

From: [Fordham, Earl W \(DOH\)](#)
To: [Schneider, Kathleen](#); [Henderson, Pamela](#)
Cc: [Austin, Michelle \(DOH\)](#)
Subject: Final Submission for 2012-2: Advance Notification to Native American Tribes...
Date: Tuesday, February 25, 2014 4:00:04 PM
Attachments: [2012-2 Compatibility Comments on Washington Proposed Regulations - WA response.docx](#)
[OTS-5539 6Final.pdf](#)

Dear Ms. Henderson:

RE: RATS ID 2012-2: Advance notification to Native American tribes of transportation of certain types of nuclear waste

Attached is a copy of the final rule revisions to Washington's Radiological Health Rules, chapter 246-231 WAC, Packaging and transportation of radioactive material. We are proposing to adopt RATS ID 2012-2, Advance notification to Native American tribes of transportation of certain types of nuclear waste.

Language or punctuation we are deleting has a solid line through it and new language or punctuation is underlined.

We believe these proposed rule revisions satisfies the compatibility and health and safety categories established in the Office of Federal and State Materials and Environmental Programs (FSME) Procedure SA-200.

If you have any questions, please contact Michelle Austin, Rules Coordinator, at (360) 236-3250 or by e-mail at michelle.austin@doh.wa.gov

Thanks,
Earl Fordham
Deputy Director, Office of Radiation Protection
Washington State Dept of Health

Compatibility Comments on Washington Proposed Regulations

Advance Notification to Native American Tribes of Transportation of Certain Types of Nuclear Waste, RATS ID: 2012-2

State Section	NRC Section	Category	NRC Subject and Comments	Washington's Comment
WAC 246-231-140(6)	71.97	B	<p>Advance notification of shipment or irradiated reactor fuel and nuclear waste.</p> <p>In WAC 246-231-140 (6), Washington needs to change "...notified or to each tribal official or to the tribal official's designee..." to "...notified, to each tribal official or to the tribal official's designee..."</p> <p>Washington needs to make the above change in order to meet the Compatibility Category B designation assigned to 10 CFR 71.97(f).</p>	<p>Washington made this correction.</p> <p>Now WAC 246-231-140 (6) reads "...notified, to each tribal official or to the tribal official's designee previously notified,..."</p>

AMENDATORY SECTION (Amending WSR 08-09-093, filed 4/18/08, effective 5/19/08)

WAC 246-231-001 Purpose and scope. (1) This chapter establishes requirements for packaging, preparation for shipment, and transportation of radioactive material.

(2) Licensees shall also comply with applicable requirements of (~~the United States Nuclear Regulatory Commission (USNRC), the United States Department of Transportation (USDOT))~~) NRC, DOT, the United States Postal Service¹ (~~(USPS)~~), and other requirements of Title 246 WAC.

(3) The regulations in this chapter apply to any licensee authorized by specific or general license issued by the department, (~~USNRC~~) NRC or an agreement state, to receive, possess, use, or transfer licensed material, if the licensee delivers that material to a carrier for transport, transports the material outside the site of usage as specified in the license, or transports that material on public highways. No provision of this chapter authorizes possession of licensed material.

¹ *Mailing Standards of the United States Postal Service, Domestic Mail Manual, 39 C.F.R. 111.1.*

AMENDATORY SECTION (Amending WSR 08-09-093, filed 4/18/08, effective 5/19/08)

WAC 246-231-005 Requirement for license. No licensee shall deliver radioactive material to a carrier for transport, or transport radioactive material, except as authorized in a general or specific license issued by the department, (~~USNRC~~) NRC or an agreement state, or as exempted in this chapter.

AMENDATORY SECTION (Amending WSR 08-09-093, filed 4/18/08, effective 5/19/08)

WAC 246-231-010 Definitions, abbreviations, and acronyms. The (~~following terms are as defined here for the purpose of this chapter~~) definitions, abbreviations, and acronyms in this section and in WAC 246-220-010 apply throughout this chapter unless the context clearly indicates otherwise. To ensure compatibility with international transportation standards, all limits in this chapter are given in terms of dual units: The International System of Units (SI) followed or preceded by U.S. standard or customary units. The U.S. customary units are not exact equivalents, but are rounded to a convenient value, providing a functionally equivalent unit. For the purpose of this chapter, either unit may be used.

(1) "A1" means the maximum activity of special form radioactive material permitted in a Type A package. This value is either listed in WAC 246-231-200, Table A-1 or may be derived in accordance with the procedures prescribed in WAC 246-231-200.

(2) "A2" means the maximum activity of radioactive material, other than special form material, LSA and SCO material, permitted in a Type A package. This value is either listed in WAC 246-231-200, Table A-1, or may be derived in accordance with the procedure prescribed in WAC 246-231-200.

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

~~((4)))~~ "Carrier" means a person engaged in the transportation of passengers or property by land or water as a common, contract, or private carrier, or by civil aircraft.

~~((5)))~~ (4) "Certificate holder" means a person who has been issued a certificate of compliance or other package approval by ~~((the U.S. Nuclear Regulatory Commission (USNRC)))~~ NRC.

~~((6)))~~ (5) "Certificate of compliance ~~((CoC))~~" means the certificate issued by ~~((the USNRC))~~ NRC under 10 C.F.R. 71 Subpart D which approves the design of a package for the transportation of radioactive material.

~~((7)))~~ (6) "Close reflection by water" means immediate contact by water of sufficient thickness for maximum reflection of neutrons.

~~((8)))~~ (7) "Consignment" means each shipment of a package or groups of packages or load of radioactive material offered by a shipper for transport.

~~((9)))~~ (8) "Containment system" means the assembly of components of the packaging intended to retain the radioactive material during transport.

~~((10)))~~ (9) "Conveyance" means:

(a) For transport by public highway or rail any transport vehicle or large freight container;

(b) For transport by water any vessel, or any hold, compartment, or defined deck area of a vessel including any transport vehicle on board the vessel; and

(c) For transport by any aircraft.

~~((11)))~~ (10) "Criticality safety index (CSI)" means the dimensionless number (rounded up to the next tenth) assigned to and placed on the label of a fissile material package, to designate the degree of control of accumulation of packages containing fissile material during transportation. Determination of the criticality safety index is described in WAC 246-231-094, 246-231-096, and 10 C.F.R. 71.59.

~~((12)) "Department" means the Washington state department of health, which has been designated as the state radiation control agency under chapter 70.98 RCW.~~

~~((13)))~~ (11) "Deuterium" means, for the purposes of WAC 246-231-040 and 246-231-094, deuterium and any deuterium compounds, including heavy water, in which the ratio of deuterium atoms to hydrogen atoms exceeds 1:5000.

~~((14)))~~ (12) "DOT" ~~((and "USDOT"))~~ means the United States Department of Transportation. ~~((USDOT))~~ DOT regulations are found in Code of Federal Regulations Title 49 Transportation.

~~((15)))~~ (13) "Exclusive use" means the sole use by a single consignor of a conveyance for which all initial, intermediate, and final loading and unloading are carried out in accordance with the direction of the consignor or consignee. The consignor and the carrier must ensure that any loading or unloading is performed by personnel having radiological training and resources appropriate for safe handling of the consignment. The consignor must issue specific instructions, in

writing, for maintenance of exclusive use shipment controls, and include them with the shipping paper information provided to the carrier by the consignor.

~~((16))~~ (14) "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 WAC 246-231-040.

~~((17))~~ (15) "Graphite" means graphite with a boron equivalent content less than 5 parts per million and density greater than 1.5 grams per cubic centimeter.

~~((18))~~ "License" means a license issued by the department.

~~(19)~~ "Licensed material" means radioactive, by product, source, or special nuclear material received, possessed, used, or transferred under a general or specific license issued by the department pursuant to the regulations in this chapter, or issued by the USNRC or an agreement state pursuant to equivalent regulations.

~~(20)~~ "Licensee" means any person who is licensed by the department under these rules and the act.

~~(21))~~ (16) "Indian tribe" means an Indian or Alaskan native tribe, band, nation, pueblo, village, or community that the Secretary of the Interior acknowledges to exist as an Indian tribe pursuant to the Federally Recognized Indian Tribe List Act of 1994, 25 U.S.C. 479a. A current listing of officially recognized Indian tribes may be found at: <http://www.bia.gov/cs/groups/mywcsp/documents/text/idc-020733.pdf>.

(17) "Low specific activity (LSA) material" means radioactive material with limited specific activity which is nonfissile or is excepted under WAC 246-231-040 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 material 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; or

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

(iii) Radioactive material for which the A2 value is unlimited; or

(iv) Other radioactive material in which the activity is distributed throughout and the estimated average specific activity does not exceed 30 times the value for exempt material activity concentration determined in accordance with Appendix A.

(b) LSA-II.

(i) Water with tritium concentration up to 0.8 TBq/liter (20.0 Ci/liter); or

(ii) Other material in which the activity is distributed throughout, and the average specific activity does not exceed 1E-4 A2/g for solids and gases, and 1E-5 A2/g for liquids.

(c) LSA-III. Solids (e.g., consolidated wastes, activated materials), excluding powders, that satisfy the requirements of the 10 C.F.R. 71.77, 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.); and

(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 A2; and

(iii) The estimated average specific activity of the solid does not exceed $2\text{E}-3$ A2/g.

((+22+)) (18) "Low toxicity alpha emitters" means natural uranium, depleted uranium, natural thorium; uranium-235, uranium-238, thorium-232, thorium-228 or thorium-230 when contained in ores or physical or chemical concentrates or tailings; or alpha emitters with a half-life of less than ten days.

((+23+)) (19) "Maximum normal operating pressure" means the maximum gauge pressure that would develop in the containment system in a period of one year under the heat condition specified in ((USNRC)) NRC regulations 10 C.F.R. 71.71 (c)(1), in the absence of venting, external cooling by an ancillary system, or operational controls during transport.

((+24+)) (20) "Natural thorium" means thorium with the naturally occurring distribution of thorium isotopes (essentially 100 weight percent thorium-232).

((+25+)) (21) "Normal form radioactive material" means radioactive material that has not been demonstrated to qualify as "special form radioactive material."

((+26+)) (22) "Nuclear waste" as used in WAC 246-231-140 means any quantity of radioactive material (not including radiography sources being returned to the manufacturer) required to be in Type B packaging while transported to, through, or across state boundaries to a disposal site, or to a collection point for transport to a disposal site. Nuclear waste, as used in these regulations, is a special classification of radioactive waste.

((+27+)) (23) "Optimum interspersed hydrogenous moderation" means the presence of hydrogenous material between packages to such an extent that the maximum nuclear reactivity results.

((+28+)) (24) "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 ((USDOT)) DOT regulations in 49 C.F.R. 173.

(c) "Type B package" means a Type B packaging together with its radioactive contents. ((On)) Upon approval by ((the-USNRC)) NRC, a Type B package design is designated by ((the-USNRC)) NRC as B(U) unless the package has a maximum normal operating pressure of more than 700 kPa (100 lbs/in²) gauge or a pressure relief device that would allow the release of radioactive material to the environment under the tests specified in ((USNRC)) NRC regulations 10 C.F.R. 71.73 (hypothetical accident conditions), 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 ((USDOT)) DOT regulations in 49 C.F.R. 173. 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.

((+29+)) (25) "Packaging" means the assembly of components necessary to ensure compliance with the packaging requirements of this chapter. 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.

((+30+)) (26) "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 5 mm (0.2 in); and

(c) It satisfies the requirements of 10 C.F.R. 71.75. A special form encapsulation designed in accordance with ((the USNRC)) NRC requirements 10 C.F.R. 71.4 in effect on June 30, 1983, (see 10 C.F.R. 71, revised as of January 1, 1983), and constructed before July 1, 1985, and a special form encapsulation designed in accordance with the requirements of ((the USNRC)) NRC requirements in 10 C.F.R. 71.4 in effect on March 31, 1996 (see 10 C.F.R. 71, revised as of January 1, 1983), and constructed before April 1, 1998, may continue to be used. Any other special form encapsulation must meet the specifications of this definition.

((+31+)) (27) "Specific activity of a radionuclide" means the radioactivity of the radionuclide per unit mass of that nuclide. The specific activity of a material in which the radionuclide is essentially uniformly distributed is the radioactivity per unit mass of the material.

((+32+)) (28) "Spent nuclear fuel" or "spent fuel" means fuel that has been withdrawn from a nuclear reactor following irradiation, has undergone at least one year's decay since being used as a source of energy in a power reactor, and has not been chemically separated into its constituent elements by reprocessing. Spent fuel includes the special nuclear material, by-product material, source material, and other radioactive materials associated with fuel assemblies.

((+33+)) (29) "State" means a state of the United States, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands.

((+34+)) (30) "Surface contaminated object (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 nonfixed contamination on the accessible surface averaged over 300 cm² (or the area of the surface if less than 300 cm²) does not exceed 4 Bq/cm² (1E-4 microcurie/cm²) for beta and gamma and low toxicity alpha emitters, or 0.4 Bq/cm² (1E-5 microcurie/cm²) for all other alpha emitters;

(ii) The fixed contamination on the accessible surface averaged over 300 cm² (or the area of the surface if less than 300 cm²) does not exceed 4E+4 Bq/cm² (1.0 microcurie/cm²) for beta and gamma and low toxicity alpha emitters, or 4E+3 Bq/cm² (0.1 microcurie/cm²) for all other alpha emitters; and

(iii) The nonfixed contamination plus the fixed contamination on the inaccessible surface averaged over 300 cm² (or the area of the surface if less than 300 cm²) does not exceed 4E+4 Bq/cm² (1 microcurie/cm²) for beta and gamma and low toxicity alpha emitters, or 4E+3 Bq/cm² (0.1 microcurie/cm²) 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 nonfixed contamination on the accessible surface averaged over 300 cm² (or the area of the surface if less than 300 cm²) does not exceed 400 Bq/cm² (1E-2 microcurie/cm²) for beta and gamma and low toxicity alpha emitters or 40 Bq/cm² (1E-3 microcurie/cm²) for all other alpha emitters;

(ii) The fixed contamination on the accessible surface averaged over 300 cm² (or the area of the surface if less than 300 cm²) does not exceed 8E+5 Bq/cm² (20 microcuries/cm²) for beta and gamma and low toxicity alpha emitters, or 8E+4 Bq/cm² (2 microcuries/cm²) for all other alpha emitters; and

(iii) The nonfixed contamination plus the fixed contamination on the inaccessible surface averaged over 300 cm² (or the area of the surface if less than 300 cm²) does not exceed 8E+5 Bq/cm² (20 microcuries/cm²) for beta and gamma and low toxicity alpha emitters, or 8E+4 Bq/cm² (2 microcuries/cm²) for all other alpha emitters.

~~((35))~~ (31) "Transport index (TI)" 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 (mSv) per hour at 1 meter (3.3 ft) from the external surface of the package by 100 (equivalent to the maximum radiation level in millirem per hour at 1 meter (3.3 ft)).

~~((36))~~ (32) "Tribal official" means the highest ranking individual who represents tribal leadership, such as the chief, president, or tribal council leadership.

(33) "Type A quantity" means a quantity of radioactive material, the aggregate radioactivity of which does not exceed A1 for special form radioactive material, or A2 for normal form radioactive material, where A1 and A2 are given in Table A-1 of WAC 246-231-200, or may be determined by procedures described in WAC 246-231-200.

~~((37))~~ (34) "Type B quantity" means a quantity of radioactive material greater than a Type A quantity.

~~((38))~~ (35) "Unirradiated uranium" means uranium containing not more than 2E+3 Bq of plutonium per gram of uranium-235, not more than 9E+6 Bq of fission products per gram of uranium-235, and not more than 5E-3 g of uranium-236 per gram of uranium-235.

~~((39))~~ (36) Uranium-Natural, depleted, enriched.

(a) "Natural uranium" means uranium with the naturally occurring distribution of uranium isotopes (approximately 0.711 weight percent uranium-235, and the remainder by weight essentially uranium-238).

