrease the effectiveness of the plan. Within six months after amending the emergency plan, the licensee shall furnish the amended plan to both the director and to affected offsite response organizations. Any proposed amendment to the emergency plan that decreases, or potentially decreases, the effectiveness of the approved emergency plan may not be implemented without prior approval by the director.

(E) Each licensee preparing technetium-99m radiopharmaceuticals from molybdenum-99/technetium-99m generators or rubidium-82 from strontium-82/rubidium-82 generators shall test the generator eluates for molybdenum-99 breakthrough or strontium-82 and strontium-85 contamination, respectively, in accordance with rule 3701:1-58-35 -of the Administrative Code. The licensee shall record the results of each test and retain each record for three years after the record is made.

(2) Each licensee authorized under paragraph (I) of rule 3701:1-40-17 of the Administrative Code to produce PET radioactive drugs for noncommercial transfer to medical use licensees in its consortium shall:

(a) Satisfy the labeling requirements in paragraph (A)(4) of rule 3701:1-46-43 of the Administrative Code for each PET radioactive drug transport radiation shield and each syringe, vial, or other container used to hold a PET radioactive drug intended for noncommercial distribution to members of its consortium.

(b) Possess and use instrumentation to measure the radioactivity of the PET radioactive drugs intended for noncommercial distribution to members of its consortium and meet the procedural, radioactivity measurement, instrument test, instrument check, and instrument adjustment requirements in paragraph (C) of rule 3701:1-46-43 of the Administrative Code.

(3) A licensee that is a pharmacy authorized under paragraph (I) of rule 3701:1-40-17 of the Administrative Code to produce PET radioactive drugs for noncommercial transfer to medical use licensees in its consortium shall require that any individual that prepares PET radioactive drugs shall be:

(a) An authorized nuclear pharmacist that meets the requirements in paragraph (B)(2) of rule 3701:1-46-43 of the Administrative Code, or

(b) An individual under the supervision of an authorized nuclear pharmacist as specified in rule 3701:1-58-14 of the Administrative Code.

(4) A pharmacy, authorized under paragraph (I) of rule 3701:1-40-17 of the Administrative Code to produce PET radioactive drugs for noncommercial transfer to medical use licensees in its consortium that allows an individual to work as an authorized nuclear pharmacist, shall meet the requirements of paragraph (B)(5) of rule 3701:1-46-43 of the Administrative Code.

*** DRAFT – NOT FOR FILING ***

3701:1-40-22 **Specific licenses of broad scope.**

(A) An application for specific license of broad scope shall be made in accordance with rules 3701:1-38-02 and 3701:1-40-14 of the Administrative Code.

(1) If a current licensee wants to obtain a broad scope license, the application will be considered by the director if the application addresses and meets requirements of this chapter and rule 3701:1-38-02 of the Administrative Code.

(2) Broad scope licensees are not exempt from the notification requirements in paragraph (C) of rule 3701:1-40-18 of the Administrative Code.

(B) A "type A specific license of broad scope", or "type A broad license" is a specific license authorizing receipt, acquisition, ownership, possession, use, and transfer of any chemical or physical form of the byproduct ~~or accelerator-produced~~ material specified in the license, but not exceeding quantities specified in the license, for authorized purposes, with quantities usually greater than one curie.

(C) A "type B specific license of broad scope" or "type B broad license" is a specific license authorizing receipt, acquisition, ownership, possession, use, and transfer of any chemical or physical form of byproduct ~~or accelerator-produced~~ material specified in column I of the appendix to this rule for authorized purposes. The possession limit for a type B broad license, if only one radionuclide is possessed thereunder, is the quantity specified for that radionuclide in column I of the appendix to this rule. If two or more radionuclides are possessed under a type B broad license, the possession limit for each is calculated as follows:

(1) For each radionuclide, determine the ratio of the quantity possessed to the applicable quantity specified for that radionuclide in column I of the appendix to this rule.

(2) Add the ratios for all radionuclides possessed under the license. The possession limit is reached when the sum of all ratios ~~exceed~~exceeds unity.

(D) A "type C specific license of broad scope" or "type C broad license" is a specific license authorizing receipt, acquisition, ownership, possession, use, and transfer of any chemical or physical form of byproduct ~~or accelerator-produced~~ material specified in column II of the appendix to this rule, for authorized purposes. The possession limit for a type C broad license, if only one radionuclide is possessed thereunder, is the quantity specified for that radionuclide in column II of the appendix to this rule. If two or more radionuclides are possessed under a type C broad license, the possession limit for each is calculated as follows:

(1) For each radionuclide, determine the ratio of the quantity possessed to the applicable quantity specified for that radionuclide in column II of the appendix to this rule.

(2) Add the ratios for all radionuclides possessed under the license. The possession limit is reached when the sum of all ratios ~~exceed~~exceeds unity.

3701:1-46-02 **Purpose and scope.**

(A) This chapter establishes general licenses for the possession and use of byproduct~~, accelerator produced~~ material~~, or radium~~ and a general license for ownership of byproduct~~, accelerator produced~~ material~~, or radium~~. Specific provisions of Chapter 3701:1-40 of the Administrative Code are applicable to general licenses established by this chapter. These provisions are specified in rule 3701:1-46-03 of the Administrative Code or in the particular general license.

(B) This chapter prescribes requirements for the issuance of specific licenses to persons who manufacture or initially transfer items containing byproduct~~, accelerator produced~~ material~~, or radium~~ for sale or distribution to persons generally licensed under Chapter 3701:1-46 or 3701:1-58 of the Administrative Code –or equivalent regulations of the United States nuclear regulatory commission or equivalent agreement state regulations.

(C) This chapter also prescribes certain rules governing holders of these licenses. In addition, this chapter prescribes requirements for the issuance of specific licenses to persons who introduce byproduct~~, accelerator produced~~ material~~, or radium~~ into a product or material owned by or in the possession of the licensee or person and rules governing holders of such licenses. Further, this chapter describes procedures and prescribes requirements for the issuance of sealed source and device certificates (covering radiation safety information about a product) to manufacturers or initial transferors of sealed sources or devices containing sealed sources which are to be used by persons specifically licensed under Chapter 3701:1-40 of the Administrative Code or equivalent regulations of the United States nuclear regulatory commission or an agreement state.

(D) The provisions and requirements of this chapter are in addition to, and not in substitution for, other requirements of Chapter 3701:1-40 of the Administrative Code which apply to applications and licenses subject to this chapter.

3701:1-46-05 **Certain measuring, gauging or controlling devices.**

(A) A general license is hereby issued to commercial and industrial firms; research, educational, and medical institutions; individuals in the conduct of their business; and state or local government agencies to acquire, receive, possess, use or transfer, in accordance with the provisions of paragraphs (B) to (D) of this rule, radioactive 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.

(B)

(1) The general license in paragraph (A) of this rule applies only to radioactive material contained in devices which have been manufactured or initially transferred and labeled in accordance with the specifications contained in:

(a) A specific license issued under rule 3701:1-46-30 of the Administrative Code;

(b) An equivalent specific license issued by an agreement state; or

(c) An equivalent specific license issued by the United States nuclear regulatory commission.

(2) The devices must have been received from one of the specific licensees described in paragraph (B)(1) of this rule or through a transfer made under paragraph (C)(9) of this rule.