(b) "Depleted uranium" means uranium containing less uranium-235 than the naturally occurring distribution of uranium isotopes.

(c) "Enriched uranium" means uranium containing more uranium-235 than the naturally occurring distribution of uranium isotopes.

AMENDATORY SECTION (Amending WSR 08-09-093, filed 4/18/08, effective 5/19/08)

WAC 246-231-030 Transportation of licensed material. (1) Each licensee who transports licensed material outside the site of usage, as specified in the license issued by the department, ((USNRC)) NRC or an agreement state, or where transport is on public highways, or who delivers licensed material to a carrier for transport, shall comply with the applicable requirements of the ((USDOT)) DOT regulations in 49 C.F.R. 107, 171 through 180, and 390 through 397, appropriate to the mode of transport.

(a) The licensee shall particularly note ((USDOT)) DOT regulations in the following areas:

(i) Packaging—49 C.F.R. 173: Subparts A, B, and I.

(ii) Marking and labeling—49 C.F.R. 172: Subpart D, 172.400 through 172.407; and Subpart E, 172.436 through 172.441.

(iii) Placarding—49 C.F.R. 172: Subpart F, especially 172.500 through 172.519 and 172.556, and appendices B and C.

(iv) Accident reporting—49 C.F.R. 171.15 and 171.16.

(v) Shipping papers and emergency information—49 C.F.R. 172: Subparts C and G.

(vi) Hazardous material employee training—49 C.F.R. 172: Subpart H.

(vii) Security plans—49 C.F.R. 172: Subpart I.

(viii) Hazardous material shipper/carrier registration—49 C.F.R. 107: Subpart G.

(b) The licensee shall also note ((USDOT)) DOT regulations pertaining to the following modes of transportation:

(i) Rail—49 C.F.R. 174: Subparts A through D and K.

(ii) Air—49 C.F.R. 175.

(iii) Vessel—49 C.F.R. 176: Subparts A through F and M.

(iv) Public Highway—49 C.F.R. 177 and 390 through 397.

(2) If ((USDOT)) DOT regulations are not applicable to a shipment of licensed material, the licensee shall conform to the standards and requirements of the ((USDOT)) DOT specified in ((paragraph)) subsection (1) of this section to the same extent as if the shipment or transportation were subject to ((USDOT)) DOT regulations. A request for modification, waiver, or exemption from those requirements, and any notification referred to in those requirements, must be filed with, or made to, the Director, Office of Nuclear Material Safety and Safeguards, ((U.S. Nuclear Regulatory Commission)) NRC, Washington, D.C. 20555-0001.

WAC 246-231-040 Exemptions. (1) Common and contract carriers, freight forwarders, and warehouse workers who are subject to the rules and regulations of the United States Department of Transportation (49 C.F.R. 170 through 189) or the United States Postal Service (*Mailing Standards of the United States Postal Service, Domestic Mail Manual*, 39 C.F.R. 111.1) are exempt from this chapter to the extent that they transport or store radioactive material in the regular course of their carriage for another or storage incident thereto. Common and contract carriers who are not subject to the rules and regulations of the (~~United States Department of Transportation~~) DOT or United States Postal Service are subject to WAC 246-231-005 and other applicable sections of these regulations.

(2) Any licensee who delivers radioactive material to a carrier for transport, where such transport is subject to the regulations of the United States Postal Service, is exempt from the provisions of WAC 246-231-005.

(3) **Exemption of physicians.** Any physician as defined in WAC 246-220-010 who is licensed by the department, (~~the USNRC~~) NRC or an agreement state, to dispense drugs in the practice of medicine, is exempt from WAC 246-220-030 with respect to transport by the physician of licensed material for use in the practice of medicine. However, any physician operating under this exemption must be licensed under chapter 246-240 WAC, 10 C.F.R. 35, or the equivalent agreement state regulations.

(4) **Exemption for low-level materials.** A licensee is exempt from all requirements of this chapter with respect to shipment or carriage of the following low-level materials:

(a) Natural material and ores containing naturally occurring radionuclides that are not intended to be processed for use of these radionuclides, provided the activity concentration of the material does not exceed ten times the values specified in WAC 246-231-200, Table A-2.

(b) Materials for which the activity concentration is not greater than the activity concentration values specified in WAC 246-231-200, Table A-2, or for which the consignment activity is not greater than the limit for an exempt consignment found in WAC 246-231-200, Table A-2.

(5) **Exemption from classification as fissile material.** Fissile material meeting at least one of the requirements in (a) through (f) of this subsection is exempt from classification as fissile material and from the fissile material package standards of 10 C.F.R. 71.55 and 71.59, but are subject to all other requirements of this chapter, except as noted.

(a) Individual package containing 2 grams or less fissile material.

(b) Individual or bulk packaging containing 15 grams or less of fissile material provided the package has at least 200 grams of solid nonfissile material for every gram of fissile material. Lead, beryllium, graphite, and hydrogenous material enriched in deuterium may be present in the package but must not be included in determining the required mass for solid nonfissile material.

(c)(i) Low concentrations of solid fissile material commingled with solid nonfissile material, provided that:

(A) There ~~((is))~~ are at least 2000 grams of solid nonfissile material for every gram of fissile material; and

(B) There ~~((is))~~ are no more than 180 grams of fissile material distributed within 360 kg of contiguous nonfissile material.

(ii) Lead, beryllium, graphite, and hydrogenous material enriched in deuterium may be present in the package but must not be included in determining the required mass of solid nonfissile material.

(d) Uranium enriched in uranium-235 to a maximum of 1 percent by weight, and with total plutonium and uranium-233 content of up to 1 percent of the mass of uranium-235, provided that the mass of any beryllium, graphite, and hydrogenous material enriched in deuterium constitutes less than 5 percent of the uranium mass.

(e) Liquid solutions of uranyl nitrate enriched in uranium-235 to a maximum of 2 percent by mass, with a total plutonium and uranium-233 content not exceeding 0.002 percent of the mass of uranium, and with a minimum nitrogen to uranium atomic ratio (N/U) of 2. The material must be contained in at least a ~~((USDOT))~~ DOT Type A package.

(f) Packages containing, individually, a total plutonium mass of not more than 1000 grams, of which not more than 20 percent by mass may consist of plutonium-239, plutonium-241, or any combination of these radionuclides.

AMENDATORY SECTION (Amending WSR 99-15-105, filed 7/21/99, effective 8/21/99)

WAC 246-231-050 General licenses for carriers. (1) A general license is hereby issued to any common or contract carrier not exempted under WAC 246-231-040 to receive, possess, transport and store radioactive material in the regular course of their carriage for another or storage incident thereto, provided the transportation and storage is in accordance with the applicable requirements of the regulations, appropriate to the mode of transport, of the United States Department of Transportation.

(2) A general license is hereby issued to any private carrier to transport radioactive material, provided the transportation is in accordance with the applicable requirements of the regulations, appropriate to the mode of transport, of the United States Department of Transportation insofar as such regulations relate to the loading and storage of packages, placarding of the transporting vehicle, shipping papers, and incident reporting. Any notification of incidents referred to in those requirements shall be filed with, or made to, the department.

(3) Persons who transport radioactive material pursuant to the general licenses of subsection (1) or (2) of this section are exempt from the requirements of chapters 246-221 and 246-222 WAC to the extent that they transport radioactive material.

(4) A general license is hereby issued to deliver radioactive material to a carrier¹ for transport provided that:

(a) The licensee complies with the applicable requirements of the regulations, appropriate to the mode of transport, of the United States Department of Transportation insofar as such regulations relate to the packaging of radioactive material, to shipping papers, and to the monitoring, marking and labeling of those packages.

(b) The licensee has established procedures for opening and closing packages in which radioactive material is transported to provide safety and to assure that, prior to the delivery to a carrier for transport, each package is properly closed for transport.

(c) Prior to delivery of a package to a carrier for transport, the licensee shall assure that any special instructions needed to safely open the package are sent to or have been made available to the consignee.

(d) In addition to the requirements of the United States Department of Transportation, each package of Type A or B quantity radioactive material prepared for shipment must have the innermost container labeled as to the isotope, chemical form, number of ~~((becquerels))~~ becquerels or subunits thereof, and date of determination of activity and each innermost container shall be tested to assure that the container is properly sealed and that contamination which would cause undue hazard to public health and safety or property is not present prior to transportation. This requirement does not apply to properly packaged shipments of radioactive waste consigned to a commercial low level radioactive waste disposal facility.

~~((Note 1--))~~ ¹ For the purpose of this regulation, licensees who transport their own licensed material as a private carrier are considered to have delivered such material to a carrier for transport.

AMENDATORY SECTION (Amending WSR 08-09-093, filed 4/18/08, effective 5/19/08)

WAC 246-231-060 General license--~~((USNRC-approved))~~ NRC-approved package. (1) A general license is hereby issued to any licensee of the department, ~~((USNRC))~~ NRC, or an agreement state, to transport, or to deliver to a carrier for transport, licensed material in a package for which a license, certificate of compliance, or other approval has been issued by ~~((the USNRC))~~ NRC.

(2) This general license applies only to a licensee who has a quality assurance program approved by ~~((the USNRC))~~ NRC as satisfying the provisions of 10 C.F.R. 71 Subpart H.

(3) This general license applies only to a licensee who:

(a) Has a copy of the certificate of compliance, or other approval of the package, and has the drawings and other documents referenced in the approval relating to the use and maintenance of the packaging and to the actions to be taken before shipment;

(b) Complies with the terms and conditions of the license, certificate, or other approval, as applicable, and the applicable requirements of 10 C.F.R. 71 Subparts A, G, and H; and

(c) Before the licensee's first use of the package, submits in writing to: ATTN: Document Control Desk, Director, Spent Fuel Project Office, Office of Nuclear Material Safety and Safeguards, using an appropriate method listed in 10 C.F.R. 71.1(a), the licensee's name and license number and the package identification number specified in the package approval.

(4) This general license applies only when the package approval authorizes use of the package under this general license.

(5) For a Type B or fissile material package, the design of which was approved by ~~((the USNRC))~~ NRC before April 1, 1996, the general license is subject to the additional restrictions of 10 C.F.R. 71.19.

AMENDATORY SECTION (Amending WSR 08-09-093, filed 4/18/08, effective 5/19/08)

WAC 246-231-090 General license—Use of foreign approved package.

(1) A general license is issued to any licensee of the department, ((USNRC)) NRC, or an agreement state, to transport, or to deliver to a carrier for transport, licensed material in a package the design of which has been approved in a foreign national competent authority certificate that has been revalidated by ((USDOT)) DOT as meeting the applicable requirements of 49 C.F.R. 171.12.

(2) Except as otherwise provided in this section, the general license applies only to a licensee who has a quality assurance program approved by ((the USNRC)) NRC as satisfying the applicable provisions of 10 C.F.R. 71 Subpart H.

(3) This general license applies only to shipments made to or from locations outside the United States.

(4) This general license applies only to a licensee who:

(a) Has a copy of the applicable certificate, the revalidation, and the drawings and other documents referenced in the certificate, relating to the use and maintenance of the packaging and to the actions to be taken before shipment; and

(b) Complies with the terms and conditions of the certificate and revalidation, and with the applicable requirements of 10 C.F.R. 71 Subparts A, G, and H. With respect to the quality assurance provisions of Subpart H of 10 C.F.R. 71, the licensee is exempt from design, construction, and fabrication considerations.

AMENDATORY SECTION (Amending WSR 08-09-093, filed 4/18/08, effective 5/19/08)

WAC 246-231-094 General license—Fissile material. (1) A general license is issued to any licensee of the department, ((USNRC)) NRC, or an agreement state, to transport fissile material, or to deliver fissile material to a carrier for transport, if the material is shipped in accordance with this section. The fissile material need not be contained in a package which meets the standards of 10 C.F.R. 71 Subparts E and F; however, the material must be contained in a Type A package. The Type A package must also meet the ((USDOT)) DOT requirements of 49 C.F.R. 173.417(a).

(2) The general license applies only to a licensee who has a quality assurance program approved by ((the USNRC)) NRC as satisfying the provisions of 10 C.F.R. 71 Subpart H.

(3) The general license applies only when a package's contents:

(a) Contain no more than a Type A quantity of radioactive material; and

(b) Contain less than 500 total grams of beryllium, graphite, or hydrogenous material enriched in deuterium.

(4) The general license applies only to packages containing fissile material that are labeled with a CSI which:

(a) Has been determined in accordance with subsection (5) of this section;

(b) Has a value less than or equal to 10; and

(c) For a shipment of multiple packages containing fissile material, the sum of the CSIs must be less than or equal to 50 (for shipment on a nonexclusive use conveyance) and less than or equal to 100 (for shipment on an exclusive use conveyance).

(5)(a) The value for the CSI must be greater than or equal to the number calculated by the following equation:

$$CSI = 10 \left[\frac{\text{grams of } ^{235}\text{U}}{X} + \frac{\text{grams of } ^{233}\text{U}}{Y} + \frac{\text{grams of Pu}}{Z} \right];$$

(b) The calculated CSI must be rounded up to the first decimal place;

(c) The values of X, Y, and Z used in the CSI equation must be taken from WAC 246-231-200 Table-1 or Table-2, as appropriate;

(d) If Table-2 is used to obtain the value of X, then the values for the terms in the equation for uranium-233 and plutonium must be assumed to be zero; and

(e) Values from Table-1 for X, Y, and Z must be used to determine the CSI if:

(i) Uranium-233 is present in the package;

(ii) The mass of plutonium exceeds 1 percent of the mass of uranium-235;

(iii) The uranium is of unknown uranium-235 enrichment or greater than 24 weight percent enrichment; or

(iv) Substances having a moderating effectiveness (i.e., an average hydrogen density greater than H₂O) (e.g., certain hydrocarbon oils or plastics) are present in any form, except as polyethylene used for packing or wrapping.

Table-1.
Mass Limits for General License Packages
Containing Mixed Quantities of Fissile Ma-
terial or Uranium-235 of Unknown Enrich-
ment per WAC 246-231-094(5)

Fissile material	Fissile material mass mixed with moderating substances having an average hydrogen density less than or equal to H₂O (grams)	Fissile material mass mixed with moderating substances having an average hydrogen density greater than H₂O^a (grams)
²³⁵ U (X)	60	38
²³³ U (Y)	43	27
²³⁹ Pu or ²⁴¹ Pu (Z)	37	24

^a When mixtures of moderating substances are present, the lower mass limits shall be used if more than 15 percent of the moderating substance has an average hydrogen density greater than H₂O.

Table-2.
Mass Limits for General License Packages
Containing Uranium-235 of Known Enrichment
per WAC 246-231-094(5)

Uranium enrichment in weight percent of ²³⁵ U not exceeding	Fissile material mass of ²³⁵ U (X) (grams)
24	60
20	63
15	67
11	72
10	76
9.5	78
9	81
8.5	82
8	85
7.5	88
7	90
6.5	93
6	97
5.5	102
5	108
4.5	114
4	120
3.5	132
3	150
2.5	180
2	246
1.5	408
1.35	480
1	1,020
0.92	1,800

AMENDATORY SECTION (Amending WSR 08-09-093, filed 4/18/08, effective 5/19/08)

WAC 246-231-096 General license—Plutonium-beryllium special form material. (1) A general license is issued to any licensee of the department, ((USNRC)) NRC, or an agreement state, to transport fissile material in the form of plutonium-beryllium (Pu-Be) special form sealed sources, or to deliver Pu-Be sealed sources to a carrier for transport, if the material is shipped in accordance with this section. This material must be contained in a Type A package. The Type A package must also meet the ((USDOT)) DOT requirements of 49 C.F.R. 173.417(a).

(2) The general license applies only to a licensee who has a quality assurance program approved by ((the USNRC)) NRC as satisfying the provisions of 10 C.F.R. 71 Subpart H.

(3) The general license applies only when a package's contents:

(a) Contain no more than a Type A quantity of radioactive material; and

(b) Contain less than 1000 g of plutonium, provided that: Plutonium-239, plutonium-241, or any combination of these radionuclides, constitutes less than 240 g of the total quantity of plutonium in the package.

(4) The general license applies only to packages labeled with a CSI which:

(a) Has been determined in accordance with subsection (5) of this section;

(b) Has a value less than or equal to 100; and

(c) For a shipment of multiple packages containing Pu-Be sealed sources, the sum of the CSIs must be less than or equal to 50 (for shipment on a nonexclusive use conveyance) and less than or equal to 100 (for shipment on an exclusive use conveyance).

(5)(a) The value for the CSI must be greater than or equal to the number calculated by the following equation:

$$CSI = 10 \left[\frac{\text{grams of } ^{239}\text{Pu} + \text{grams of } ^{241}\text{Pu}}{24} \right]; \text{ and}$$

(b) The calculated CSI must be rounded up to the first decimal place.

AMENDATORY SECTION (Amending WSR 08-09-093, filed 4/18/08, effective 5/19/08)

WAC 246-231-098 External radiation standards for all packages.

(1) Except as provided in subsection (2) of this section, each package of radioactive materials offered for transportation must be designed and prepared for shipment so that under conditions normally incident to transportation the radiation level does not exceed 2 mSv/((h)) hour (200 mrem/((h)) hour) at any point on the external surface of the package, and the transport index does not exceed 10.

(2) A package that exceeds the radiation level limits specified in subsection (1) of this section must be transported by exclusive use shipment only, and the radiation levels for such shipment must not exceed the following during transportation:

(a) 2 mSv/((h)) hour (200 mrem/((h)) hour) on the external surface of the package, unless the following conditions are met, in which case the limit is 10 mSv/((h)) hour (1000 mrem/((h)) hour):

(i) The shipment is made in a closed transport vehicle;

(ii) The package is secured within the vehicle so that its position remains fixed during transportation; and

(iii) There are no loading or unloading operations between the beginning and end of the transportation;

(b) 2 mSv/((h)) hour (200 mrem/((h)) hour) at any point on the outer surface of the vehicle, including the top and underside of the vehicle; or in the case of a flat-bed style vehicle, at any point on the vertical planes projected from the outer edges of the vehicle, on the upper surface of the load or enclosure, if used, and on the lower external surface of the vehicle; and

(c) 0.1 mSv/((h)) hour (10 mrem/((h)) hour) at any point 2 meters (80 in) from the outer lateral surfaces of the vehicle (excluding the

top and underside of the vehicle); or in the case of a flat-bed style vehicle, at any point 2 meters (6.6 feet) from the vertical planes projected by the outer edges of the vehicle (excluding the top and underside of the vehicle); and

(d) 0.02 mSv/((h)) hour (2 mrem/((h)) hour) in any normally occupied space, except that this provision does not apply to private carriers, if exposed personnel under their control wear radiation dosimetry devices in conformance with WAC 246-221-090 and 246-221-100.

(3) For shipments made under the provisions of subsection (2) of this section, the shipper shall provide specific written instructions to the carrier for maintenance of the exclusive use shipment controls. The instructions must be included with the shipping paper information.

(4) The written instructions required for exclusive use shipments must be sufficient so that, when followed, they will cause the carrier to avoid actions that will unnecessarily delay delivery or unnecessarily result in increased radiation levels or radiation exposures to transport workers or members of the general public.

AMENDATORY SECTION (Amending WSR 08-09-093, filed 4/18/08, effective 5/19/08)

WAC 246-231-106 Preliminary determinations. Before the first use of any packaging for the shipment of licensed material:

(1) The licensee shall ascertain that there are no cracks, pinholes, uncontrolled voids, or other defects that could significantly reduce the effectiveness of the packaging;

(2) Where the maximum normal operating pressure will exceed 35 kPa (5 lbs/in²) gauge, the licensee shall test the containment system at an internal pressure at least fifty percent higher than the maximum normal operating pressure, to verify the capability of that system to maintain its structural integrity at that pressure; and

(3) The licensee shall conspicuously and durably mark the packaging with its model number, serial number, gross weight, and a package identification number assigned by ((the USNRC)) NRC. Before applying the model number, the licensee shall determine that the packaging has been fabricated in accordance with the design approved by ((the U.S. Nuclear Regulatory Commission)) NRC.

AMENDATORY SECTION (Amending WSR 08-09-093, filed 4/18/08, effective 5/19/08)

WAC 246-231-110 Routine determinations. Before each shipment of licensed material, the licensee shall ensure that the package with its contents satisfies the applicable requirements of this chapter and of the license. The licensee shall determine that:

(1) The package is proper for the contents to be shipped;

(2) The package is in unimpaired physical condition except for superficial defects such as marks or dents;

(3) Each closure device of the packaging, including any required gasket, is properly installed and secured and free of defects;

(4) Any system for containing liquid is adequately sealed and has adequate space or other specified provision for expansion of the liquid;

(5) Any pressure relief device is operable and set in accordance with written procedures;

(6) The package has been loaded and closed in accordance with written procedures;

(7) For fissile material, any moderator or neutron absorber, if required, is present and in proper condition;

(8) Any structural part of the package that could be used to lift or tie down the package during transport is rendered inoperable for that purpose, unless it satisfies the design requirements of 10 C.F.R. 71.45;

(9) The level of nonfixed (removable) radioactive contamination on the external surfaces of each package offered for shipment is as low as reasonably achievable, and within the limits specified in ((US-DOE)) DOT regulations in 49 C.F.R. 173.443;

(10) External radiation levels around the package and around the vehicle, if applicable, will not exceed the limits specified in WAC 246-231-098 at any time during transportation; and

(11) Accessible package surface temperatures will not exceed the limits specified in 10 C.F.R. 71.43(g) at any time during transportation.

AMENDATORY SECTION (Amending WSR 08-09-093, filed 4/18/08, effective 5/19/08)

WAC 246-231-120 Air transport of plutonium. (1) Notwithstanding the provisions of any general licenses and notwithstanding any exemptions stated directly in this chapter or included indirectly by citation of 49 C.F.R. chapter I, as may be applicable, the licensee shall assure that plutonium in any form, whether for import, export, or domestic shipment, is not transported by air or delivered to a carrier for air transport unless:

(a) The plutonium is contained in a medical device designed for individual human application; or

(b) The plutonium is contained in a material in which the specific activity is less than or equal to the activity concentration values for plutonium specified in WAC 246-231-200, Table A-2, and in which the radioactivity is essentially uniformly distributed; or

(c) The plutonium is shipped in a single package containing no more than an A2 quantity of plutonium in any isotope or form, and is shipped in accordance with WAC 246-231-030; or

(d) The plutonium is shipped in a package specifically authorized for the shipment of plutonium by air in the Certificate of Compliance for that package issued by ((the U.S. Nuclear Regulatory Commission)) NRC.

(2) Nothing in subsection (1) of this section is to be interpreted as removing or diminishing the requirements of ((USNRC)) NRC regulations 10 C.F.R. 73.24.

(3) For a shipment of plutonium by air which is subject to subsection (1)(d) of this section, the licensee shall, through special arrangement with the carrier, require compliance with 49 C.F.R.

175.704 ((USDOT)) DOT regulations applicable to the air transport of plutonium.

AMENDATORY SECTION (Amending WSR 08-09-093, filed 4/18/08, effective 5/19/08)

WAC 246-231-133 Public inspection of application. Applications for approval of a package design under this chapter, which are submitted to ((the USNRC)) NRC, may be made available for public inspection, in accordance with provisions of 10 C.F.R. 2 and 9. This includes an application to amend or revise an existing package design, any associated documents and drawings submitted with the application, and any responses to ((USNRC)) NRC requests for additional information.

AMENDATORY SECTION (Amending WSR 08-09-093, filed 4/18/08, effective 5/19/08)

WAC 246-231-136 Records. (1) Each licensee shall maintain, for a period of three years after shipment, a record of each shipment of licensed material not exempt under WAC 246-231-040(4), showing where applicable:

(a) Identification of the packaging by model number and serial number;

(b) Verification that there are no significant defects in the packaging, as shipped;

(c) Volume and identification of coolant;

(d) Type and quantity of licensed material in each package, and the total quantity of each shipment;

(e) For each item of irradiated fissile material:

(i) Identification by model number and serial number;

(ii) Irradiation and decay history to the extent appropriate to demonstrate that its nuclear and thermal characteristics comply with license conditions; and

(iii) Any abnormal or unusual condition relevant to radiation safety;

(f) Date of the shipment;

(g) For fissile packages and for Type B packages, any special controls exercised;

(h) Name and address of the transferee;

(i) Address to which the shipment was made; and

(j) Results of the determinations required by WAC 246-231-110 and by the conditions of the package approval.

(2) Each certificate holder shall maintain, for a period of three years after the life of the packaging to which they apply, records identifying the packaging by model number, serial number, and date of manufacture.

(3) The licensee, certificate holder, and an applicant for a ((CoC)) certificate of compliance, shall make available to ((the USNRC)) NRC for inspection, upon reasonable notice, all records required by 10 C.F.R. 71.91. Records are only valid if stamped, ini-

tialed, or signed and dated by authorized personnel, or otherwise authenticated.

(4) The licensee, certificate holder, and an applicant for a ~~((C))~~ certificate of compliance shall maintain sufficient written records to furnish evidence of the quality of packaging. The records to be maintained include results of the determinations required by WAC 246-231-106; design, fabrication, and assembly records; results of reviews, inspections, tests, and audits; results of monitoring work performance and materials analyses; and results of maintenance, modification, and repair activities. Inspection, test, and audit records must identify the inspector or data recorder, the type of observation, the results, the acceptability, and the action taken in connection with any deficiencies noted. These records must be retained for three years after the life of the packaging to which they apply.

AMENDATORY SECTION (Amending WSR 08-09-093, filed 4/18/08, effective 5/19/08)

WAC 246-231-140 Advance notification of shipment of irradiated reactor fuel and nuclear waste. (1)(a) As specified in subsections (2), (3), and (4) of this section, each licensee shall provide advance notification to the governor of a state, or the governor's designee, of the shipment of licensed material, ~~((through,))~~ within or across the boundary of the state, before the transport, or delivery to a carrier, for transport, of licensed material outside the confines of the licensee's plant or other place of use or storage.

(b) As specified in subsections (2), (3), and (4) of this section, after June 11, 2013, each licensee shall provide advance notification to the tribal official of participating tribes referenced in subsection (3)(c)(iii) of this section, or the official's designee, of the shipment of licensed material within or across the boundary of the tribe's reservation before the transport, or delivery to a carrier for transport, of licensed material outside the confines of the licensee's plant or other place of use or storage.

(2) Advance notification is required under this section for shipments of irradiated reactor fuel in quantities less than that subject to advance notification requirements of ~~((USNRC))~~ NRC regulations 10 C.F.R. 73.37(f). Advance notification is also required under this section for shipment of licensed material, other than irradiated fuel, meeting the following three conditions:

(a) The licensed material is required by this section to be in Type B packaging for transportation;

(b) The licensed material is being transported to or across a state boundary en route to a disposal facility or to a collection point for transport to a disposal facility; and

(c) The quantity of licensed material in a single package exceeds the least of the following:

(i) 3000 times the A1 value of the radionuclides as specified in WAC 246-231-200, Table A-1 for special form radioactive material;

(ii) 3000 times the A2 value of the radionuclides as specified in WAC 246-231-200, Table A-1 for normal form radioactive material; or

(iii) 1000 TBq (27,000 Ci).

(3) Procedures for submitting advance notification.

(a) The notification must be made in writing to the office of each appropriate governor or governor's designee, to the office of each appropriate tribal official or tribal official's designee, and to the Director, Division of ~~((Nuclear))~~ Security Policy, Office of Nuclear Security and Incident Response.

(b) A notification delivered by mail must be postmarked at least seven days before the beginning of the seven-day period during which departure of the shipment is estimated to occur.

(c) A notification delivered by any other means than mail must reach the office of the governor or ~~((of))~~ the governor's designee, or of the tribal official or the tribal official's designee, at least four days before the beginning of the seven-day period during which departure of the shipment is estimated to occur.

(i) A list of the names and mailing addresses of the governors' designees receiving advance notification of transportation of nuclear waste was published in the *Federal Register* on June 30, 1995, (60 FR 34306).

(ii) The list of governors' designees and tribal officials' designees of participating tribes will be published annually in the *Federal Register* on or about June 30 to reflect any changes in information.

(iii) A list of the names and mailing addresses of the governors' designees and tribal officials' designees of participating tribes is available on request from the Director, Division of Intergovernmental Liaison and Rulemaking, Office of Federal and State Materials and Environmental Management Programs, ~~((U.S. Nuclear Regulatory Commission))~~ NRC, Washington, D.C. 20555-0001.

(d) The licensee shall retain a copy of the notification as a record for three years.

(4) Information to be furnished in advance notification of shipment. Each advance notification of shipment of irradiated reactor fuel or nuclear waste must contain the following information:

(a) The name, address, and telephone number of the shipper, carrier, and receiver of the irradiated reactor fuel or nuclear waste shipment;

(b) A description of the irradiated reactor fuel or nuclear waste contained in the shipment, as specified in the regulations of ~~((US-DOF))~~ DOT in 49 C.F.R. 172.202 and 172.203(d);

(c) The point of origin of the shipment and the seven-day period during which departure of the shipment is estimated to occur;

(d) The seven-day period during which arrival of the shipment at state boundaries or tribal reservation boundaries is estimated to occur;

(e) The destination of the shipment, and the seven-day period during which arrival of the shipment is estimated to occur; and

(f) A point of contact, with a telephone number, for current shipment information.

(5) Revision notice. A licensee who finds that schedule information previously furnished to a governor or governor's designee, or a tribal official or tribal official's designee, in accordance with this section, will not be met, shall telephone a responsible individual in the office of the governor of the state or of the governor's designee or the tribal official or the tribal official's designee, and inform that individual of the extent of the delay beyond the schedule originally reported. The licensee shall maintain a record of the name of the individual contacted for three years.

(6) Cancellation notice.

(a) Each licensee who cancels an irradiated reactor fuel or nuclear waste shipment for which advance notification has been sent shall send a cancellation notice to the governor of each state or to the governor's designee previously notified, to each tribal official or to the tribal official's designee previously notified, and to the Director, Division of ~~((Nuclear))~~ Security Policy, Office of Nuclear Security and Incident Response.

(b) The licensee shall state in the notice that it is a cancellation and identify the advance notification that is being canceled. The licensee shall retain a copy of the notice as a record for three years.

AMENDATORY SECTION (Amending WSR 08-09-093, filed 4/18/08, effective 5/19/08)

WAC 246-231-150 Quality assurance requirements. (1) Purpose. Quality assurance requirements apply to design, purchase, fabrication, handling, shipping, storing, cleaning, assembly, inspection, testing, operation, maintenance, repair, and modification of components of packaging that are important to safety. As used in this chapter, "quality assurance" comprises all those planned and systematic actions necessary to provide adequate confidence that a system or component will perform satisfactorily in service. Quality assurance includes quality control, which comprises those quality assurance actions related to control of the physical characteristics and quality of the material or component to predetermined requirements. The licensee, certificate holder, and applicant for a ~~((CoE))~~ certificate of compliance are responsible for the quality assurance requirements as they apply to design, fabrication, testing, and modification of packaging. Each licensee is responsible for the quality assurance provision which applies to its use of packaging for the shipment of licensed material subject to this chapter.

(2) Establishment of program. Each licensee, certificate holder, and applicant for a ~~((CoE))~~ certificate of compliance shall establish, maintain, and execute a quality assurance program satisfying each of the applicable criteria in 10 C.F.R. 71.101 through 71.137 and satisfying any specific provisions that are applicable to the licensee's activities including procurement of packaging. The licensee, certificate holder, and applicant for a ~~((CoE))~~ certificate of compliance shall execute the applicable criteria in a graded approach to an extent that is commensurate with the quality assurance requirement's importance to safety.