(C) Any person who acquires, receives, possesses, uses or transfers radioactive material in a device pursuant to the general license in paragraph (A) of this rule:

(1) Shall assure that all labels affixed to the device at the time of receipt and bearing a statement that removal of the label is prohibited are maintained thereon and shall comply with all instructions and precautions provided by such labels;

(2) Shall assure that the device is tested for leakage of radioactive material and proper operation of the on-off mechanism and indicator, if any, at no longer than six-month intervals or at such other intervals as are specified in the label; however:

(a) Devices containing only krypton need not be tested for leakage of radioactive material, and

(b) Devices containing only tritium or not more than 3.7 megabecquerels (one hundred microcuries) of other beta and/or gamma emitting material or three hundred seventy kilobecquerels (ten microcuries) of alpha emitting material and devices held in storage in the original shipping container prior to initial installation need not be tested for any purpose;

(3) Shall assure that the tests required by paragraph (C)(2) of this rule and other testing, installation, servicing, and removal from installation involving the radioactive materials, its shielding or containment, are performed:

(a) In accordance with the instructions provided by the labels; or

(b) By a person holding a specific license pursuant to this chapter and Chapter 3701:1-40 of the Administrative Code or from an agreement state or the United States nuclear regulatory commission to perform such activities;

(4) Shall maintain records showing compliance with the requirements of paragraphs (C)(2) and (C)(3) of this rule. The records must show the results of tests. The records also must show the dates of performance of, and the names of persons performing, testing, installing, servicing, and removing from the installation radioactive material and its shielding or containment. The licensee shall retain these records as follows:

(a) Each record of a test for leakage or radioactive material required by paragraph (C)(2) of this rule must be retained for three years after the next required leak test is performed or until the sealed source is transferred or disposed of.

(b) Each record of a test of the on-off mechanism and indicator required by paragraph (C)(2) of this rule must be retained for three years after the next required test of the on-off mechanism and indicator is performed or until the sealed source is transferred or disposed of.

(c) Each record that is required by paragraph (C)(3) of this rule must be retained for three years from the date of the recorded event or until the device is transferred or disposed of.

(5) Shall immediately suspend operation of the device if there is a failure of, or damage to, or any indication of a possible failure of or damage to, the shielding of the radioactive material or the on-off mechanism or indicator, or upon the detection of one hundred eighty-five becquerels (0.005 microcurie) or more removable radioactive material. The device may not be operated until it has been repaired by the manufacturer or other person holding a specific license to repair such devices that was issued under Chapters 3701:1-40 and 3701:1-46 of the Administrative Code or by an agreement state or the United States nuclear regulatory commission. The device and any radioactive material from the device

may only be disposed of by transfer to a person authorized by a specific license to receive the radioactive material in the device or as otherwise approved by the director. A report containing a brief description of the event and the remedial action taken; and, in the case of detection of one hundred eighty-five becquerels (0.005 microcurie) or more removable radioactive material or failure of or damage to a source likely to result in contamination of the premises or the environs, a plan for ensuring that the premises and environs are acceptable for unrestricted use, must be furnished to the director within thirty days.

(6) Shall not abandon the device containing radioactive material;

(7) Shall not export the device containing radioactive material except in accordance with applicable United States nuclear regulatory commission regulations;

(8)

(a) Shall transfer or dispose of the device containing radioactive material only by export as provided by paragraph (C)(7) of this rule, by transfer to another general licensee as authorized in paragraph (C)(9) of this rule, or to a person authorized to receive the device by a specific license issued under this chapter and Chapter 3701:1-40 of the Administrative Code, utilizing a licensed broker or other authorized waste collector, or equivalent regulations of an agreement state, United States nuclear regulatory commission, or as approved under paragraph (C)(8)(c) of this rule.

(b) Shall within thirty days after the transfer of a device to a specific licensee or export, furnish a report to the director by an appropriate method listed in rule 3701:1-40-04 of the Administrative Code, The report must contain:

(i) The identification of the device by manufacturer's (or initial transferor's) name, model number, and serial number;

(ii) The name, address, and license number of the person receiving the device; and

(iii) The date of the transfer.

(c) Shall obtain written director approval before transferring the device to any other specific licensee not specifically identified in paragraph (C)(8)(a) of this rule; however, a holder of a specific license may transfer a device for possession and use under its own specific license without prior approval, if the holder:

(i) Verifies that the specific license authorizes the possession and use, or applies for and obtains an amendment to the license authorizing the possession and use;

(ii) Removes, alters, covers, or clearly and unambiguously augments the existing label (otherwise required by paragraph (C)(1) of this rule) so that the device is labeled in compliance with rule 3701:1-38-18 of the Administrative Code; however the manufacturer, model number, and serial number must be retained;

(iii) Obtains the manufacturer's or initial transferor's information concerning maintenance that would be applicable under the specific license (such as leak testing procedures); and

(iv) Reports the transfer under paragraph (C)(8)(b) of this rule.

(9) Shall transfer the device to another general licensee only if:

(a) The device remains in use at a particular location. In this case, the transferor shall give the transferee a copy of this rule and any safety documents identified in the label of the device. Within thirty days of the transfer, the transferor shall report to the department:

(i) The manufacturer's (or initial transferor's) name;

(ii) The model number and the serial number of the device transferred;

(iii) The transferee's name and mailing address for the location of use; and

(iv) The name, title, and phone number of the responsible individual identified by the transferee in accordance with paragraph (C)(12) of this rule to have knowledge of and authority to take actions to ensure compliance with the appropriate rules and requirements; or

(b) The device is held in storage by an intermediate person in the original shipping container at its intended location of use prior to initial use by a general licensee.

(10) Shall comply with the provisions of paragraphs (A) and (B) of rule 3701:1-38-21 of the Administrative Code for reporting radiation incidents, theft or loss of licensed material, but shall be exempt from the other requirements of Chapter 3701:1-38 of the Administrative Code.

(11) Shall respond to written requests from the director to provide information relating to the general license within thirty calendar days of the date of the request, or other time specified in the request. If the general licensee cannot provide the requested information within the allotted time, it shall, within that same time period, request a longer period to supply the information by providing

the director, by an appropriate method listed in rule 3701:1-40-04 of the Administrative Code, a written justification for the request.

(12) Shall appoint an individual responsible for having knowledge of the appropriate rules and requirements and the authority for taking required actions to comply with appropriate rules and requirements. The general licensee, through this individual, shall ensure the day-to-day compliance with appropriate rules and requirements. This appointment does not relieve the general licensee of responsibility in this regard.

(13)

(a) Shall report, in accordance with paragraphs (C)(13)(b) and (C)(13)(c) of this rule, devices containing at least three hundred seventy megabecquerels (ten millicuries) of cesium-137, 3.7 megabecquerels (0.1 millicurie) of strontium-90, thirty-seven megabecquerels (one millicurie) of cobalt-60, 3.7 ~~kilobecquerels~~megabecquerels (0.1 ~~microcurie~~millicurie) of radium, or thirty-seven megabecquerels (one millicurie) of americium-241 or any other transuranic, i.e., element with atomic number greater than uranium (92), based on the activity indicated on the label. Each address for a location of use, as described under paragraph (C)(13)(c)(iv) of this rule, represents a separate general license and requires a separate registration and fee.

(b) If in possession of a device meeting the criteria of paragraph (C)(13)(a) of this rule, shall report these devices annually to the director and shall pay the fee required by paragraph ~~(U)~~(S) of rule 3701:1-38-02 of the Administrative Code. Reporting must be done by verifying, correcting, and/or adding to the information provided in a request received from the director. The information must be submitted to the director within thirty days of the date of the request for information or as otherwise indicated in the request. In addition, a general licensee holding devices meeting the criteria of paragraph (C)(13)(a) of this rule is subject to the bankruptcy notification requirement in Chapter 3701:1-40 of the Administrative Code.

(c) In reporting the devices, the general licensee shall furnish the following information and any other information specifically requested by the director:

(i) Name and mailing address of the general licensee.

(ii) Information about each device: the manufacturer (or initial transferor), model number, serial number, the radionuclide and activity (as indicated on the label).

(iii) Name, title, and telephone number of the responsible person designated as a representative of the general licensee under paragraph (C)(12) of this rule.

(iv) Address or location at which the device(s) are used and/or stored.

(v) Certification by the responsible representative of the general licensee that the information concerning the device(s) has been verified through a physical inventory and checking of label information.

(vi) Certification by the responsible representative of the general licensee that they are aware of the requirements of the general license.