(3) Approval of program. Before the use of any package for the shipment of licensed material subject to this chapter, each licensee shall obtain ~~((USNRC))~~ NRC approval of its quality assurance program. Using an appropriate method listed in 10 C.F.R. 71.1(a), each licensee shall file a description of its quality assurance program, including a discussion of which requirements of 10 C.F.R. 71 Subpart H are applicable and how they will be satisfied, by submitting the description to: ATTN: Document Control Desk, Director, Spent Fuel Project Office, Office of Nuclear Material Safety and Safeguards.

(4) Radiography containers. A program for transport container inspection and maintenance limited to radiographic exposure devices, source changers, or packages transporting these devices and meeting

the requirements of WAC 246-243-120(2), is deemed to satisfy the requirements of WAC 246-231-060(2) and 246-231-150(2).

AMENDATORY SECTION (Amending WSR 08-09-093, filed 4/18/08, effective 5/19/08)

WAC 246-231-170 Quality assurance program. (1) The licensee, certificate holder, and applicant for a ((C)) certificate of compliance shall establish, at the earliest practicable time consistent with the schedule for accomplishing the activities, a quality assurance program that complies with the requirements of 10 C.F.R. 71.101 through 71.137. The licensee, certificate holder, and applicant for a ((C)) certificate of compliance shall document the quality assurance program by written procedures or instructions and shall carry out the program in accordance with those procedures throughout the period during which the packaging is used. The licensee, certificate holder, and applicant for a ((C)) certificate of compliance shall identify the material and components to be covered by the quality assurance program, the major organizations participating in the program, and the designated functions of these organizations.

(2) The licensee, certificate holder, and applicant for a ((C)) certificate of compliance, through its quality assurance program, shall provide control over activities affecting the quality of the identified materials and components to an extent consistent with their importance to safety, and as necessary to assure conformance to the approved design of each individual package used for the shipment of radioactive material. The licensee, certificate holder, and applicant for a ((C)) certificate of compliance shall assure that activities affecting quality are accomplished under suitably controlled conditions. Controlled conditions include the use of appropriate equipment; suitable environmental conditions for accomplishing the activity, such as adequate cleanliness; and assurance that all prerequisites for the given activity have been satisfied. The licensee, certificate holder, and applicant for a ((C)) certificate of compliance shall take into account the need for special controls, processes, test equipment, tools, and skills to attain the required quality, and the need for verification of quality by inspection and test.

(3) The licensee, certificate holder, and applicant for a ((C)) certificate of compliance shall base the requirements and procedures of its quality assurance program on the following considerations concerning the complexity and proposed use of the package and its components:

- (a) The impact of malfunction or failure of the item to safety;
- (b) The design and fabrication complexity or uniqueness of the item;
- (c) The need for special controls and surveillance over processes and equipment;
- (d) The degree to which functional compliance can be demonstrated by inspection or test; and
- (e) The quality history and degree of standardization of the item.

(4) The licensee, certificate holder, and applicant for a ((C)) certificate of compliance shall provide for indoctrination and training of personnel performing activities affecting quality, as necessary

to assure that suitable proficiency is achieved and maintained. The licensee, certificate holder, and applicant for a ((CœC)) certificate of compliance shall review the status and adequacy of the quality assurance program at established intervals. Management of other organizations participating in the quality assurance program shall review regularly the status and adequacy of that part of the quality assurance program they are executing.

AMENDATORY SECTION (Amending WSR 08-09-093, filed 4/18/08, effective 5/19/08)

WAC 246-231-186 Quality assurance records. The licensee, certificate holder, and applicant for a ((CœC)) certificate of compliance shall maintain sufficient written records to describe the activities affecting quality. The records must include the instructions, procedures, and drawings required by 10 C.F.R. 71.111 to prescribe quality assurance activities and must include closely related specifications such as required qualifications of personnel, procedures, and equipment. The records must include the instructions or procedures which establish a records retention program that is consistent with applicable regulations and designates factors such as duration, location, and assigned responsibility. The licensee, certificate holder, and applicant for a ((CœC)) certificate of compliance shall retain these records for three years beyond the date when the licensee, certificate holder, and applicant for a ((CœC)) certificate of compliance last engaged in the activity for which the quality assurance program was developed. If any portion of the written procedures or instructions is superseded, the licensee, certificate holder, and applicant for a ((CœC)) certificate of compliance shall retain the superseded material for three years after it is superseded.

AMENDATORY SECTION (Amending WSR 11-03-068, filed 1/18/11, effective 2/18/11)

WAC 246-231-200 Appendix A-Determination of A1 and A2. (1) Values of A1 and A2 for individual radionuclides, which are the basis for many activity limits elsewhere in these regulations, are given in this section, Table A-1. The curie (Ci) values specified are obtained by converting from the Terabecquerel (TBq) value. The Terabecquerel values are the regulatory standard. The curie values are for information only and are not intended to be the regulatory standard. Where values of A1 or A2 are unlimited, it is for radiation control purposes only. For nuclear criticality safety, some materials are subject to controls placed on fissile material.

(2)(a) For individual radionuclides whose identities are known, but which are not listed in this section, Table A-1, the A1 and A2 values contained in this section, Table A-3 may be used. Otherwise, the licensee shall obtain prior ((USNRC)) NRC approval of the A1 and A2 values for radionuclides not listed in this section, Table A-1, before shipping the material.

(b) For individual radionuclides whose identities are known, but which are not listed in this section, Table A-2, the exempt material activity concentration and exempt consignment activity values contained in this section, Table A-3 may be used. Otherwise, the licensee shall obtain prior ((USNRC)) NRC approval of the exempt material activity concentration and exempt consignment activity values for radionuclides not listed in this section, Table A-2, before shipping the material.

(c) The licensee shall submit requests for prior approval, described under (a) and (b) of this subsection, to ((the USNRC)) NRC in accordance with 10 C.F.R. 71.1.

(3) In the calculations of A1 and A2 for a radionuclide not in this section, Table A-1, a single radioactive decay chain, in which radionuclides are present in their naturally occurring proportions, and in which no daughter radionuclide has a half-life either longer than ten days, or longer than that of the parent radionuclide, shall be considered as a single radionuclide, and the activity to be taken into account, and the A1 or A2 value to be applied shall be those corresponding to the parent radionuclide of that chain. In the case of radioactive decay chains in which any daughter radionuclide has a half-life either longer than ten days, or greater than that of the parent radionuclide, the parent and those daughter radionuclides shall be considered as mixtures of different radionuclides.

(4) For mixtures of radionuclides whose identities and respective activities are known, the following conditions apply:

(a) For special form radioactive material, the maximum quantity transported in a Type A package:

$$\sum_I \frac{B(i)}{A1(i)} \quad \text{less than or equal to } 1$$

Where B(i) is the activity of radionuclide I, and A1(i) is the A1 value for radionuclide I.

(b) For normal form radioactive material, the maximum quantity transported in a Type A package:

$$\sum_I \frac{B(i)}{A2(i)} \quad \text{less than or equal to } 1$$

Where B(i) is the activity of radionuclide I and A2(i) is the A2 value for radionuclide I.

(c) Alternatively, the A1 value for mixtures of special form material may be determined as follows:

$$A1 \text{ for mixture} = \frac{1}{\sum_I \frac{f(i)}{A1(i)}}$$

Where f(i) is the fraction of activity for radionuclide I in the mixture and A1(i) is the appropriate A1 value for radionuclide I.

(d) Alternatively, the A2 value for mixtures of normal form material may be determined as follows:

$$A2 \text{ for mixture} = \frac{1}{\sum_I \frac{f(i)}{A2(i)}}$$

Where f(i) is the fraction of activity for radionuclide I in the mixture and A2(i) is the appropriate A2 value for radionuclide I.

(e) The exempt activity concentration for mixtures of nuclides may be determined as follows:

$$\text{Exempt activity concentration for mixture} = \frac{1}{\sum_I \frac{f(i)}{[A](i)}}$$

Where f(i) is the fraction of activity concentration of radionuclide I in the mixture, and A is the activity concentration of material containing radionuclide I.

(f) The activity limit for an exempt consignment for mixtures of radionuclides may be determined as follows:

$$\text{Exempt consignment activity limit for mixture} = \frac{1}{\sum_I \frac{f(i)}{A(i)}}$$

Where f(i) is the fraction of activity of radionuclide I in the mixture, and A is the activity limit for exempt consignments for radionuclide I.

(5) When the identity of each radionuclide is known, but the individual activities of some of the radionuclides are not known, the radionuclides may be grouped and the lowest A1 or A2 value, as appropriate, for the radionuclides in each group may be used in applying the formulas in subsection (4) of this section. Groups may be based on the total alpha activity and the total beta/gamma activity when these are known, using the lowest A1 or A2 values for the alpha emitters and beta/gamma emitters.

Table A-1.—A1 and A2 Values for Radionuclides

Symbol of radionuclide	Element and atomic number	A1 (TBq)	A1 (Ci) ^b	A2 (TBq)	A2 (Ci) ^b	Specific activity	
						(TBq/g)	(Ci/g)
Ac-225 (a)	Actinium (89)	8.0X10 ⁻¹	2.2X10 ¹	6.0X10 ⁻³	1.6X10 ⁻¹	2.1X10 ³	5.8X10 ⁴
Ac-227 (a)		9.0X10 ⁻¹	2.4X10 ¹	9.0X10 ⁻⁵	2.4X10 ⁻³	2.7	7.2X10 ¹
Ac-228		6.0X10 ⁻¹	1.6X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	8.4X10 ⁴	2.2X10 ⁶
Ag-105	Silver (47)	2.0	5.4X10 ¹	2.0	5.4X10 ¹	1.1X10 ³	3.0X10 ⁴
Ag-108m (a)		7.0X10 ⁻¹	1.9X10 ¹	7.0X10 ⁻¹	1.9X10 ¹	9.7X10 ⁻¹	2.6X10 ¹
Ag-110m (a)		4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	1.8X10 ²	4.7X10 ³
Ag-111		2.0	5.4X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	5.8X10 ³	1.6X10 ⁵
Al-26	Aluminum (13)	1.0X10 ⁻¹	2.7	1.0X10 ⁻¹	2.7	7.0X10 ⁻⁴	1.9X10 ⁻²

Symbol of radionuclide	Element and atomic number	A1 (TBq)	A1 (Ci) ^b	A2 (TBq)	A2 (Ci) ^b	Specific activity	
						(TBq/g)	(Ci/g)
Am-241	Americium (95)	1.0X10 ¹	2.7X10 ²	1.0X10 ⁻³	2.7X10 ⁻²	1.3X10 ⁻¹	3.4
Am-242m (a)		1.0X10 ¹	2.7X10 ²	1.0X10 ⁻³	2.7X10 ⁻²	3.6X10 ⁻¹	1.0X10 ¹
Am-243 (a)		5.0	1.4X10 ²	1.0X10 ⁻³	2.7X10 ⁻²	7.4X10 ⁻³	2.0X10 ⁻¹
Ar-37	Argon (18)	4.0X10 ¹	1.1X10 ³	4.0X10 ¹	1.1X10 ³	3.7X10 ³	9.9X10 ⁴
Ar-39		4.0X10 ¹	1.1X10 ³	2.0X10 ¹	5.4X10 ²	1.3	3.4X10 ¹
Ar-41		3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	1.5X10 ⁶	4.2X10 ⁷
As-72	Arsenic (33)	3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	6.2X10 ⁴	1.7X10 ⁶
As-73		4.0X10 ¹	1.1X10 ³	4.0X10 ¹	1.1X10 ³	8.2X10 ²	2.2X10 ⁴
As-74		1.0	2.7X10 ¹	9.0X10 ⁻¹	2.4X10 ¹	3.7X10 ³	9.9X10 ⁴
As-76		3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	5.8X10 ⁴	1.6X10 ⁶
As-77		2.0X10 ¹	5.4X10 ²	7.0X10 ⁻¹	1.9X10 ¹	3.9X10 ⁴	1.0X10 ⁶
At-211 (a)	Astatine (85)	2.0X10 ¹	5.4X10 ²	5.0X10 ⁻¹	1.4X10 ¹	7.6X10 ⁴	2.1X10 ⁶
Au-193	Gold (79)	7.0	1.9X10 ²	2.0	5.4X10 ¹	3.4X10 ⁴	9.2X10 ⁵
Au-194		1.0	2.7X10 ¹	1.0	2.7X10 ¹	1.5X10 ⁴	4.1X10 ⁵
Au-195		1.0X10 ¹	2.7X10 ²	6.0	1.6X10 ²	1.4X10 ²	3.7X10 ³
Au-198		1.0	2.7X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	9.0X10 ³	2.4X10 ⁵
Au-199		1.0X10 ¹	2.7X10 ²	6.0X10 ⁻¹	1.6X10 ¹	7.7X10 ³	2.1X10 ⁵
Ba-131 (a)	Barium (56)	2.0	5.4X10 ¹	2.0	5.4X10 ¹	3.1X10 ³	8.4X10 ⁴
Ba-133		3.0	8.1X10 ¹	3.0	8.1X10 ¹	9.4	2.6X10 ²
Ba-133m		2.0X10 ¹	5.4X10 ²	6.0X10 ⁻¹	1.6X10 ¹	2.2X10 ⁴	6.1X10 ⁵
Ba-140 (a)		5.0X10 ⁻¹	1.4X10 ¹	3.0X10 ⁻¹	8.1	2.7X10 ³	7.3X10 ⁴
Be-7	Beryllium (4)	2.0X10 ¹	5.4X10 ²	2.0X10 ¹	5.4X10 ²	1.3X10 ⁴	3.5X10 ⁵
Be-10		4.0X10 ¹	1.1X10 ³	6.0X10 ⁻¹	1.6X10 ¹	8.3X10 ⁻⁴	2.2X10 ⁻²
Bi-205	Bismuth (83)	7.0X10 ⁻¹	1.9X10 ¹	7.0X10 ⁻¹	1.9X10 ¹	1.5X10 ³	4.2X10 ⁴
Bi-206		3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	3.8X10 ³	1.0X10 ⁵
Bi-207		7.0X10 ⁻¹	1.9X10 ¹	7.0X10 ⁻¹	1.9X10 ¹	1.9	5.2X10 ¹
Bi-210		1.0	2.7X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	4.6X10 ³	1.2X10 ⁵
Bi-210m (a)		6.0X10 ⁻¹	1.6X10 ¹	2.0X10 ⁻²	5.4X10 ⁻¹	2.1X10 ⁻⁵	5.7X10 ⁻⁴
Bi-212 (a)		7.0X10 ⁻¹	1.9X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	5.4X10 ⁵	1.5X10 ⁷
Bk-247	Berkelium (97)	8.0	2.2X10 ²	8.0X10 ⁻⁴	2.2X10 ⁻²	3.8X10 ⁻²	1.0
Bk-249 (a)		4.0X10 ¹	1.1X10 ³	3.0X10 ⁻¹	8.1	6.1X10 ¹	1.6X10 ³
Br-76	Bromine (35)	4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	9.4X10 ⁴	2.5X10 ⁶
Br-77		3.0	8.1X10 ¹	3.0	8.1X10 ¹	2.6X10 ⁴	7.1X10 ⁵
Br-82		4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁴	1.1X10 ⁶
C-11	Carbon (6)	1.0	2.7X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	3.1X10 ⁷	8.4X10 ⁸
C-14		4.0X10 ¹	1.1X10 ³	3.0	8.1X10 ¹	1.6X10 ⁻¹	4.5
Ca-41	Calcium (20)	Unlimited	Unlimited	Unlimited	Unlimited	3.1X10 ⁻³	8.5X10 ⁻²
Ca-45		4.0X10 ¹	1.1X10 ³	1.0	2.7X10 ¹	6.6X10 ²	1.8X10 ⁴
Ca-47 (a)		3.0	8.1X10 ¹	3.0X10 ⁻¹	8.1	2.3X10 ⁴	6.1X10 ⁵
Cd-109	Cadmium (48)	3.0X10 ¹	8.1X10 ²	2.0	5.4X10 ¹	9.6X10 ¹	2.6X10 ³
Cd-113m		4.0X10 ¹	1.1X10 ³	5.0X10 ⁻¹	1.4X10 ¹	8.3	2.2X10 ²
Cd-115 (a)		3.0	8.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	1.9X10 ⁴	5.1X10 ⁵
Cd-115m		5.0X10 ⁻¹	1.4X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	9.4X10 ²	2.5X10 ⁴
Ce-139	Cerium (58)	7.0	1.9X10 ²	2.0	5.4X10 ¹	2.5X10 ²	6.8X10 ³
Ce-141		2.0X10 ¹	5.4X10 ²	6.0X10 ⁻¹	1.6X10 ¹	1.1X10 ³	2.8X10 ⁴
Ce-143		9.0X10 ⁻¹	2.4X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	2.5X10 ⁴	6.6X10 ⁵
Ce-144 (a)		2.0X10 ⁻¹	5.4	2.0X10 ⁻¹	5.4	1.2X10 ²	3.2X10 ³