(14) Shall report changes to the mailing address for the location of use (including change in name of general licensee) to the director within thirty days of the effective date of the change.

(15) May not hold devices that are not in use for longer than two years. If devices with shutters are not being used, the shutter must be locked in the closed position. The testing required by paragraph (C)(2) of this rule need not be performed during the period of storage only. However, when devices are put back into service or transferred to another person, and have not been tested within the required test interval, they must be tested for leakage before use or transfer and the shutter tested before use. Devices kept in standby for future use are excluded from the two year time limit if the general licensee performs quarterly physical inventories of these devices while they are in standby.

(D) The director may order the inspection of any facility licensed under this rule if the director determines that an appropriate reason for the inspection exists. These inspections shall be considered as full cost inspections as defined in rule 3701:1-38-02 of the Administrative Code. The reasons the director may conduct for cause inspections include, but are not limited to,

(1) Failure to respond to official correspondence,

(2) Release of radioactive material to the environment,

(3) Investigations of alleged violations of department rules, or

(4) Failure to comply with the license application process.

~~(E) All portable devices containing radioactive material, used within the state of Ohio, shall be licensed in accordance with rule 3701:1-38-02 and paragraph (I) of rule 3701:1-40-14 of the Administrative Code.~~

~~(F)~~(E) The general license in paragraph (A) of this rule does not authorize the manufacture or import of devices containing radioactive material.

3701:1-46-08 **Americium-241 or radium-226 in the form of calibration or reference sources.**

(A) A general license is hereby issued to those persons listed below to own, receive, acquire, possess, use and transfer, in accordance with the provisions of paragraphs (B) and (C) of this rule, americium-241 or radium-226 in the form of calibration or reference sources.

(B) The general license in paragraph (A) of this rule applies only to calibration or reference sources which have been manufactured or initially transferred in accordance with the specifications contained in a specific license issued pursuant to rule 3701:1-46-37 of the Administrative Code or in accordance with the specifications contained in a specific license issued to the manufacturer by the United States nuclear regulatory commission or another agreement state which authorizes manufacture of the sources for distribution to persons with a general license by the United States nuclear regulatory commission or another agreement state.

(C) The general license in paragraph (A) of this rule is subject to the provisions of paragraph (D) of 3701:1-40-08, paragraphs (A) to (C) of 3701:1-40-16, rules 3701:1-40-19 to 3701:1-40-21, and Chapter 3701:1-38 of the Administrative Code. In addition, persons who own, receive, acquire, possess, use and transfer one or more calibration or reference sources pursuant to this general license:

(1) Shall not possess at any one time, at any one location of storage or use, more than one hundred eighty-five kilobecquerels (five microcuries) of americium-241 or radium-226 in such sources:

(2) Shall not receive, possess, use or transfer such source unless the source, or the storage container, bears a label which includes the following statement or a substantially similar statement which contains the information called for in the following statement for Am-241:

(a) The receipt, possession, use and transfer of this source, model __, serial no. __, are subject to a general license and the regulations of the United States 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 AMERICIUM-241. DO NOT TOUCH RADIOACTIVE PORTION OF THIS SOURCE"

(Name of manufacturer or initial transferor)

Or for radium-226;

(b) The receipt, possession, use and transfer of this source, model_____, serial no. _____, are subject to a general license and the regulations of the United States nuclear regulatory commission or an agreement 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 initial transferor)

Sources generally licensed under the nuclear regulatory commission or an agreement state prior to January 19, 1975, may bear labels authorized by the United States nuclear regulatory commission regulations in effect on January 1, 1975.

(3) Shall not transfer, abandon, or dispose of such source except by transfer to a person authorized by a license pursuant to this chapter or from an agreement state, the United States nuclear regulatory commission to receive the source.

(4) Shall store such source, except when the source is being used, in a closed container adequately designed and constructed to contain either americium-241 or radium-226, as applicable which might otherwise escape during storage.

(5) Shall not use such source for any purpose other than the calibration of radiation detectors or the standardization of other sources.

(D) This general license does not authorize the manufacture or import of calibration or reference sources containing americium-241 or radium-226.

(E) This general license does not authorize the export of calibration or reference sources containing americium-241 or radium-226.

3701:1-46-11 **General license for use of ~~either~~ byproduct ~~or accelerator-produced~~ material for certain in-vitro clinical or laboratory testing.**

(A) A general license is hereby issued to any physician, veterinarian in the practice of veterinary medicine, clinical laboratory or hospital to receive, acquire, possess, transfer, or use, for any of the following stated tests, in accordance with the provisions of paragraphs (B) to (F) of this rule, the following byproduct ~~or accelerator-produced~~ materials in prepackaged units:

(1) Iodine-125, in units not exceeding three hundred seventy kilobecquerels (ten microcuries) each for use in in-vitro clinical or laboratory tests not involving internal or external administration of byproduct ~~or accelerator-produced~~ material, or the radiation therefrom, to human beings or animals.

(2) Iodine-131, in units not exceeding three hundred seventy kilobecquerels (ten microcuries) each for use in in-vitro clinical or laboratory tests not involving internal or external administration of byproduct material, or the radiation therefrom, to human beings or animals.

(3) Carbon-14, in units not exceeding three hundred seventy kilobecquerels (ten microcuries) each for use in in-vitro clinical or laboratory tests not involving internal or external administration of byproduct material, or the radiation therefrom, to human beings or animals.

(4) Hydrogen-3 (tritium), in units not exceeding 1.85 megabecquerels (fifty microcuries) each for use in in-vitro clinical or laboratory tests not involving internal or external administration of byproduct material, or the radiation therefrom, to human beings or animals.

(5) Iron-59, in units not exceeding seven hundred forty kilobecquerels (twenty microcuries) each for use in in-vitro clinical or laboratory tests not involving internal or external administration of byproduct material, or the radiation therefrom, to human beings, or animals.

(6) Selenium-75, in units not exceeding three hundred seventy kilobecquerels (ten microcuries) each for use in in-vitro clinical or laboratory tests not involving internal or external administration of byproduct material, or the radiation therefrom, to human beings or animals.

(7) Mock iodine-125 reference or calibration sources, in units not exceeding 1.85 kilobecquerels (0.05 microcurie) of iodine-129 and one hundred eighty-five becquerels (0.005 microcurie) of americium-241 each for use in in-vitro clinical or laboratory tests not involving internal or external administration of byproduct material, or the radiation therefrom, to human beings or animals.

(8) Cobalt-57, in units not exceeding three hundred seventy kilobecquerels (ten microcuries) each for use in in-vitro clinical or laboratory tests not involving internal or external administration of ~~accelerator produced~~byproduct material, or the radiation therefrom, to human beings or animals.

(B) A person shall not receive, acquire, possess, use, or transfer byproduct ~~or accelerator produced~~ material under the general license established by paragraph (A) of this rule unless that person:

(1) Has filed the radioactive materials in-vitro testing form with the director; or

(2) Has a license that authorizes the medical use of byproduct ~~or accelerator produced~~ material that was issued under rules for medical uses of radioactive material.

(C) A person who receives, acquires, possesses, or uses byproduct ~~or accelerator produced~~ material pursuant to the general license established by paragraph (A) of this rule shall comply with the following:

(1) The general licensee shall not possess at any one time, pursuant to the general license in paragraph (A) of this rule, at any one location of storage or use, a total amount of iodine-125, iodine-131, selenium-75, iron-59, and/or cobalt-57 in excess of 7.4 megabecquerels (two hundred microcuries).

(2) The general licensee shall store the byproduct ~~or accelerator produced~~ material, until used, in the original shipping container or in a container providing equivalent radiation protection.

(3) The general licensee shall use the byproduct ~~or accelerator produced~~ material only for the uses authorized by paragraph (A) of this rule.