Symbol of radionuclide	Element and atomic number	A1 (TBq)	A1 (Ci) ^b	A2 (TBq)	A2 (Ci) ^b	Specific activity	
						(TBq/g)	(Ci/g)
Cf-248	Californium (98)	4.0X10 ¹	1.1X10 ³	6.0X10 ⁻³	1.6X10 ⁻¹	5.8X10 ¹	1.6X10 ³
Cf-249		3.0	8.1X10 ¹	8.0X10 ⁻⁴	2.2X10 ⁻²	1.5X10 ⁻¹	4.1
Cf-250		2.0X10 ¹	5.4X10 ²	2.0X10 ⁻³	5.4X10 ⁻²	4.0	1.1X10 ²
Cf-251		7.0	1.9X10 ²	7.0X10 ⁻⁴	1.9X10 ⁻²	5.9X10 ⁻²	1.6
Cf-252 (h)		5.0X10 ⁻²	1.4	3.0X10 ⁻³	8.1X10 ⁻²	2.0X10 ¹	5.4X10 ²
Cf-253 (a)		4.0X10 ¹	1.1X10 ³	4.0X10 ⁻²	1.1	1.1X10 ³	2.9X10 ⁴
Cf-254		1.0X10 ⁻³	2.7X10 ⁻²	1.0X10 ⁻³	2.7X10 ⁻²	3.1X10 ²	8.5X10 ³
Cl-36	Chlorine (17)	1.0X10 ¹	2.7X10 ²	6.0X10 ⁻¹	1.6X10 ¹	1.2X10 ⁻³	3.3X10 ⁻²
Cl-38		2.0X10 ⁻¹	5.4	2.0X10 ⁻¹	5.4	4.9X10 ⁶	1.3X10 ⁸
Cm-240	Curium (96)	4.0X10 ¹	1.1X10 ³	2.0X10 ⁻²	5.4X10 ⁻¹	7.5X10 ²	2.0X10 ⁴
Cm-241		2.0	5.4X10 ¹	1.0	2.7X10 ¹	6.1X10 ²	1.7X10 ⁴
Cm-242		4.0X10 ¹	1.1X10 ³	1.0X10 ⁻²	2.7X10 ⁻¹	1.2X10 ²	3.3X10 ³
Cm-243		9.0	2.4X10 ²	1.0X10 ⁻³	2.7X10 ⁻²	1.9X10 ⁻³	5.2X10 ¹
Cm-244		2.0X10 ¹	5.4X10 ²	2.0X10 ⁻³	5.4X10 ⁻²	3.0	8.1X10 ¹
Cm-245		9.0	2.4X10 ²	9.0X10 ⁻⁴	2.4X10 ⁻²	6.4X10 ⁻³	1.7X10 ⁻¹
Cm-246		9.0	2.4X10 ²	9.0X10 ⁻⁴	2.4X10 ⁻²	1.1X10 ⁻²	3.1X10 ⁻¹
Cm-247 (a)		3.0	8.1X10 ¹	1.0X10 ⁻³	2.7X10 ⁻²	3.4X10 ⁻⁶	9.3X10 ⁻⁵
Cm-248		2.0X10 ⁻²	5.4X10 ⁻¹	3.0X10 ⁻⁴	8.1X10 ⁻³	1.6X10 ⁻⁴	4.2X10 ⁻³
Co-55	Cobalt (27)	5.0X10 ⁻¹	1.4X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	1.1X10 ⁵	3.1X10 ⁶
Co-56		3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	1.1X10 ³	3.0X10 ⁴
Co-57		1.0X10 ¹	2.7X10 ²	1.0X10 ¹	2.7X10 ²	3.1X10 ²	8.4X10 ³
Co-58		1.0	2.7X10 ¹	1.0	2.7X10 ¹	1.2X10 ³	3.2X10 ⁴
Co-58m		4.0X10 ¹	1.1X10 ³	4.0X10 ¹	1.1X10 ³	2.2X10 ⁵	5.9X10 ⁶
Co-60		4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	4.2X10 ¹	1.1X10 ³
Cr-51	Chromium (24)	3.0X10 ¹	8.1X10 ²	3.0X10 ¹	8.1X10 ²	3.4X10 ³	9.2X10 ⁴
Cs-129	Cesium (55)	4.0	1.1X10 ²	4.0	1.1X10 ²	2.8X10 ⁴	7.6X10 ⁵
Cs-131		3.0X10 ¹	8.1X10 ²	3.0X10 ¹	8.1X10 ²	3.8X10 ³	1.0X10 ⁵
Cs-132		1.0	2.7X10 ¹	1.0	2.7X10 ¹	5.7X10 ³	1.5X10 ⁵
Cs-134		7.0X10 ⁻¹	1.9X10 ¹	7.0X10 ⁻¹	1.9X10 ¹	4.8X10 ¹	1.3X10 ³
Cs-134m		4.0X10 ¹	1.1X10 ³	6.0X10 ⁻¹	1.6X10 ¹	3.0X10 ⁵	8.0X10 ⁶
Cs-135		4.0X10 ¹	1.1X10 ³	1.0	2.7X10 ¹	4.3X10 ⁻⁵	1.2X10 ⁻³
Cs-136		5.0X10 ⁻¹	1.4X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	2.7X10 ³	7.3X10 ⁴
Cs-137 (a)		2.0	5.4X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	3.2	8.7X10 ¹
Cu-64	Copper (29)	6.0	1.6X10 ²	1.0	2.7X10 ¹	1.4X10 ⁵	3.9X10 ⁶
Cu-67		1.0X10 ¹	2.7X10 ²	7.0X10 ⁻¹	1.9X10 ¹	2.8X10 ⁴	7.6X10 ⁵
Dy-159	Dysprosium (66)	2.0X10 ¹	5.4X10 ²	2.0X10 ¹	5.4X10 ²	2.1X10 ²	5.7X10 ³
Dy-165		9.0X10 ⁻¹	2.4X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	3.0X10 ⁵	8.2X10 ⁶
Dy-166 (a)		9.0X10 ⁻¹	2.4X10 ¹	3.0X10 ⁻¹	8.1	8.6X10 ³	2.3X10 ⁵
Er-169	Erbium (68)	4.0X10 ¹	1.1X10 ³	1.0	2.7X10 ¹	3.1X10 ³	8.3X10 ⁴
Er-171		8.0X10 ⁻¹	2.2X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	9.0X10 ⁴	2.4X10 ⁶
Eu-147	Europium (63)	2.0	5.4X10 ¹	2.0	5.4X10 ¹	1.4X10 ³	3.7X10 ⁴
Eu-148		5.0X10 ⁻¹	1.4X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	6.0X10 ²	1.6X10 ⁴
Eu-149		2.0X10 ¹	5.4X10 ²	2.0X10 ¹	5.4X10 ²	3.5X10 ²	9.4X10 ³
Eu-150 (short lived)		2.0	5.4X10 ¹	7.0X10 ⁻¹	1.9X10 ¹	6.1X10 ⁴	1.6X10 ⁶
Eu-150 (long lived)		7.0X10 ⁻¹	1.9X10 ¹	7.0X10 ⁻¹	1.9X10 ¹	6.1X10 ⁴	1.6X10 ⁶
Eu-152		1.0	2.7X10 ¹	1.0	2.7X10 ¹	6.5	1.8X10 ²
Eu-152m		8.0X10 ⁻¹	2.2X10 ¹	8.0X10 ⁻¹	2.2X10 ¹	8.2X10 ⁴	2.2X10 ⁶

Symbol of radionuclide	Element and atomic number	A1 (TBq)	A1 (Ci) ^b	A2 (TBq)	A2 (Ci) ^b	Specific activity	
						(TBq/g)	(Ci/g)
Eu-154		9.0X10 ⁻¹	2.4X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	9.8	2.6X10 ²
Eu-155		2.0X10 ¹	5.4X10 ²	3.0	8.1X10 ¹	1.8X10 ¹	4.9X10 ²
Eu-156		7.0X10 ⁻¹	1.9X10 ¹	7.0X10 ⁻¹	1.9X10 ¹	2.0X10 ³	5.5X10 ⁴
F-18	Fluorine (9)	1.0	2.7X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	3.5X10 ⁶	9.5X10 ⁷
Fe-52 (a)	Iron (26)	3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	2.7X10 ⁵	7.3X10 ⁶
Fe-55		4.0X10 ¹	1.1X10 ³	4.0X10 ¹	1.1X10 ³	8.8X10 ¹	2.4X10 ³
Fe-59		9.0X10 ⁻¹	2.4X10 ¹	9.0X10 ⁻¹	2.4X10 ¹	1.8X10 ³	5.0X10 ⁴
Fe-60 (a)		4.0X10 ¹	1.1X10 ³	2.0X10 ⁻¹	5.4	7.4X10 ⁻⁴	2.0X10 ⁻²
Ga-67	Gallium (31)	7.0	1.9X10 ²	3.0	8.1X10 ¹	2.2X10 ⁴	6.0X10 ⁵
Ga-68		5.0X10 ⁻¹	1.4X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	1.5X10 ⁶	4.1X10 ⁷
Ga-72		4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	1.1X10 ⁵	3.1X10 ⁶
Gd-146 (a)	Gadolinium (64)	5.0X10 ⁻¹	1.4X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	6.9X10 ²	1.9X10 ⁴
Gd-148		2.0X10 ¹	5.4X10 ²	2.0X10 ⁻³	5.4X10 ⁻²	1.2	3.2X10 ¹
Gd-153		1.0X10 ¹	2.7X10 ²	9.0	2.4X10 ²	1.3X10 ²	3.5X10 ³
Gd-159		3.0	8.1X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	3.9X10 ⁴	1.1X10 ⁶
Ge-68 (a)	Germanium (32)	5.0X10 ⁻¹	1.4X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	2.6X10 ²	7.1X10 ³
Ge-71		4.0X10 ¹	1.1X10 ³	4.0X10 ¹	1.1X10 ³	5.8X10 ³	1.6X10 ⁵
Ge-77		3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	1.3X10 ⁵	3.6X10 ⁶
Hf-172 (a)	Hafnium (72)	6.0X10 ⁻¹	1.6X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	4.1X10 ¹	1.1X10 ³
Hf-175		3.0	8.1X10 ¹	3.0	8.1X10 ¹	3.9X10 ²	1.1X10 ⁴
Hf-181		2.0	5.4X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	6.3X10 ²	1.7X10 ⁴
Hf-182		Unlimited	Unlimited	Unlimited	Unlimited	8.1X10 ⁻⁶	2.2X10 ⁻⁴
Hg-194 (a)	Mercury (80)	1.0	2.7X10 ¹	1.0	2.7X10 ¹	1.3X10 ⁻¹	3.5
Hg-195m (a)		3.0	8.1X10 ¹	7.0X10 ⁻¹	1.9X10 ¹	1.5X10 ⁴	4.0X10 ⁵
Hg-197		2.0X10 ¹	5.4X10 ²	1.0X10 ¹	2.7X10 ²	9.2X10 ³	2.5X10 ⁵
Hg-197m		1.0X10 ¹	2.7X10 ²	4.0X10 ⁻¹	1.1X10 ¹	2.5X10 ⁴	6.7X10 ⁵
Hg-203		5.0	1.4X10 ²	1.0	2.7X10 ¹	5.1X10 ²	1.4X10 ⁴
Ho-166	Holmium (67)	4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	2.6X10 ⁴	7.0X10 ⁵
Ho-166m		6.0X10 ⁻¹	1.6X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	6.6X10 ⁻²	1.8
I-123	Iodine (53)	6.0	1.6X10 ²	3.0	8.1X10 ¹	7.1X10 ⁴	1.9X10 ⁶
I-124		1.0	2.7X10 ¹	1.0	2.7X10 ¹	9.3X10 ³	2.5X10 ⁵
I-125		2.0X10 ¹	5.4X10 ²	3.0	8.1X10 ¹	6.4X10 ²	1.7X10 ⁴
I-126		2.0	5.4X10 ¹	1.0	2.7X10 ¹	2.9X10 ³	8.0X10 ⁴
I-129		Unlimited	Unlimited	Unlimited	Unlimited	6.5X10 ⁻⁶	1.8X10 ⁻⁴
I-131		3.0	8.1X10 ¹	7.0X10 ⁻¹	1.9X10 ¹	4.6X10 ³	1.2X10 ⁵
I-132		4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	3.8X10 ⁵	1.0X10 ⁷
I-133		7.0X10 ⁻¹	1.9X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	4.2X10 ⁴	1.1X10 ⁶
I-134		3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	9.9X10 ⁵	2.7X10 ⁷
I-135 (a)		6.0X10 ⁻¹	1.6X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	1.3X10 ⁵	3.5X10 ⁶
In-111	Indium (49)	3.0	8.1X10 ¹	3.0	8.1X10 ¹	1.5X10 ⁴	4.2X10 ⁵
In-113m		4.0	1.1X10 ²	2.0	5.4X10 ¹	6.2X10 ⁵	1.7X10 ⁷
In-114m (a)		1.0X10 ¹	2.7X10 ²	5.0X10 ⁻¹	1.4X10 ¹	8.6X10 ²	2.3X10 ⁴
In-115m		7.0	1.9X10 ²	1.0	2.7X10 ¹	2.2X10 ⁵	6.1X10 ⁶
Ir-189 (a)	Iridium (77)	1.0X10 ¹	2.7X10 ²	1.0X10 ¹	2.7X10 ²	1.9X10 ³	5.2X10 ⁴
Ir-190		7.0X10 ⁻¹	1.9X10 ¹	7.0X10 ⁻¹	1.9X10 ¹	2.3X10 ³	6.2X10 ⁴
Ir-192 (c)		1.0	2.7X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	3.4X10 ²	9.2X10 ³
Ir-194		3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	3.1X10 ⁴	8.4X10 ⁵