(4) The general licensee shall not transfer the byproduct ~~or accelerator produced~~ material except by transfer to a person authorized to receive it by a license pursuant to this chapter, from the United States nuclear regulatory commission, or from an agreement state or transfer the byproduct ~~or accelerator produced~~ material in any manner other than in the unopened, labeled shipping container as received from the supplier.

(5) The general licensee shall dispose of the mock iodine-125 reference or calibration sources described in paragraph (A)(7) of this rule as required by rule 3701:1-38-19 of the Administrative Code.

(D) The general licensee shall not receive, acquire, possess or use byproduct ~~or accelerator produced~~ material pursuant to paragraph (A) of this rule:

(1) Except as prepackaged units which are labeled in accordance with the provisions of a specific license issued under the provisions of rule 3701:1-46-42 of the Administrative Code or in accordance with the provisions of a specific license issued by the United States nuclear regulatory commission or an agreement state that authorizes manufacture and distribution of iodine-125, iodine-131, carbon-14, hydrogen-3 (tritium), selenium-75, iron-59, mock iodine-125, or cobalt-57 for distribution to persons generally licensed by the United States nuclear regulatory commission or an agreement state.

(2) Unless the following statement, or a substantially similar statement which contains the information called for in the following statement, appears on a label affixed to each prepackaged unit or appears in a leaflet or brochure which accompanies the package: This radioactive material may be received, acquired, possessed, and used only by physicians, veterinarians in the practice of veterinary medicine, 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 therefrom, to human beings or animals. Its receipt, acquisition, possession, use, and transfer are subject to the regulations and a general license of the United States 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)

(E) The licensee possessing or using byproduct ~~or accelerator produced~~ materials under the general license of paragraph (A) of this rule shall report in writing to the director any changes in the information furnished by the licensee in department form HEA-5518, "In-Vitro Testing With Radioactive Material Form." The report shall be furnished within thirty days after the effective date of such change.

(F) Any person using byproduct ~~or accelerator produced~~ material pursuant to the general license of paragraph (A) of this rule is exempt from the requirements of Chapter 3701:1-38 of the Administrative Code with respect to byproduct ~~or accelerator produced~~ materials covered by that general license, except that such persons using the mock iodine-125 described in paragraph (A)(7) of this rule shall comply with the provisions of paragraph (A) of rule 3701:1-38-19 of the Administrative Code and paragraphs (A) and (B) of rule 3701:1-38-21 of the Administrative Code.

3701:1-46-37 **Calibration or reference sources containing americium-241 or radium-226: requirements for license to manufacture or initially transfer.**

An application for a specific license to manufacture or initially transfer calibration or reference sources containing americium-241 or radium-226, for distribution to persons generally licensed under rule 3701:1-46-08 of the Administrative Code, will be approved if:

(A) The applicant satisfies the general requirements of rule 3701:1-40-15 of the Administrative Code;

(B) The applicant submits sufficient information regarding each type of calibration or reference source pertinent to evaluation of the potential radiation exposure, including:

(1) Chemical and physical form and maximum quantity of americium-241 or radium-226 in the source;

(2) Details of construction and design;

(3) Details of the method of incorporation and binding of the americium-241 or radium-226 in the source;

(4) Procedures for and results of prototype testing of sources, which are designed to contain more than one hundred eighty-five becquerels (0.005 microcurie) of americium-241 or radium-226, to demonstrate that the americium-241 or radium-226 contained in each source will not be released or be removed from the source under normal conditions of use;

(5) Details of quality control procedures to be followed in manufacture of the source;

(6) Description of labeling to be affixed to the source or the storage container for the source;

(7) Any additional information, including experimental studies and tests, required by the director to facilitate a determination of the safety of the source.

(C) Each source will contain no more than one hundred eighty-five kilobecquerels (five microcuries) of americium-241 or radium-226.

(D) The director determines, with respect to any type of source containing more than one hundred eighty five-becquerels (0.005 microcurie) of americium-241, or radium-226 that:

(1) The method of incorporation and binding of the americium-241 or radium-226 in the source is such that the americium-241 or radium-226 will not be released or be removed from the source under normal conditions of use and handling of the source; and

(2) The source has been subjected to and has satisfactorily passed the prototype tests prescribed by rule 3701:1-46-46 of the Administrative Code.

*** DRAFT – NOT FOR FILING ***

3701:1-46-38 **Calibration or reference sources containing americium-241 or radium-226: labeling of devices.**

~~Each person licensed under rule 3701:1-46-37 of the Administrative Code shall affix to each source, or storage container for the source, a label which shall contain sufficient information relative to safe use and storage of the source and shall include the following statement or a substantially similar statement which contains the information called for in the following statement:~~

~~Sources licensed by the United States nuclear regulatory commission prior to January 19, 1975, may bear labels authorized by the regulations in effect on January 1, 1975.~~

(A) Each person licensed under rule 3701:1-46-37 of the Administrative Code shall affix to each source, or storage container for the source, a label which shall contain sufficient information relative to safe use and storage of the source and shall include one of the following statements or a substantially similar statement which contains the information called for in one of the following statements:

~~(A)~~(1) For americium-241:

The receipt, possession, use and transfer of this source, model __-, serial no. __-, are subject to a general license and the regulations of the United States 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 AMERICIUM-241.

DO NOT TOUCH RADIOACTIVE PORTION OF THIS SOURCE."

Name of manufacturer or initial transferor.

~~(B)~~(2) For radium-226:

The receipt, possession, use and transfer of this source, model __-, serial no. __-, are subject to a general license and the regulations of the United States 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 RADIUM-226.

DO NOT TOUCH RADIOACTIVE PORTION OF THIS SOURCE."

Name of manufacturer or initial transferor.

(B) Sources licensed by the United States nuclear regulatory commission prior to January 19, 1975, may bear labels authorized by the regulations in effect on January 1, 1975.

3701:1-46-39 **Calibration or reference sources containing americium-241 or radium-226: leak testing of each source.**

Each person licensed under rule 3701:1-46-37 of the Administrative Code shall perform a dry wipe test upon each source containing more than 3.7 kilobecquerels (0.1 ~~microcuries~~microcurie) of americium-241 or radium-226 prior to transferring the source to a general licensee under rule 3701:1-46-08 of the Administrative Code. This test shall be performed by wiping the entire radioactive surface of the source with a filter paper with the application of moderate finger pressure. The radioactivity on the paper shall be measured by using radiation detection instrumentation capable of detecting one hundred eighty-five becquerels (0.005 microcurie) of americium-241 or radium-226. If any such test discloses more than one hundred eighty-five becquerels (0.005 microcurie) of radioactive material, the source shall be deemed to be leaking or losing americium-241 or radium-226 and shall not be transferred to a general licensee under rule 3701:1-46-08 of the Administrative Code.

3701:1-46-42 **Manufacture and distribution of byproduct material ~~or accelerator produced material~~ for certain in-vitro clinical or laboratory testing under general license.**

An application for a specific license to manufacturer or distribute byproduct material ~~or accelerator produced material~~ for use under the general license in rule 3701:1-46-11 of the Administrative Code will be approved if:

(A) The applicant satisfies the general requirements specified in rule 3701:1-40-15 of the Administrative Code.

(B) The byproduct material ~~or accelerator produced material~~ is to be prepared for distribution in prepackaged units of:

(1) Iodine-125 in units not exceeding ~~three hundred seventy kilobecquerels~~0.37 megabecquerel (ten microcuries) each.

(2) Iodine-131 in units not exceeding ~~three hundred seventy kilobecquerels~~0.37 megabecquerel (ten microcuries) each.

(3) Carbon-14 in units not exceeding ~~three hundred seventy kilobecquerels~~0.37 megabecquerel (ten microcuries) each.

(4) Hydrogen-3 (tritium) in units not exceeding 1.85 megabecquerels (fifty microcuries) each.

(5) Iron-59 in units not exceeding ~~seven hundred forty kilobecquerels~~0.74 megabecquerel (twenty microcuries) each.