Symbol of radionuclide	Element and atomic number	A1 (TBq)	A1 (Ci) ^b	A2 (TBq)	A2 (Ci) ^b	Specific activity	
						(TBq/g)	(Ci/g)
K-40	Potassium (19)	9.0X10 ⁻¹	2.4X10 ¹	9.0X10 ⁻¹	2.4X10 ¹	2.4X10 ⁻⁷	6.4X10 ⁻⁶
K-42		2.0X10 ⁻¹	5.4	2.0X10 ⁻¹	5.4	2.2X10 ⁵	6.0X10 ⁶
K-43		7.0X10 ⁻¹	1.9X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	1.2X10 ⁵	3.3X10 ⁶
Kr-81	Krypton (36)	4.0X10 ¹	1.1X10 ³	4.0X10 ¹	1.1X10 ³	7.8X10 ⁻⁴	2.1X10 ⁻²
Kr-85		1.0X10 ¹	2.7X10 ²	1.0X10 ¹	2.7X10 ²	1.5X10 ¹	3.9X10 ²
Kr-85m		8.0	2.2X10 ²	3.0	8.1X10 ¹	3.0X10 ⁵	8.2X10 ⁶
Kr-87		2.0X10 ⁻¹	5.4	2.0X10 ⁻¹	5.4	1.0X10 ⁶	2.8X10 ⁷
La-137	Lanthanum (57)	3.0X10 ¹	8.1X10 ²	6.0	1.6X10 ²	1.6X10 ⁻³	4.4X10 ⁻²
La-140		4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	2.1X10 ⁴	5.6X10 ⁵
Lu-172	Lutetium (71)	6.0X10 ⁻¹	1.6X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	4.2X10 ³	1.1X10 ⁵
Lu-173		8.0	2.2X10 ²	8.0	2.2X10 ²	5.6X10 ¹	1.5X10 ³
Lu-174		9.0	2.4X10 ²	9.0	2.4X10 ²	2.3X10 ¹	6.2X10 ²
Lu-174m		2.0X10 ¹	5.4X10 ²	1.0X10 ¹	2.7X10 ²	2.0X10 ²	5.3X10 ³
Lu-177		3.0X10 ¹	8.1X10 ²	7.0X10 ⁻¹	1.9X10 ¹	4.1X10 ³	1.1X10 ⁵
Mg-28 (a)	Magnesium (12)	3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	2.0X10 ⁵	5.4X10 ⁶
Mn-52	Manganese (25)	3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	1.6X10 ⁴	4.4X10 ⁵
Mn-53		Unlimited	Unlimited	Unlimited	Unlimited	6.8X10 ⁻⁵	1.8X10 ⁻³
Mn-54		1.0	2.7X10 ¹	1.0	2.7X10 ¹	2.9X10 ²	7.7X10 ³
Mn-56		3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	8.0X10 ⁵	2.2X10 ⁷
Mo-93	Molybdenum (42)	4.0X10 ¹	1.1X10 ³	2.0X10 ¹	5.4X10 ²	4.1X10 ⁻²	1.1
Mo-99 (a) (i)		1.0	2.7X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	1.8X10 ⁴	4.8X10 ⁵
N-13	Nitrogen (7)	9.0X10 ⁻¹	2.4X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	5.4X10 ⁷	1.5X10 ⁹
Na-22	Sodium (11)	5.0X10 ⁻¹	1.4X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	2.3X10 ²	6.3X10 ³
Na-24		2.0X10 ⁻¹	5.4	2.0X10 ⁻¹	5.4	3.2X10 ⁵	8.7X10 ⁶
Nb-93m	Niobium (41)	4.0X10 ¹	1.1X10 ³	3.0X10 ¹	8.1X10 ²	8.8	2.4X10 ²
Nb-94		7.0X10 ⁻¹	1.9X10 ¹	7.0X10 ⁻¹	1.9X10 ¹	6.9X10 ⁻³	1.9X10 ⁻¹
Nb-95		1.0	2.7X10 ¹	1.0	2.7X10 ¹	1.5X10 ³	3.9X10 ⁴
Nb-97		9.0X10 ⁻¹	2.4X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	9.9X10 ⁵	2.7X10 ⁷
Nd-147	Neodymium (60)	6.0	1.6X10 ²	6.0X10 ⁻¹	1.6X10 ¹	3.0X10 ³	8.1X10 ⁴
Nd-149		6.0X10 ⁻¹	1.6X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	4.5X10 ⁵	1.2X10 ⁷
Ni-59	Nickel (28)	Unlimited	Unlimited	Unlimited	Unlimited	3.0X10 ⁻³	8.0X10 ⁻²
Ni-63		4.0X10 ¹	1.1X10 ³	3.0X10 ¹	8.1X10 ²	2.1	5.7X10 ¹
Ni-65		4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	7.1X10 ⁵	1.9X10 ⁷
Np-235	Neptunium (93)	4.0X10 ¹	1.1X10 ³	4.0X10 ¹	1.1X10 ³	5.2X10 ¹	1.4X10 ³
Np-236 (short-lived)		2.0X10 ¹	5.4X10 ²	2.0	5.4X10 ¹	4.7X10 ⁻⁴	1.3X10 ⁻²
Np-236 (long-lived)		9.0X10 ⁰	2.4X10 ²	2.0X10 ⁻²	5.4X10 ⁻¹	4.7X10 ⁻⁴	1.3X10 ⁻²
Np-237		2.0X10 ¹	5.4X10 ²	2.0X10 ⁻³	5.4X10 ⁻²	2.6X10 ⁻⁵	7.1X10 ⁻⁴
Np-239		7.0	1.9X10 ²	4.0X10 ⁻¹	1.1X10 ¹	8.6X10 ³	2.3X10 ⁵
Os-185	Osmium (76)	1.0	2.7X10 ¹	1.0	2.7X10 ¹	2.8X10 ²	7.5X10 ³
Os-191		1.0X10 ¹	2.7X10 ²	2.0	5.4X10 ¹	1.6X10 ³	4.4X10 ⁴
Os-191m		4.0X10 ¹	1.1X10 ³	3.0X10 ¹	8.1X10 ²	4.6X10 ⁴	1.3X10 ⁶
Os-193		2.0	5.4X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	6.0X10 ⁴	5.3X10 ⁵
Os-194 (a)		3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	1.1X10 ¹	3.1X10 ²
P-32	Phosphorus (15)	5.0X10 ⁻¹	1.4X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	1.1X10 ⁴	2.9X10 ⁵
P-33		4.0X10 ¹	1.1X10 ³	1.0	2.7X10 ¹	5.8X10 ³	1.6X10 ⁵

Symbol of radionuclide	Element and atomic number	A1 (TBq)	A1 (Ci) ^b	A2 (TBq)	A2 (Ci) ^b	Specific activity	
						(TBq/g)	(Ci/g)
Pa-230 (a)	Protactinium (91)	2.0	5.4X10 ¹	7.0X10 ⁻²	1.9	1.2X10 ³	3.3X10 ⁴
Pa-231		4.0	1.1X10 ²	4.0X10 ⁻⁴	1.1X10 ⁻²	1.7X10 ⁻³	4.7X10 ⁻²
Pa-233		5.0	1.4X10 ²	7.0X10 ⁻¹	1.9X10 ¹	7.7X10 ²	2.1X10 ⁴
Pb-201	Lead (82)	1.0	2.7X10 ¹	1.0	2.7X10 ¹	6.2X10 ⁴	1.7X10 ⁶
Pb-202		4.0X10 ¹	1.1X10 ³	2.0X10 ¹	5.4X10 ²	1.2X10 ⁻⁴	3.4X10 ⁻³
Pb-203		4.0	1.1X10 ²	3.0	8.1X10 ¹	1.1X10 ⁴	3.0X10 ⁵
Pb-205		Unlimited	Unlimited	Unlimited	Unlimited	4.5X10 ⁻⁶	1.2X10 ⁻⁴
Pb-210 (a)		1.0	2.7X10 ¹	5.0X10 ⁻²	1.4	2.8	7.6X10 ¹
Pb-212 (a)		7.0X10 ⁻¹	1.9X10 ¹	2.0X10 ⁻¹	5.4	5.1X10 ⁴	1.4X10 ⁶
Pd-103 (a)	Palladium (46)	4.0X10 ¹	1.1X10 ³	4.0X10 ¹	1.1X10 ³	2.8X10 ³	7.5X10 ⁴
Pd-107		Unlimited	Unlimited	Unlimited	Unlimited	1.9X10 ⁻⁵	5.1X10 ⁻⁴
Pd-109		2.0	5.4X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	7.9X10 ⁴	2.1X10 ⁶
Pm-143	Promethium (61)	3.0	8.1X10 ¹	3.0	8.1X10 ¹	1.3X10 ²	3.4X10 ³
Pm-144		7.0X10 ⁻¹	1.9X10 ¹	7.0X10 ⁻¹	1.9X10 ¹	9.2X10 ¹	2.5X10 ³
Pm-145		3.0X10 ¹	8.1X10 ²	1.0X10 ¹	2.7X10 ²	5.2	1.4X10 ²
Pm-147		4.0X10 ¹	1.1X10 ³	2.0	5.4X10 ¹	3.4X10 ¹	9.3X10 ²
Pm-148m (a)		8.0X10 ⁻¹	2.2X10 ¹	7.0X10 ⁻¹	1.9X10 ¹	7.9X10 ²	2.1X10 ⁴
Pm-149		2.0	5.4X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	1.5X10 ⁴	4.0X10 ⁵
Pm-151		2.0	5.4X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	2.7X10 ⁴	7.3X10 ⁵
Po-210	Polonium (84)	4.0X10 ¹	1.1X10 ³	2.0X10 ⁻²	5.4X10 ⁻¹	1.7X10 ²	4.5X10 ³
Pr-142	Praseodymium (59)	4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	4.3X10 ⁴	1.2X10 ⁶
Pr-143		3.0	8.1X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	2.5X10 ³	6.7X10 ⁴
Pt-188 (a)	Platinum (78)	1.0	2.7X10 ¹	8.0X10 ⁻¹	2.2X10 ¹	2.5X10 ³	6.8X10 ⁴
Pt-191		4.0	1.1X10 ²	3.0	8.1X10 ¹	8.7X10 ³	2.4X10 ⁵
Pt-193		4.0X10 ¹	1.1X10 ³	4.0X10 ¹	1.1X10 ³	1.4	3.7X10 ¹
Pt-193m		4.0X10 ¹	1.1X10 ³	5.0X10 ⁻¹	1.4X10 ¹	5.8X10 ³	1.6X10 ⁵
Pt-195m		1.0X10 ¹	2.7X10 ²	5.0X10 ⁻¹	1.4X10 ¹	6.2X10 ³	1.7X10 ⁵
Pt-197		2.0X10 ¹	5.4X10 ²	6.0X10 ⁻¹	1.6X10 ¹	3.2X10 ⁴	8.7X10 ⁵
Pt-197m		1.0X10 ¹	2.7X10 ²	6.0X10 ⁻¹	1.6X10 ¹	3.7X10 ⁵	1.0X10 ⁷
Pu-236	Plutonium (94)	3.0X10 ¹	8.1X10 ²	3.0X10 ⁻³	8.1X10 ⁻²	2.0X10 ¹	5.3X10 ²
Pu-237		2.0X10 ¹	5.4X10 ²	2.0X10 ¹	5.4X10 ²	4.5X10 ²	1.2X10 ⁴
Pu-238		1.0X10 ¹	2.7X10 ²	1.0X10 ⁻³	2.7X10 ⁻²	6.3X10 ⁻¹	1.7X10 ¹
Pu-239		1.0X10 ¹	2.7X10 ²	1.0X10 ⁻³	2.7X10 ⁻²	2.3X10 ⁻³	6.2X10 ⁻²
Pu-240		1.0X10 ¹	2.7X10 ²	1.0X10 ⁻³	2.7X10 ⁻²	8.4X10 ⁻³	2.3X10 ⁻¹
Pu-241 (a)		4.0X10 ¹	1.1X10 ³	6.0X10 ⁻²	1.6	3.8	1.0X10 ²
Pu-242		1.0X10 ¹	2.7X10 ²	1.0X10 ⁻³	2.7X10 ⁻²	1.5X10 ⁻⁴	3.9X10 ⁻³
Pu-244 (a)		4.0X10 ⁻¹	1.1X10 ¹	1.0X10 ⁻³	2.7X10 ⁻²	6.7X10 ⁻⁷	1.8X10 ⁻⁵
Ra-223 (a)	Radium (88)	4.0X10 ⁻¹	1.1X10 ¹	7.0X10 ⁻³	1.9X10 ⁻¹	1.9X10 ³	5.1X10 ⁴
Ra-224 (a)		4.0X10 ⁻¹	1.1X10 ¹	2.0X10 ⁻²	5.4X10 ⁻¹	5.9X10 ³	1.6X10 ⁵
Ra-225 (a)		2.0X10 ⁻¹	5.4	4.0X10 ⁻³	1.1X10 ⁻¹	1.5X10 ³	3.9X10 ⁴
Ra-226 (a)		2.0X10 ⁻¹	5.4	3.0X10 ⁻³	8.1X10 ⁻²	3.7X10 ⁻²	1.0
Ra-228 (a)		6.0X10 ⁻¹	1.6X10 ¹	2.0X10 ⁻²	5.4X10 ⁻¹	1.0X10 ¹	2.7X10 ²
Rb-81	Rubidium (37)	2.0	5.4X10 ¹	8.0X10 ⁻¹	2.2X10 ¹	3.1X10 ⁵	8.4X10 ⁶
Rb-83 (a)		2.0	5.4X10 ¹	2.0	5.4X10 ¹	6.8X10 ²	1.8X10 ⁴
Rb-84		1.0	2.7X10 ¹	1.0	2.7X10 ¹	1.8X10 ³	4.7X10 ⁴

Symbol of radionuclide	Element and atomic number	A1 (TBq)	A1 (Ci) ^b	A2 (TBq)	A2 (Ci) ^b	Specific activity	
						(TBq/g)	(Ci/g)
Rb-86		5.0X10 ⁻¹	1.4X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	3.0X10 ³	8.1X10 ⁴
Rb-87		Unlimited	Unlimited	Unlimited	Unlimited	3.2X10 ⁻⁹	8.6X10 ⁻⁸
Rb (nat)		Unlimited	Unlimited	Unlimited	Unlimited	6.7X10 ⁶	1.8X10 ⁸
Re-184	Rhenium (75)	1.0	2.7X10 ¹	1.0	2.7X10 ¹	6.9X10 ²	1.9X10 ⁴
Re-184m		3.0	8.1X10 ¹	1.0	2.7X10 ¹	1.6X10 ²	4.3X10 ³
Re-186		2.0	5.4X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	6.9X10 ³	1.9X10 ⁵
Re-187		Unlimited	Unlimited	Unlimited	Unlimited	1.4X10 ⁻⁹	3.8X10 ⁻⁸
Re-188		4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	3.6X10 ⁴	9.8X10 ⁵
Re-189 (a)		3.0	8.1X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	2.5X10 ⁴	6.8X10 ⁵
Re (nat)		Unlimited	Unlimited	Unlimited	Unlimited	0.0	2.4X10 ⁻⁸
Rh-99	Rhodium (45)	2.0	5.4X10 ¹	2.0	5.4X10 ¹	3.0X10 ³	8.2X10 ⁴
Rh-101		4.0	1.1X10 ²	3.0	8.1X10 ¹	4.1X10 ¹	1.1X10 ³
Rh-102		5.0X10 ⁻¹	1.4X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	4.5X10 ¹	1.2X10 ³
Rh-102m		2.0	5.4X10 ¹	2.0	5.4X10 ¹	2.3X10 ²	6.2X10 ³
Rh-103m		4.0X10 ¹	1.1X10 ³	4.0X10 ¹	1.1X10 ³	1.2X10 ⁶	3.3X10 ⁷
Rh-105		1.0X10 ¹	2.7X10 ²	8.0X10 ⁻¹	2.2X10 ¹	3.1X10 ⁴	8.4X10 ⁵
Rn-222 (a)	Radon (86)	3.0X10 ⁻¹	8.1	4.0X10 ⁻³	1.1X10 ⁻¹	5.7X10 ³	1.5X10 ⁵
Ru-97	Ruthenium (44)	5.0	1.4X10 ²	5.0	1.4X10 ²	1.7X10 ⁴	4.6X10 ⁵
Ru-103 (a)		2.0	5.4X10 ¹	2.0	5.4X10 ¹	1.2X10 ³	3.2X10 ⁴
Ru-105		1.0	2.7X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	2.5X10 ⁵	6.7X10 ⁶
Ru-106 (a)		2.0X10 ⁻¹	5.4	2.0X10 ⁻¹	5.4	1.2X10 ²	3.3X10 ³
S-35	Sulphur (16)	4.0X10 ¹	1.1X10 ³	3.0	8.1X10 ¹	1.6X10 ³	4.3X10 ⁴
Sb-122	Antimony (51)	4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	1.5X10 ⁴	4.0X10 ⁵
Sb-124		6.0X10 ⁻¹	1.6X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	6.5X10 ²	1.7X10 ⁴
Sb-125		2.0	5.4X10 ¹	1.0	2.7X10 ¹	3.9X10 ¹	1.0X10 ³
Sb-126		4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	3.1X10 ³	8.4X10 ⁴
Sc-44	Scandium (21)	5.0X10 ⁻¹	1.4X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	6.7X10 ⁵	1.8X10 ⁷
Sc-46		5.0X10 ⁻¹	1.4X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	1.3X10 ³	3.4X10 ⁴
Sc-47		1.0X10 ¹	2.7X10 ²	7.0X10 ⁻¹	1.9X10 ¹	3.1X10 ⁴	8.3X10 ⁵
Sc-48		3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	5.5X10 ⁴	1.5X10 ⁶
Se-75	Selenium (34)	3.0	8.1X10 ¹	3.0	8.1X10 ¹	5.4X10 ²	1.5X10 ⁴
Se-79		4.0X10 ¹	1.1X10 ³	2.0	5.4X10 ¹	2.6X10 ⁻³	7.0X10 ⁻²
Si-31	Silicon (14)	6.0X10 ⁻¹	1.6X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	1.4X10 ⁶	3.9X10 ⁷
Si-32		4.0X10 ¹	1.1X10 ³	5.0X10 ⁻¹	1.4X10 ¹	3.9	1.1X10 ²
Sm-145	Samarium (62)	1.0X10 ¹	2.7X10 ²	1.0X10 ¹	2.7X10 ²	9.8X10 ¹	2.6X10 ³
Sm-147		Unlimited	Unlimited	Unlimited	Unlimited	8.5X10 ⁻¹	2.3X10 ⁻⁸
Sm-151		4.0X10 ¹	1.1X10 ³	1.0X10 ¹	2.7X10 ²	9.7X10 ⁻¹	2.6X10 ¹
Sm-153		9.0	2.4X10 ²	6.0X10 ⁻¹	1.6X10 ¹	1.6X10 ⁴	4.4X10 ⁵
Sn-113 (a)	Tin (50)	4.0	1.1X10 ²	2.0	5.4X10 ¹	3.7X10 ²	1.0X10 ⁴
Sn-117m		7.0	1.9X10 ²	4.0X10 ⁻¹	1.1X10 ¹	3.0X10 ³	8.2X10 ⁴
Sn-119m		4.0X10 ¹	1.1X10 ³	3.0X10 ¹	8.1X10 ²	1.4X10 ²	3.7X10 ³
Sn-121m (a)		4.0X10 ¹	1.1X10 ³	9.0X10 ⁻¹	2.4X10 ¹	2.0	5.4X10 ¹
Sn-123		8.0X10 ⁻¹	2.2X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	3.0X10 ²	8.2X10 ³
Sn-125		4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ³	1.1X10 ⁵
Sn-126 (a)		6.0X10 ⁻¹	1.6X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	1.0X10 ⁻³	2.8X10 ⁻²
Sr-82 (a)	Strontium (38)	2.0X10 ⁻¹	5.4	2.0X10 ⁻¹	5.4	2.3X10 ³	6.2X10 ⁴
Sr-85		2.0	5.4X10 ¹	2.0	5.4X10 ¹	8.8X10 ²	2.4X10 ⁴

Symbol of radionuclide	Element and atomic number	A1 (TBq)	A1 (Ci) ^b	A2 (TBq)	A2 (Ci) ^b	Specific activity	
						(TBq/g)	(Ci/g)
Sr-85m		5.0	1.4X10 ²	5.0	1.4X10 ²	1.2X10 ⁶	3.3X10 ⁷
Sr-87m		3.0	8.1X10 ¹	3.0	8.1X10 ¹	4.8X10 ⁵	1.3X10 ⁷
Sr-89		6.0X10 ⁻¹	1.6X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	1.1X10 ³	2.9X10 ⁴
Sr-90 (a)		3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	5.1	1.4X10 ²
Sr-91 (a)		3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	1.3X10 ⁵	3.6X10 ⁶
Sr-92 (a)		1.0	2.7X10 ¹	3.0X10 ⁻¹	8.1	4.7X10 ⁵	1.3X10 ⁷
T(H-3)	Tritium (1)	4.0X10 ¹	1.1X10 ³	4.0X10 ¹	1.1X10 ³	3.6X10 ²	9.7X10 ³
Ta-178 (long-lived)	Tantalum (73)	1.0	2.7X10 ¹	8.0X10 ⁻¹	2.2X10 ¹	4.2X10 ⁶	1.1X10 ⁸
Ta-179		3.0X10 ¹	8.1X10 ²	3.0X10 ¹	8.1X10 ²	4.1X10 ¹	1.1X10 ³
Ta-182		9.0X10 ⁻¹	2.4X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	2.3X10 ²	6.2X10 ³
Tb-157	Terbium (65)	4.0X10 ¹	1.1X10 ³	4.0X10 ¹	1.1X10 ³	5.6X10 ⁻¹	1.5X10 ¹
Tb-158		1.0	2.7X10 ¹	1.0	2.7X10 ¹	5.6X10 ⁻¹	1.5X10 ¹
Tb-160		1.0	2.7X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	4.2X10 ²	1.1X10 ⁴
Tc-95m (a)	Technetium (43)	2.0	5.4X10 ¹	2.0	5.4X10 ¹	8.3X10 ²	2.2X10 ⁴
Tc-96		4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	1.2X10 ⁴	3.2X10 ⁵
Tc-96m (a)		4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	1.4X10 ⁶	3.8X10 ⁷
Tc-97		Unlimited	Unlimited	Unlimited	Unlimited	5.2X10 ⁻⁵	1.4X10 ⁻³
Tc-97m		4.0X10 ¹	1.1X10 ³	1.0	2.7X10 ¹	5.6X10 ²	1.5X10 ⁴
Tc-98		8.0X10 ⁻¹	2.2X10 ¹	7.0X10 ⁻¹	1.9X10 ¹	3.2X10 ⁻⁵	8.7X10 ⁻⁴
Tc-99		4.0X10 ¹	1.1X10 ³	9.0X10 ⁻¹	2.4X10 ¹	6.3X10 ⁻⁴	1.7X10 ⁻²
Tc-99m		1.0X10 ¹	2.7X10 ²	4.0	1.1X10 ²	1.9X10 ⁵	5.3X10 ⁶
Te-121	Tellurium (52)	2.0	5.4X10 ¹	2.0	5.4X10 ¹	2.4X10 ³	6.4X10 ⁴
Te-121m		5.0	1.4X10 ²	3.0	8.1X10 ¹	2.6X10 ²	7.0X10 ³
Te-123m		8.0	2.2X10 ²	1.0	2.7X10 ¹	3.3X10 ²	8.9X10 ³
Te-125m		2.0X10 ¹	5.4X10 ²	9.0X10 ⁻¹	2.4X10 ¹	6.7X10 ²	1.8X10 ⁴
Te-127		2.0X10 ¹	5.4X10 ²	7.0X10 ⁻¹	1.9X10 ¹	9.8X10 ⁴	2.6X10 ⁶
Te-127m (a)		2.0X10 ¹	5.4X10 ²	5.0X10 ⁻¹	1.4X10 ¹	3.5X10 ²	9.4X10 ³
Te-129		7.0X10 ⁻¹	1.9X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	7.7X10 ⁵	2.1X10 ⁷
Te-129m (a)		8.0X10 ⁻¹	2.2X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	1.1X10 ³	3.0X10 ⁴
Te-131m (a)		7.0X10 ⁻¹	1.9X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	3.0X10 ⁴	8.0X10 ⁵
Te-132 (a)		5.0X10 ⁻¹	1.4X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	3.1X10 ⁴	3.0X10 ⁵
Th-227	Thorium (90)	1.0X10 ¹	2.7X10 ²	5.0X10 ⁻³	1.4X10 ⁻¹	1.1X10 ³	3.1X10 ⁴
Th-228 (a)		5.0X10 ⁻¹	1.4X10 ¹	1.0X10 ⁻³	2.7X10 ⁻²	3.0X10 ¹	8.2X10 ²
Th-229		5.0	1.4X10 ²	5.0X10 ⁻⁴	1.4X10 ⁻²	7.9X10 ⁻³	2.1X10 ⁻¹
Th-230		1.0X10 ¹	2.7X10 ²	1.0X10 ⁻³	2.7X10 ⁻²	7.6X10 ⁻⁴	2.1X10 ⁻²
Th-231		4.0X10 ¹	1.1X10 ³	2.0X10 ⁻²	5.4X10 ⁻¹	2.0X10 ⁴	5.3X10 ⁵
Th-232		Unlimited	Unlimited	Unlimited	Unlimited	4.0X10 ⁻⁹	1.1X10 ⁻⁷
Th-234 (a)		3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	8.6X10 ²	2.3X10 ⁴
Th(nat)		Unlimited	Unlimited	Unlimited	Unlimited	8.1X10 ⁻⁹	2.2X10 ⁻⁷
Ti-44 (a)	Titanium (22)	5.0X10 ⁻¹	1.4X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	6.4	1.7X10 ²
Tl-200	Thallium (81)	9.0X10 ⁻¹	2.4X10 ¹	9.0X10 ⁻¹	2.4X10 ¹	2.2X10 ⁴	6.0X10 ⁵
Tl-201		1.0X10 ¹	2.7X10 ²	4.0	1.1X10 ²	7.9X10 ³	2.1X10 ⁵
Tl-202		2.0	5.4X10 ¹	2.0	5.4X10 ¹	2.0X10 ³	5.3X10 ⁴
Tl-204		1.0X10 ¹	2.7X10 ²	7.0X10 ⁻¹	1.9X10 ¹	1.7X10 ¹	4.6X10 ²
Tm-167	Thulium (69)	7.0	1.9X10 ²	8.0X10 ⁻¹	2.2X10 ¹	3.1X10 ³	8.5X10 ⁴
Tm-170		3.0	8.1X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	2.2X10 ²	6.0X10 ³
Tm-171		4.0X10 ¹	1.1X10 ³	4.0X10 ¹	1.1X10 ³	4.0X10 ¹	1.1X10 ³

Symbol of radionuclide	Element and atomic number	A1 (TBq)	A1 (Ci) ^b	A2 (TBq)	A2 (Ci) ^b	Specific activity	
						(TBq/g)	(Ci/g)
U-230 (fast lung absorption) (a)(d)	Uranium (92)	4.0X10 ¹	1.1X10 ³	1.0X10 ⁻¹	2.7	1.0X10 ³	2.7X10 ⁴
U-230 (medium lung absorption) (a)(e)		4.0X10 ¹	1.1X10 ³	4.0X10 ⁻³	1.1X10 ⁻¹	1.0X10 ³	2.7X10 ⁴
U-230 (slow lung absorption) (a)(f)		3.0X10 ¹	8.1X10 ²	3.0X10 ⁻³	8.1X10 ⁻²	1.0X10 ³	2.7X10 ⁴
U-232 (fast lung absorption) (d)		4.0X10 ¹	1.1X10 ³	1.0X10 ⁻²	2.7X10 ⁻¹	8.3X10 ⁻¹	2.2X10 ¹
U-232 (medium lung absorption) (e)		4.0X10 ¹	1.1X10 ³	7.0X10 ⁻³	1.9X10 ⁻¹	8.3X10 ⁻¹	2.2X10 ¹
U-232 (slow lung absorption) (f)		1.0X10 ¹	2.7X10 ²	1.0X10 ⁻³	2.7X10 ⁻²	8.3X10 ⁻¹	2.2X10 ¹
U-233 (fast lung absorption) (d)		4.0X10 ¹	1.1X10 ³	9.0X10 ⁻²	2.4	3.6X10 ⁻⁴	9.7X10 ⁻³
U-233 (medium lung absorption) (e)		4.0X10 ¹	1.1X10 ³	2.0X10 ⁻²	5.4X10 ⁻¹	3.6X10 ⁻⁴	9.7X10 ⁻³
U-233 (slow lung absorption) (f)		4.0X10 ¹	1.1X10 ³	6.0X10 ⁻³	1.6X10 ⁻¹	3.6X10 ⁻⁴	9.7X10 ⁻³
U-234 (fast lung absorption) (d)		4.0X10 ¹	1.1X10 ³	9.0X10 ⁻²	2.4	2.3X10 ⁻⁴	6.2X10 ⁻³
U-234 (medium lung absorption) (e)		4.0X10 ¹	1.1X10 ³	2.0X10 ⁻²	5.4X10 ⁻¹	2.3X10 ⁻⁴	6.2X10 ⁻³
U-234 (slow lung absorption) (f)		4.0X10 ¹	1.1X10 ³	6.0X10 ⁻³	1.6X10 ⁻¹	2.3X10 ⁻⁴	6.2X10 ⁻³
U-235 (all lung absorption types) (a), (d), (e), (f)		Unlimited	Unlimited	Unlimited	Unlimited	8.0X10 ⁻⁸	2.2X10 ⁻⁶
U-236 (fast lung absorption) (d)		Unlimited	Unlimited	Unlimited	Unlimited	2.4X10 ⁻⁶	6.5X10 ⁻⁵
U-236 (medium lung absorption) (e)		4.0X10 ¹	1.1X10 ³	2.0X10 ⁻²	5.4X10 ⁻¹	2.4X10 ⁻⁶	6.5X10 ⁻⁵
U-236 (slow lung absorption) (f)		4.0X10 ¹	1.1X10 ³	6.0X10 ⁻³	1.6X10 ⁻¹	2.4X10 ⁻⁶	6.5X10 ⁻⁵
U-238 (all lung absorption types) (d), (e), (f)		Unlimited	Unlimited	Unlimited	Unlimited	1.2X10 ⁻⁸	3.4X10 ⁻⁷
U (nat)		Unlimited	Unlimited	Unlimited	Unlimited	2.6X10 ⁻⁸	7.1X10 ⁻⁷
U (enriched to 20% or less) (g)		Unlimited	Unlimited	Unlimited	Unlimited	See Table A-4	See Table A-4
U (dep)		Unlimited	Unlimited	Unlimited	Unlimited	See Table A-4	See Table A-3
V-48	Vanadium (23)	4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	6.3X10 ³	1.7X10 ⁵
V-49		4.0X10 ¹	1.1X10 ³	4.0X10 ¹	1.1X10 ³	3.0X10 ²	8.1X10 ³
W-178 (a)	Tungsten (74)	9.0	2.4X10 ²	5.0	1.4X10 ²	1.3X10 ³	3.4X10 ⁴
W-181		3.0X10 ¹	8.1X10 ²	3.0X10 ¹	8.1X10 ²	2.2X10 ²	6.0X10 ³
W-185		4.0X10 ¹	1.1X10 ³	8.0X10 ⁻¹	2.2X10 ¹	3.5X10 ²	9.4X10 ³
W-187		2.0	5.4X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	2.6X10 ⁴	7.0X10 ⁵
W-188 (a)		4.0X10 ⁻¹	1.1X10 ¹	3.0X10 ⁻¹	8.1	3.7X10 ²	1.0X10 ⁴
Xe-122 (a)	Xenon (54)	4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	4.8X10 ⁴	1.3X10 ⁶
Xe-123		2.0	5.4X10 ¹	7.0X10 ⁻¹	1.9X10 ¹	4.4X10 ⁵	1.2X10 ⁷
Xe-127		4.0	1.1X10 ²	2.0	5.4X10 ¹	1.0X10 ³	2.8X10 ⁴
Xe-131m		4.0X10 ¹	1.1X10 ³	4.0X10 ¹	1.1X10 ³	3.1X10 ³	8.4X10 ⁴
Xe-133		2.0X10 ¹	5.4X10 ²	1.0X10 ¹	2.7X10 ²	6.9X10 ³	1.9X10 ⁵
Xe-135		3.0	8.1X10 ¹	2.0	5.4X10 ¹	9.5X10 ⁴	2.6X10 ⁶
Y-87 (a)	Yttrium (39)	1.0	2.7X10 ¹	1.0	2.7X10 ¹	1.7X10 ⁴	4.5X10 ⁵
Y-88		4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	5.2X10 ²	1.4X10 ⁴
Y-90		3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	2.0X10 ⁴	5.4X10 ⁵
Y-91		6.0X10 ⁻¹	1.6X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	9.1X10 ²	2.5X10 ⁴
Y-91m		2.0	5.4X10 ¹	2.0	5.4X10 ¹	1.5X10 ⁶	4.2X10 ⁷