(6) Selenium-75 in units not exceeding ~~three hundred seventy kilobecquerels~~0.37 megabecquerel (ten microcuries) each.

(7) Mock iodine-125 in units not exceeding 1.85 kilobecquerels (0.05 microcurie) of iodine-129 and ~~one hundred eighty five becquerels~~0.185 kilobecquerel (0.005 microcurie) of americium-241 each.

(8) Cobalt-57 in units not exceeding ~~three hundred seventy kilobecquerels~~0.37 megabecquerel (ten microcuries) each.

(C) Each prepackaged unit bears a durable, clearly visible label:

(1) Identifying the radioactive contents as to chemical form and radionuclide, and indicating that the amount of radioactivity does not exceed ~~three hundred seventy kilobecquerels~~0.37 megabecquerel (ten microcuries) of iodine-131, iodine-125, selenium-75, cobalt-57, or carbon-14; 1.85 megabecquerels (fifty

microcuries) of hydrogen-3 (tritium); or ~~seven hundred forty kilobecquerels~~0.74 megabecquerel (twenty microcuries) of iron-59; or mock iodine-125 in units not exceeding 1.85 kilobecquerels (0.05 microcurie) of iodine-129 and ~~1.850~~0.185 ~~becquerels~~kilobecquerel (0.005 microcurie) of americium-241 each; and

(2) Displaying the radiation symbol described in paragraph (A) of rule 3701:1-38-18 of the Administrative Code and the words, "Caution, Radioactive Material", and "Not for Internal or External Use in Humans or Animals."

(D) The following statement, or a substantially similar statement which contains the information called for in the following statement, appears on a label affixed to each prepackaged unit or appears in a leaflet or brochure which accompanies the package: ~~The radioactive material may be received, acquired, possessed, and used only by physicians, veterinarians in the practice of veterinary medicine, 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 therefrom, to human beings or animals. Its receipt, acquisition, possession, use, and transfer are subject to the regulations and a general license of the United States 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)~~

"The radioactive material may be received, acquired, possessed, and used only by physicians, veterinarians in the practice of veterinary medicine, 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 therefrom, to human beings or animals. Its receipt, acquisition, possession, use, and transfer are subject to the regulations and a general license of the United States 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)"

(E) The label affixed to the unit, or the leaflet or brochure which accompanies the package, contains adequate information as to the precautions to be observed in handling and storing such byproduct ~~or accelerator produced~~ 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 paragraph (A) of rule 3701:1-38-19 of the Administrative Code.

*** DRAFT – NOT FOR FILING ***

3701:1-46-43 **Manufacture, preparation, or transfer for commercial distribution of radioactive drugs containing radioactive material for medical use.**

(A) An application for a specific license to manufacture, prepare, or transfer for commercial distribution radioactive drugs containing radioactive material for use by persons authorized pursuant to -Chapter 3701:1-58 of the Administrative Code or equivalent regulations of an agreement state will be approved if:

(1) The applicant satisfies the general requirements specified in rule 3701:1-40-15 of the Administrative Code;

(2) The applicant submits evidence that the applicant is at least one of the following:

(a) ~~Registered or licensed with the United States food and drug administration as a drug manufacturer;~~Registered with the United States food and drug administration as the owner or operator of a drug establishment that engages in the manufacture, preparation, propagation, compounding, or processing of a drug under 21 C.F.R. 207.20(a) (as published in the April 1, 2009 Code of Federal Regulations);

(b) Registered or licensed with a state agency as a drug manufacturer; ~~or~~

(c) Licensed as a pharmacy by a state board of pharmacy; ~~or~~

(d) Operating as a nuclear pharmacy within a federal medical institution~~.~~; or

(e) A positron emission tomography (PET) drug production facility registered with a state agency.

(3) The applicant submits information on the radionuclide; the chemical and physical form; the maximum activity per vial, syringe, generator, or other container of the radioactive drug; and the shielding provided by the packaging to show it is appropriate for the safe handling and storage of the radioactive drugs by medical use licensees; and

(4) The applicant satisfies the following labeling requirements:

(a) A label is affixed to each transport radiation shield, whether it is constructed of lead, glass, plastic, or other material, of a radioactive drug to be transferred for commercial distribution. The label must include the radiation symbol and the words "CAUTION, RADIOACTIVE MATERIAL" or "DANGER, RADIOACTIVE MATERIAL"; the name of the radioactive drug or its abbreviation; and the quantity of radioactivity at a specified date and time. For radioactive drugs with a half-life greater than one hundred days, the time may be omitted.

(b) A label is affixed to each syringe, vial, or other container used to hold a radioactive drug to be transferred for commercial distribution. The label must include the radiation symbol and the words "CAUTION, RADIOACTIVE MATERIAL" or "DANGER, RADIOACTIVE MATERIAL" and an identifier that ensures that the syringe, vial, or other container can be correlated with the information on the transport radiation shield label.

(B) A licensee described by paragraph (A)(2)(c) or (A)(2)(d) of this rule:

(1) May prepare radioactive drugs for medical use, as defined in rule 3701:1-38-01 of the Administrative Code, provided that the radioactive drug is prepared by either an authorized nuclear pharmacist, as specified in paragraphs (B)(2) and (B)(3) of this rule, or an individual under the supervision of an authorized nuclear pharmacist as specified in rule 3701:1-58-14 of the Administrative Code.

(2) May allow a pharmacist to work as an authorized nuclear pharmacist if:

(a) This individual qualifies as an authorized nuclear pharmacist as defined in rule 3701:1-58-01 of the Administrative Code,

(b) This individual meets the requirements specified in paragraph (B) of rule 3701:1-58-20 of the Administrative Code and rule 3701:1-58-22 of the Administrative Code and the licensee has received an approved license amendment identifying this individual as an authorized nuclear pharmacist, or

(c) This individual is designated as an authorized nuclear pharmacist in accordance with paragraph (B)(4) of this rule.

(3) The actions authorized in paragraphs (B)(1) and (B)(2) of this rule are permitted in spite of more restrictive language in license conditions.

(4) May designate a pharmacist (as defined in rule 3701:1-38-01 of the Administrative Code) as an authorized nuclear pharmacist if: ~~the individual is identified as of December 2, 1994, as an "authorized user" on a nuclear pharmacy license issued by the United States nuclear regulatory commission or an agreement state.~~

(a) The individual was a nuclear pharmacist preparing only radioactive drugs containing accelerator-produced radioactive material, and

(b) The individual practiced at a pharmacy at a government agency or federally recognized indian tribe before November 30, 2007 or at all other

pharmacies before August 8, 2009, or an earlier date as noticed by the United States nuclear regulatory commission.

(5) Shall provide to the director a copy of: ~~each individual's:~~

~~(a)~~

~~(i)~~(a) ~~Certification~~Each individual's certification by a specialty board whose certification process has been recognized by the United States nuclear regulatory commission or an agreement state as specified in paragraph (A) of rule 3701:1-58-20 of the Administrative Code with the written attestation signed by a preceptor as required by paragraph (B)(2) of rule 3701:1-58-20 of the Administrative Code; or

~~(ii)~~(b) The United States nuclear regulatory commission or agreement state license; or

~~(iii)~~(c) The permit issued by a ~~licensee of broad scope~~United States nuclear regulatory commission master materials licensee; ~~and~~or

(d) The permit issued by a licensee or United States nuclear regulatory commission master materials permittee of broad scope or the authorization from a commercial nuclear pharmacy authorized to list its own authorized nuclear pharmacist; or

(e) Documentation that only accelerator-produced radioactive materials were used in the practice of nuclear pharmacy at a government agency or federally recognized indian tribe before November 30, 2007, or at all other locations of use before August 8, 2009, or an earlier date as noticed by the United States nuclear regulatory commission; and

~~(b)~~(f) State pharmacy licensure or registration, no later than thirty days after the date that the licensee allows, under paragraphs (B)(2)(a) and (B)(2)(c) of this rule, the individual to work as an authorized nuclear pharmacist.

(C) A licensee shall possess and use instrumentation to measure the radioactivity of radioactive drugs. The licensee shall have procedures for use of the instrumentation. The licensee shall measure, by direct measurement or by combination of measurements and calculations, the amount of radioactivity in dosages of alpha-, beta-, or photon-emitting radioactive drugs prior to transfer for commercial distribution. In addition, the licensee shall:

(1) Perform tests before initial use, periodically, and following repair, on each instrument for accuracy, linearity, and geometry dependence, as appropriate for the use of the instrument; and make adjustments when necessary; and

(2) Check each instrument for constancy and proper operation at the beginning of each day of use.

(D) Nothing in this rule relieves the licensee from complying with applicable United States food and drug administration, other federal, and state requirements governing radioactive drugs.

3701:1-46-46 **Prototype tests for calibration or reference sources containing americium-241 or radium-226.**

An applicant for a license pursuant to rule 3701:1-46-37 of the Administrative Code shall, for any type of source which is designed to contain more than ~~one hundred eighty-five becquerels~~0.185 kilobecquerel (0.005 microcurie) of americium-241 or radium-226, conduct prototype tests, in the order listed, on each of five prototypes of such source, which contains more than ~~one hundred eighty-five becquerels~~0.185 kilobecquerel (0.005 microcurie) of americium-241 or radium-226, as follows:

-Prototype tests-

Initial measurement	The quantity of radioactive material deposited on the source shall be measured by direct counting of the source.
Dry wipe test	The entire radioactive surface of the source shall be wiped with filter paper with the application of moderate finger pressure. Removal of radioactive material from the source shall be determined by measuring the radioactivity on the filter paper or by direct measurement of the radioactivity on the source following the dry wipe.
Wet wipe test	The entire radioactive surface of the source shall be wiped with filter paper, moistened with water, with the application of moderate finger pressure. Removal of radioactive material from the source shall be determined by measuring the radioactivity on the filter paper after it has dried or by direct measurement of the radioactivity on the source following the wet wipe.
Water soak test	The source shall be immersed in water at room temperature for a period of twenty-four consecutive hours. The source shall then be removed from the water. Removal of radioactive material from the source shall be determined by direct measurement of the radioactivity on the source after it has dried or by measuring the radioactivity in the residue obtained by evaporation of the water in which the source was immersed.
Dry wipe test	On completion of the preceding tests in this rule, the dry wipe test described in this rule shall be repeated.
Observations	Removal of more than ~~one hundred eighty-five becquerels~~0.185 kilobecquerel (0.005 microcurie) of radioactivity in any test prescribed by this rule shall be cause for rejection of the source design. Results of prototype tests submitted to the director shall be given in terms of radioactivity in becquerels (or metric multiple, thereof) and per cent of removal from the total amount of radioactive material deposited on the source.

*** DRAFT – NOT FOR FILING ***

3701:1-46-51 **General license for certain items and self-luminous products containing radium-226.**

(A) A general license is hereby issued to any person to acquire, receive, possess, use, or transfer, in accordance with the provisions of paragraphs (B), (C), and (D) of this rule, radium-226 contained in the following products manufactured prior to November 30, 2007:

(1) Antiquities originally intended for use by the general public. For the purposes of this paragraph, antiquities mean products originally intended for use by the general public and distributed in the late nineteenth and early twentieth centuries, such as radium emanator jars, revigators, radium water jars, radon generators, refrigerator cards, radium bath salts, and healing pads;

(2) Intact timepieces containing greater than 0.037 megabecquerel (one microcurie), nonintact timepieces, and timepiece hands and dials no longer installed in timepieces;

(3) Luminous items installed in air, marine, or land vehicles;

(4) All other luminous products, provided that no more than one hundred items are used or stored at the same location at any one time; and

(5) Small radium sources containing no more than 0.037 megabecquerel (one microcurie) of radium-226. For the purposes of this paragraph, "small radium sources" means discrete survey instrument check sources, sources contained in radiation measuring instruments, sources used in educational demonstrations (such as cloud chambers and spinthariscopes), electron tubes, lightning rods, ionization sources, static eliminators, or as designated by the department or the United States nuclear regulatory commission.

(B) Persons who acquire, receive, possess, use, or transfer radium-226 under the general license issued in paragraph (A) of this section are exempt from the provisions of rules 3701:1-38-07, 3701:1-38-09 to 3701:1-38-18, 3701:1-38-20 to 3701:1-38-25 of the Administrative Code, to the extent that the receipt, possession, use, or transfer of radium-226 is within the terms of the general license; provided, however, that this exemption shall not be deemed to apply to any such person specifically licensed in accordance with rule 3701:1-38-02 of the Administrative Code.

(C) Any person who acquires, receives, possesses, uses, or transfers radium-226 in accordance with the general license in paragraph (A) of this section:

(1) Shall notify the department should there be any indication of possible damage to the product so that it appears it could result in a loss of the radioactive material. A report containing a brief description of the event, and the remedial action

taken, must be furnished to the department in the manner specified in rule 3701:1-40-04 of the Administrative Code within 30 days.

(2) Shall not abandon products containing radium-226. The product, and any radioactive material from the product, may only be disposed of in accordance with rule 3701:1-38-19 of the Administrative Code, or by transfer to a person authorized by a specific license to receive the radium-226 in the product or as otherwise approved by the department.

(3) Shall not export products containing radium-226 except in accordance with United States nuclear regulatory commission regulations.

(4) Shall dispose of products containing radium-226:

(a) At a disposal facility authorized to dispose of radioactive material in accordance with Chapter 3701:1-54 of the Administrative Code or equivalent regulation of an agreement state or the United States nuclear regulatory commission;

(b) By transfer to a person authorized to receive radium-226 by a specific license issued in accordance with rule 3701:1-38-02 of the Administrative Code or equivalent regulations of an agreement state or the United States nuclear regulatory commission; or

(c) As otherwise approved by the department.

(5) Shall respond to written requests from the department to provide information relating to the general license within thirty calendar days of the date of the request, or other time specified in the request. If the general licensee cannot provide the requested information within the allotted time, it shall, within that same time period, request a longer period to supply the information by providing the department, in the manner specified in rule 3701:1-40-04 of the Administrative Code, a written justification for the request.

(D) The general license in paragraph (A) of this section does not authorize the manufacture, assembly, disassembly, repair, or import of products containing radium-226, except that timepieces may be disassembled and repaired.

3701:1-58-06 **License required.**

(A) A person may manufacture, produce, acquire, receive, possess, prepare, use, or transfer radioactive material for medical use only in accordance with a specific license issued by the director, United States nuclear regulatory commission, an agreement state, ~~or NARM licensing state for NARM,~~ or as allowed in paragraph (B)(1) or (B)(2) of this rule.

(B) A specific license is not needed for an individual who:

(1) Receives, possesses, uses, or transfers radioactive material in accordance with the regulations in this chapter under the supervision of an authorized user as provided in rule 3701:1-58-14 of the Administrative Code, unless prohibited by license condition; or

(2) Prepares unsealed radioactive material for medical use in accordance with the regulations in this chapter under the supervision of an authorized nuclear pharmacist or authorized user as provided in rule 3701:1-58-14 of the Administrative Code, unless prohibited by license condition.

3701:1-58-10 **Exemptions regarding type A specific licenses of broad scope.**

A licensee possessing a type A specific license of broad scope for medical use, issued under rules 3701:1-40-22 and 3701:1-40-23 of the Administrative Code, is exempt from:

(A) The provisions of paragraph (D) of rule 3701:1-58-07 of the Administrative Code regarding the need to file an amendment to the license for medical use of radioactive material, as described in rule 3701:1-58-72 of the Administrative Code~~.~~;

(B) The provisions of paragraph (B) of rule 3701:1-58-08 of the Administrative Code~~.~~;

(C) The provisions of paragraph (E) of rule 3701:1-58-08 of the Administrative Code regarding additions to or changes in the areas of use at the addresses identified in the application or on the license~~.~~;

(D) The provisions of paragraph (A) of rule 3701:1-58-09 of the Administrative Code~~.~~;

(E) The provisions of paragraph (B)(1) of rule 3701:1-58-09 of the Administrative Code for an authorized user, an authorized nuclear pharmacist, or an authorized medical physicist~~.~~;

(F) The provisions of paragraph (B)(4~~5~~) of rule 3701:1-58-09 of the Administrative Code regarding additions to or changes in the areas of use identified in the application or on the license where radioactive material is used in accordance with either rule 3701:1-58-32 or 3701:1-58-34 of the Administrative Code~~.~~; and

(G) The provisions of paragraph (A) of rule 3701:1-58-17 of the Administrative Code.

*** DRAFT – NOT FOR FILING ***

3701:1-58-21 **Training for experienced Radiation Safety Officer, teletherapy or medical physicist, authorized medical physicist, authorized user, nuclear pharmacist, and authorized nuclear pharmacist.**

(A)

(1) An individual identified as a radiation safety officer, a teletherapy or medical physicist, or a nuclear pharmacist on a United States nuclear regulatory commission or agreement state license or a permit issued by a United States nuclear regulatory commission or agreement state broad scope licensee or master material license permit or by a master material license permittee of broad scope before October 24, 2002, need not comply with the training requirements of rule 3701:1-58-18, 3701:1-58-19, or 3701:1-58-20 of the Administrative Code, respectively.

(2) An individual identified as a radiation safety officer, an authorized medical physicist, or an authorized nuclear pharmacist on a United Stated nuclear regulatory commission or agreement state license or a permit issued by a United States nuclear regulatory commission or agreement state broad scope licensee or master material license permit or by a master material license permittee of broad scope between October 24, 2002, and April 29, 2005, need not comply with the training requirements of rule 3701:1-58-18, 3701:1-58-19, or 3701:1-58-20 of the Administrative Code, respectively.

(3) A radiation safety officer, a medical physicist, or a nuclear pharmacist, who used only accelerator-produced radioactive materials, discrete sources of radium-226, or both, for medical uses or in the practice of nuclear pharmacy at a government agency or federally recognized indian tribe before November 30, 2007, or at all other locations of use before August 8, 2009, or an earlier date as noticed by the United States nuclear regulatory commission, need not comply with the training requirements of rule 3701:1-58-18, 3701:1-58-19, or 3701:1-58-20 of the Administrative Code, respectively, when performing the same uses. A nuclear pharmacist, who prepared only radioactive drugs containing accelerator-produced radioactive materials, or a medical physicist, who used only accelerator-produced radioactive materials, at the locations and time period identified in this paragraph, qualifies as an authorized nuclear pharmacist or an authorized medical physicist, respectively, for those materials and uses performed before these dates, for purposes of this chapter.

(B)

(1) Physicians, dentists, or podiatrists identified as authorized users for the medical use of byproduct material on a license issued by the United States nuclear regulatory commission or agreement state, a permit issued by a United States nuclear regulatory commission master material licensee, a permit issued by a

United States nuclear regulatory commission or agreement state broad scope licensee, or a permit issued by a United States nuclear regulatory commission master material license broad scope permittee before October 24, 2002, who perform only those medical uses for which they were authorized on that date need not comply with the training requirements of rules 3701:1-58-100 to 3701:1-58-690 of the Administrative Code.

(2) Physicians, dentists, or podiatrists identified as authorized users for the medical use of byproduct material on a license issued by the United States nuclear regulatory commission or agreement state, a permit issued by a United States nuclear regulatory commission master material licensee, a permit issued by a United States nuclear regulatory commission or agreement state broad scope licensee, or a permit issued by a United States nuclear regulatory commission master material license broad scope permittee who perform only those medical uses for which they were authorized between October 24, 2002, and April 29, 2005, need not comply with the training requirements of rules 3701:1-58-100 to 3701:1-58-690 of the Administrative Code.

(3) Physicians, dentists, or podiatrists who used only accelerator-produced radioactive materials, discrete sources of radium-226, or both, for medical uses performed at a government agency or federally recognized indian tribe before November 30, 2007, or at all other locations of use before August 8, 2009, or an earlier date as noticed by the United States nuclear regulatory commission, need not comply with the training requirements of rules 3701:1-58-100 to 3701:1-58-690 of the Administrative Code, when performing the same medical uses. A physician, dentist, or podiatrist, who used only accelerator-produced radioactive materials, discrete sources of radium-226, or both, for medical uses at the locations and time period identified in this paragraph, qualifies as an authorized user for those materials and uses performed before these dates, for purposes of this chapter.

(C) Individuals who need not comply with training requirements as described in this section may serve as preceptors for, and supervisors of, applicants seeking authorization on United States nuclear regulatory commission licenses for the same uses for which these individuals are authorized.

*** DRAFT – NOT FOR FILING ***

3701:1-58-25 **Determination of dosages of unsealed radioactive material for medical use.**

(A) A licensee shall determine and record the activity of each dosage before medical use.

(B) For a unit dosage, this determination must be made by:

(1) Direct measurement of radioactivity; or

(2) A decay correction, based on the activity or activity concentration determined by:

(a) A manufacturer or preparer licensed under rule 3701:1-46-43 of the Administrative Code or equivalent United States nuclear regulatory commission, or agreement state~~, or NARM licensing state for NARM~~ requirements; ~~or~~

(b) An United States nuclear regulatory commission, or agreement state~~, or NARM licensing state for NARM~~ licensee for use in research in accordance with a radioactive drug research committee-approved protocol or an investigational new drug protocol accepted by United States food and drug administration~~.~~; or

(c) A PET radioactive drug producer licensed under paragraph (I) of rule 3701:1-40-14 of the Administrative Code, or equivalent United States nuclear regulatory commission or agreement state requirements.

(C) For other than unit dosages, this determination must be made by:

(1) Direct measurement of radioactivity;

(2) Combination of measurement of radioactivity and mathematical calculations; or

(3) Combination of volumetric measurements and mathematical calculations, based on the measurement made by: ~~a manufacturer or preparer licensed under rule 3701:1-46-43 of the Administrative Code or equivalent United States nuclear regulatory commission, agreement state, or NARM licensing state for NARM requirements.~~

(a) A manufacturer or preparer licensed under rule 3701:1-46-43 of the Administrative Code or equivalent United States nuclear regulatory commission, or agreement state~~, or NARM licensing state for NARM~~ requirements; or

(b) A PET radioactive drug producer licensed under paragraph (I) of rule 3701:1-40-14 of the Administrative Code, or equivalent United States nuclear regulatory commission or agreement state requirements.

(D) Unless otherwise directed by the authorized user, a licensee may not use a dosage if the dosage does not fall within the prescribed dosage range or if the dosage differs from the prescribed dosage by more than twenty ~~percent~~per cent.

(E) A licensee shall retain a record of the dosage determination required by this rule in accordance with rule 3701:1-58-79 of the Administrative Code.

*** DRAFT – NOT FOR FILING ***

3701:1-58-32 **Use of unsealed radioactive material for uptake, dilution, and excretion studies for which a written directive is not required.**

Except for quantities that require a written directive under paragraph (B) of rule 3701:1-58-15 of the Administrative Code, a licensee may use any unsealed radioactive material prepared for medical use for uptake, dilution, or excretion studies that is:

(A) Obtained from: ~~a manufacturer or preparer licensed under rule 3701:1-46-43 of the Administrative Code or equivalent United States nuclear regulatory commission or agreement state requirements;~~

(1) A manufacturer or preparer licensed under rule 3701:1-46-43 of the Administrative Code or equivalent United States nuclear regulatory commission or agreement state requirements; or

(2) A PET radioactive drug producer licensed in accordance with paragraph (1) of rule 3701:1-40-14 of the Administrative Code or equivalent United States nuclear regulatory commission or agreement state requirement; or

(B) ~~Prepared by:~~Excluding production of PET radionuclides, prepared by:

(1) An authorized nuclear pharmacist; or

(2) A physician who is an authorized user and who meets the requirements specified in rule 3701:1-58-36, or rule 3701:1-58-40 and paragraph (C)(1)(b)(vii) of rule 3701:1-58-36 of the Administrative Code; or

(3) An individual under the supervision, as specified in rule 3701:1-58-14 of the Administrative Code, of the authorized nuclear pharmacist in paragraph (B)(1) of this rule or the physician who is an authorized user in paragraph (B)(2) of this rule; or

(C) Obtained from and prepared by an United States nuclear regulatory commission or agreement state licensee for use in research in accordance with a radioactive drug research committee-approved protocol or an investigational new drug ~~(IND)~~ protocol accepted by United States food and drug administration; or

(D) Prepared by the licensee for use in research in accordance with a radioactive drug research committee-approved application or an investigational new drug ~~(IND)~~ protocol accepted by United States food and drug administration.

*** DRAFT – NOT FOR FILING ***

3701:1-58-34 **Use of unsealed radioactive material for imaging and localization studies for which a written directive is not required.**

Except for quantities that require a written directive under paragraph (B) of rule 3701:1-58-15 of the Administrative Code, a licensee may use any unsealed radioactive material prepared for medical use for imaging and localization studies that is:

(A) Obtained from: ~~a manufacturer or preparer licensed under rule 3701:1-46-43 of the Administrative Code or equivalent United States nuclear regulatory commission or agreement state requirements;~~

(1) A manufacturer or preparer licensed under rule 3701:1-46-43 of the Administrative Code or equivalent United States nuclear regulatory commission or agreement state requirements; or

(2) A PET radioactive drug producer licensed in accordance with paragraph (J) of rule 3701:1-40-14 of the Administrative Code or equivalent United States nuclear regulatory commission or agreement state requirement; or

(B) ~~Prepared by:~~Excluding production of PET radionuclides, prepared by:

(1) An authorized nuclear pharmacist;

(2) A physician who is an authorized user and who meets the requirements specified in rule 3701:1-58-36 or 3701:1-58-40 and paragraph (C)(1)(b)(vii) of rule 3701:1-58-36 of the Administrative Code; or

(3) An individual under the supervision, as specified in rule 3701:1-58-14 of the Administrative Code, of the authorized nuclear pharmacist in paragraph (B)(1) of this rule or the physician who is an authorized user in paragraph (B)(2) of this rule;

(C) Obtained from and prepared by an United States nuclear regulatory commission or agreement state licensee for use in research in accordance with a radioactive drug research committee-approved protocol or an investigational new drug ~~(IND)~~ protocol accepted by United States food and drug administration; or

(D) Prepared by the licensee for use in research in accordance with a radioactive drug research committee-approved application or an investigational new drug ~~(IND)~~ protocol accepted by United States food and drug administration.

*** DRAFT – NOT FOR FILING ***

3701:1-58-35 **Permissible molybdenum-99, strontium-82, and strontium-85 concentrations ~~concentration~~.**

(A) A licensee may not administer to humans a radiopharmaceutical that contains: ~~more than 0.15 kilobecquerel, or 0.15 microcurie of molybdenum-99 per megabecquerel, or millicurie of technetium-99m.~~

(1) More than 0.15 kilobecquerel of molybdenum-99 per megabecquerel of technetium-99m (0.15 microcurie of molybdenum-99 per millicuric of technetium-99m); or

(2) More than 0.02 kilobecquerel of strontium-82 per megabecquerel of rubidium-82 chloride injection (0.02 microcurie of strontium-82 per millicurie of rubidium-82 chloride); or more than 0.2 kilobecquerel of strontium-85 per megabecquerel of rubidium-82 chloride injection (0.2 microcurie of strontium-85 per millicurie of rubidium-82).

(B) A licensee that uses molybdenum-99/technetium-99m generators for preparing a technetium-99m radiopharmaceutical shall measure the molybdenum-99 concentration of the first eluate after receipt of a generator to demonstrate compliance with paragraph (A) of this rule.

~~(C) If a licensee is required to measure the molybdenum-99 concentration, the licensee shall retain a record of each measurement in accordance with rule 3701:1-58-85 of the Administrative Code.~~

(C) A licensee that uses a strontium-82/rubidium-82 generator for preparing a rubidium-82 radiopharmaceutical shall, before the first patient use of the day, measure the concentration of radionuclides strontium-82 and strontium-85 to demonstrate compliance with paragraph (A) of this rule.

(D) If a licensee is required to measure the molybdenum-99 concentration or strontium-82 and strontium-85 concentrations, the licensee shall retain a record of each measurement in accordance with rule 3701:1-58-85 of the Administrative Code.

*** DRAFT – NOT FOR FILING ***

3701:1-58-37 **Use of unsealed radioactive material for which a written directive is required.**

A licensee may use any unsealed radioactive material prepared for medical use and for which a written directive is required that is:

(A) Obtained from: ~~a manufacturer or preparer licensed under rule 3701:1-46-43 of the Administrative Code or equivalent United States nuclear regulatory commission or agreement state requirements;~~

(1) A manufacturer or preparer licensed under rule 3701:1-46-43 of the Administrative Code or equivalent United States nuclear regulatory commission or agreement state requirements; or

(2) A PET radioactive drug producer licensed in accordance with paragraph (I) of rule 3701:1-40-14 of the Administrative Code or equivalent United States nuclear regulatory commission or agreement state requirement; or

(B) ~~Prepared by:~~Prepared by, excluding production of PET radionuclides:

(1) An authorized nuclear pharmacist;

(2) A physician who is an authorized user and who meets the requirements specified in rule 3701:1-58-36 or 3701:1-58-40 of the Administrative Code; or

(3) An individual under the supervision, as specified in rule 3701:1-58-14 of the Administrative Code, of the- authorized nuclear pharmacist in paragraph (B)(1) of this rule or the physician who is an authorized user in paragraph (B)(2) of this rule;

(C) Obtained from and prepared by an United States nuclear regulatory commission or agreement state licensee for use in research in accordance with an investigational new drug ~~(IND)~~ protocol accepted by United States food and drug administration; or

(D) Prepared by the licensee for use in research in accordance with an investigational new drug ~~(IND)~~ protocol accepted by United States food and drug administration.

3701:1-58-85 **Records of molybdenum-99, strontium-82, and strontium-85 concentrations.**

~~A licensee shall maintain a record of the molybdenum-99 concentration tests required by paragraph (B) of rule 3701:1-58-35 of the Administrative Code for three years. The record must include, for each measured elution of technetium-99m, the ratio of the measures expressed as kilobecquerel, or microcuries of molybdenum-99 per megabecquerel, or millicurie of technetium-99m, the time and date of the measurement, and the name of the individual who made the measurement.~~A licensee shall maintain a record of the molybdenum-99 concentration or strontium-82 and strontium-85 concentration tests required by paragraph (B) of rule 3701:1-58-35 of the Administrative Code for three years. The record must include:

(A) For each measured elution of technetium-99m, the ratio of the measures expressed as kilobecquerel (microcuries) of molybdenum-99 per megabecquerel (millicurie) of technetium-99m, the time and date of the measurement, and the name of the individual who made the measurement; or

(B) For each measured elution of rubidium-82, the ratio of the measures expressed as kilobecquerel (microcuries) of strontium-82 per megabecquerel (millicurie) of rubidium-82, kilobecquerel (microcuries) of strontium-85 per megabecquerel (millicurie) of rubidium-82, the time and date of the measurement, and the name of the individual who made the measurement.