Symbol of radionuclide	Element and atomic number	A1 (TBq)	A1 (Ci) ^b	A2 (TBq)	A2 (Ci) ^b	Specific activity	
						(TBq/g)	(Ci/g)
Y-92		2.0X10 ⁻¹	5.4	2.0X10 ⁻¹	5.4	3.6X10 ⁵	9.6X10 ⁶
Y-93		3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	1.2X10 ⁵	3.3X10 ⁶
Yb-169	Ytterbium (70)	4.0	1.1X10 ²	1.0	2.7X10 ¹	8.9X10 ²	2.4X10 ⁴
Yb-175		3.0X10 ¹	8.1X10 ²	9.0X10 ⁻¹	2.4X10 ¹	6.6X10 ³	1.8X10 ⁵
Zn-65	Zinc (30)	2.0	5.4X10 ¹	2.0	5.4X10 ¹	3.0X10 ²	8.2X10 ³
Zn-69		3.0	8.1X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	1.8X10 ⁶	4.9X10 ⁷
Zn-69m (a)		3.0	8.1X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	1.2X10 ⁵	3.3X10 ⁶
Zr-88	Zirconium (40)	3.0	8.1X10 ¹	3.0	8.1X10 ¹	6.6X10 ²	1.8X10 ⁴
Zr-93		Unlimited	Unlimited	Unlimited	Unlimited	9.3X10 ⁻⁵	2.5X10 ⁻³
Zr-95 (a)		2.0	5.4X10 ¹	8.0X10 ⁻¹	2.2X10 ¹	7.9X10 ²	2.1X10 ⁴
Zr-97 (a)		4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	7.1X10 ⁴	1.9X10 ⁶

- (a) A₁ (and/or A₂) values include contributions from daughter nuclides with half-lives less than ten days.
(b) (Reserved.)
(c) The quantity may be determined from a measurement of the rate of decay or a measurement of the radiation level at a prescribed distance from the source.
(d) These values apply only to compounds of uranium that take the chemical form of UF₆, UO₂F₂ and UO₂(NO₃)₂ in both normal and accident conditions of transport.
(e) These values apply only to compounds of uranium that take the chemical form of UO₃, UF₄, UCl₄ and hexavalent compounds in both normal and accident conditions of transport.
(f) These values apply to all compounds of uranium other than those specified in notes (d) and (e) of this table.
(g) These values apply to unirradiated uranium only.
(h) A₁ = 0.1 TBq (2.7 Ci) and A₂ = 0.001 TBq (0.027 Ci) for Cf-252 for domestic use.
(i) A₂ = 0.74 TBq (20 Ci) for Mo-99 for domestic use.

Table A-2.—Exempt Material Activity Concentrations and Exempt Consignment Activity Limits for Radionuclides

Symbol of radionuclide	Element and atomic number	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
Ac-225	Actinium (89)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁴	2.7X10 ⁻⁷
Ac-227	-	1.0X10 ⁻¹	2.7X10 ⁻¹²	1.0X10 ³	2.7X10 ⁻⁸
Ac-228	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Ag-105	Silver (47)	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Ag-108m (b)	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Ag-110m	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Ag-111	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁶	2.7X10 ⁻⁵
Al-26	Aluminum (13)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶
Am-241	Americium (95)	1.0	2.7X10 ⁻¹¹	1.0X10 ⁴	2.7X10 ⁻⁷
Am-242m (b)	-	1.0	2.7X10 ⁻¹¹	1.0X10 ⁴	2.7X10 ⁻⁷
Am-243 (b)	-	1.0	2.7X10 ⁻¹¹	1.0X10 ³	2.7X10 ⁻⁸
Ar-37	Argon (18)	1.0X10 ⁶	2.7X10 ⁻⁵	1.0X10 ⁸	2.7X10 ⁻³
Ar-39	-	1.0X10 ⁷	2.7X10 ⁻⁴	1.0X10 ⁴	2.7X10 ⁻⁷
Ar-41	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁹	2.7X10 ⁻²
As-72	Arsenic (33)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶
As-73	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁷	2.7X10 ⁻⁴
As-74	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
As-76	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁵	2.7X10 ⁻⁶
As-77	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁶	2.7X10 ⁻⁵
At-211	Astatine (85)	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁷	2.7X10 ⁻⁴
Au-193	Gold (79)	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁷	2.7X10 ⁻⁴
Au-194	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Au-195	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁷	2.7X10 ⁻⁴

Symbol of radionuclide	Element and atomic number	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
Au-198	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Au-199	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Ba-131	Barium (56)	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Ba-133	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Ba-133m	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Ba-140 (b)	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶
Be-7	Beryllium (4)	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁷	2.7X10 ⁻⁴
Be-10	-	1.0X10 ⁴	2.7X10 ⁻⁷	1.0X10 ⁶	2.7X10 ⁻⁵
Bi-205	Bismuth (83)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Bi-206	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶
Bi-207	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Bi-210	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁶	2.7X10 ⁻⁵
Bi-210m	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶
Bi-212 (b)	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶
Bk-247	Berkelium (97)	1.0	2.7X10 ⁻¹¹	1.0X10 ⁴	2.7X10 ⁻⁷
Bk-249	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁶	2.7X10 ⁻⁵
Br-76	Bromine (35)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶
Br-77	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Br-82	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
C-11	Carbon (6)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
C-14	-	1.0X10 ⁴	2.7X10 ⁻⁷	1.0X10 ⁷	2.7X10 ⁻⁴
Ca-41	Calcium (20)	1.0X10 ⁵	2.7X10 ⁻⁶	1.0X10 ⁷	2.7X10 ⁻⁴
Ca-45	-	1.0X10 ⁴	2.7X10 ⁻⁷	1.0X10 ⁷	2.7X10 ⁻⁴
Ca-47	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Cd-109	Cadmium (48)	1.0X10 ⁴	2.7X10 ⁻⁷	1.0X10 ⁶	2.7X10 ⁻⁵
Cd-113m	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁶	2.7X10 ⁻⁵
Cd-115	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Cd-115m	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁶	2.7X10 ⁻⁵
Ce-139	Cerium (58)	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Ce-141	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁷	2.7X10 ⁻⁴
Ce-143	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Ce-144 (b)	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁵	2.7X10 ⁻⁶
Cf-248	Californium (98)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁴	2.7X10 ⁻⁷
Cf-249	-	1.0	2.7X10 ⁻¹¹	1.0X10 ³	2.7X10 ⁻⁸
Cf-250	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁴	2.7X10 ⁻⁷
Cf-251	-	1.0	2.7X10 ⁻¹¹	1.0X10 ³	2.7X10 ⁻⁸
Cf-252	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁴	2.7X10 ⁻⁷
Cf-253	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁵	2.7X10 ⁻⁶
Cf-254	-	1.0	2.7X10 ⁻¹¹	1.0X10 ³	2.7X10 ⁻⁸
Cl-36	Chlorine (17)	1.0X10 ⁴	2.7X10 ⁻⁷	1.0X10 ⁶	2.7X10 ⁻⁵
Cl-38	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶
Cm-240	Curium (96)	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁵	2.7X10 ⁻⁶
Cm-241	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Cm-242	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁵	2.7X10 ⁻⁶
Cm-243	-	1.0	2.7X10 ⁻¹¹	1.0X10 ⁴	2.7X10 ⁻⁷
Cm-244	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁴	2.7X10 ⁻⁷

Symbol of radionuclide	Element and atomic number	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
Cm-245	-	1.0	2.7X10 ⁻¹¹	1.0X10 ³	2.7X10 ⁻⁸
Cm-246	-	1.0	2.7X10 ⁻¹¹	1.0X10 ³	2.7X10 ⁻⁸
Cm-247	-	1.0	2.7X10 ⁻¹¹	1.0X10 ⁴	2.7X10 ⁻⁷
Cm-248	-	1.0	2.7X10 ⁻¹¹	1.0X10 ³	2.7X10 ⁻⁸
Co-55	Cobalt (27)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Co-56	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶
Co-57	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Co-58	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Co-58m	-	1.0X10 ⁴	2.7X10 ⁻⁷	1.0X10 ⁷	2.7X10 ⁻⁴
Co-60	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶
Cr-51	Chromium (24)	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁷	2.7X10 ⁻⁴
Cs-129	Cesium (55)	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁵	2.7X10 ⁻⁶
Cs-131	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁶	2.7X10 ⁻⁵
Cs-132	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶
Cs-134	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁴	2.7X10 ⁻⁷
Cs-134m	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁵	2.7X10 ⁻⁶
Cs-135	-	1.0X10 ⁴	2.7X10 ⁻⁷	1.0X10 ⁷	2.7X10 ⁻⁴
Cs-136	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶
Cs-137 (b)	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁴	2.7X10 ⁻⁷
Cu-64	Copper (29)	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Cu-67	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Dy-159	Dysprosium (66)	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁷	2.7X10 ⁻⁴
Dy-165	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁶	2.7X10 ⁻⁵
Dy-166	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁶	2.7X10 ⁻⁵
Er-169	Erbium (68)	1.0X10 ⁴	2.7X10 ⁻⁷	1.0X10 ⁷	2.7X10 ⁻⁴
Er-171	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Eu-147	Europium (63)	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Eu-148	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Eu-149	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁷	2.7X10 ⁻⁴
Eu-150 (short lived)	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁶	2.7X10 ⁻⁵
Eu-150 (long lived)	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Eu-152	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Eu-152m	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Eu-154	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Eu-155	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁷	2.7X10 ⁻⁴
Eu-156	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
F-18	Fluorine (9)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Fe-52	Iron (26)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Fe-55	-	1.0X10 ⁴	2.7X10 ⁻⁷	1.0X10 ⁶	2.7X10 ⁻⁵
Fe-59	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Fe-60	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁵	2.7X10 ⁻⁶
Ga-67	Gallium (31)	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Ga-68	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶
Ga-72	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶
Gd-146	Gadolinium (64)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Gd-148	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁴	2.7X10 ⁻⁷

Symbol of radionuclide	Element and atomic number	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
Gd-153	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁷	2.7X10 ⁻⁴
Gd-159	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁶	2.7X10 ⁻⁵
Ge-68	Germanium (32)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶
Ge-71	-	1.0X10 ⁴	2.7X10 ⁻⁷	1.0X10 ⁸	2.7X10 ⁻³
Ge-77	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶
Hf-172	Hafnium (72)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Hf-175	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Hf-181	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Hf-182	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Hg-194	Mercury (80)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Hg-195m	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Hg-197	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁷	2.7X10 ⁻⁴
Hg-197m	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Hg-203	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁵	2.7X10 ⁻⁶
Ho-166	Holmium (67)	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁵	2.7X10 ⁻⁶
Ho-166m	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
I-123	Iodine (53)	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁷	2.7X10 ⁻⁴
I-124	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
I-125	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁶	2.7X10 ⁻⁵
I-126	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
I-129	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁵	2.7X10 ⁻⁶
I-131	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
I-132	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶
I-133	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
I-134	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶
I-135	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
In-111	Indium (49)	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
In-113m	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
In-114m	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
In-115m	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Ir-189	Iridium (77)	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁷	2.7X10 ⁻⁴
Ir-190	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Ir-192	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁴	2.7X10 ⁻⁷
Ir-194	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁵	2.7X10 ⁻⁶
K-40	Potassium (19)	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
K-42	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
K-43	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Kr-81	Krypton (36)	1.0X10 ⁴	2.7X10 ⁻⁷	1.0X10 ⁷	2.7X10 ⁻⁴
Kr-85	-	1.0X10 ⁵	2.7X10 ⁻⁶	1.0X10 ⁴	2.7X10 ⁻⁷
Kr-85m	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ¹⁰	2.7X10 ⁻¹
Kr-87	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁹	2.7X10 ⁻²
La-137	Lanthanum (57)	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁷	2.7X10 ⁻⁴
La-140	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶
Lu-172	Lutetium (71)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Lu-173	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁷	2.7X10 ⁻⁴
Lu-174	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁷	2.7X10 ⁻⁴

Symbol of radionuclide	Element and atomic number	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
Lu-174m	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁷	2.7X10 ⁻⁴
Lu-177	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁷	2.7X10 ⁻⁴
Mg-28	Magnesium (12)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶
Mn-52	Manganese (25)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶
Mn-53	-	1.0X10 ⁴	2.7X10 ⁻⁷	1.0X10 ⁹	2.7X10 ⁻²
Mn-54	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Mn-56	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶
Mo-93	Molybdenum (42)	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁸	2.7X10 ⁻³
Mo-99	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
N-13	Nitrogen (7)	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁹	2.7X10 ⁻²
Na-22	Sodium (11)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Na-24	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶
Nb-93m	Niobium (41)	1.0X10 ⁴	2.7X10 ⁻⁷	1.0X10 ⁷	2.7X10 ⁻⁴
Nb-94	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Nb-95	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Nb-97	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Nd-147	Neodymium (60)	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Nd-149	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Ni-59	Nickel (28)	1.0X10 ⁴	2.7X10 ⁻⁷	1.0X10 ⁸	2.7X10 ⁻³
Ni-63	-	1.0X10 ⁵	2.7X10 ⁻⁶	1.0X10 ⁸	2.7X10 ⁻³
Ni-65	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Np-235	Neptunium (93)	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁷	2.7X10 ⁻⁴
Np-236 (short-lived)	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁷	2.7X10 ⁻⁴
Np-236 (long-lived)	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁵	2.7X10 ⁻⁶
Np-237 (b)	-	1.0	2.7X10 ⁻¹¹	1.0X10 ³	2.7X10 ⁻⁸
Np-239	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁷	2.7X10 ⁻⁴
Os-185	Osmium (76)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Os-191	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁷	2.7X10 ⁻⁴
Os-191m	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁷	2.7X10 ⁻⁴
Os-193	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Os-194	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁵	2.7X10 ⁻⁶
P-32	Phosphorus (15)	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁵	2.7X10 ⁻⁶
P-33	-	1.0X10 ⁵	2.7X10 ⁻⁶	1.0X10 ⁸	2.7X10 ⁻³
Pa-230	Protactinium (91)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Pa-231	-	1.0	2.7X10 ⁻¹¹	1.0X10 ³	2.7X10 ⁻⁸
Pa-233	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁷	2.7X10 ⁻⁴
Pb-201	Lead (82)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Pb-202	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁶	2.7X10 ⁻⁵
Pb-203	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Pb-205	-	1.0X10 ⁴	2.7X10 ⁻⁷	1.0X10 ⁷	2.7X10 ⁻⁴
Pb-210 (b)	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁴	2.7X10 ⁻⁷
Pb-212 (b)	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶
Pd-103	Palladium (46)	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁸	2.7X10 ⁻³
Pd-107	-	1.0X10 ⁵	2.7X10 ⁻⁶	1.0X10 ⁸	2.7X10 ⁻³
Pd-109	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁶	2.7X10 ⁻⁵
Pm-143	Promethium (61)	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵

Symbol of radionuclide	Element and atomic number	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
Pm-144	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Pm-145	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁷	2.7X10 ⁻⁴
Pm-147	-	1.0X10 ⁴	2.7X10 ⁻⁷	1.0X10 ⁷	2.7X10 ⁻⁴
Pm-148m	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Pm-149	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁶	2.7X10 ⁻⁵
Pm-151	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Po-210	Polonium (84)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁴	2.7X10 ⁻⁷
Pr-142	Praseodymium (59)	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁵	2.7X10 ⁻⁶
Pr-143	-	1.0X10 ⁴	2.7X10 ⁻⁷	1.0X10 ⁶	2.7X10 ⁻⁵
Pt-188	Platinum (78)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Pt-191	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Pt-193	-	1.0X10 ⁴	2.7X10 ⁻⁷	1.0X10 ⁷	2.7X10 ⁻⁴
Pt-193m	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁷	2.7X10 ⁻⁴
Pt-195m	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Pt-197	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁶	2.7X10 ⁻⁵
Pt-197m	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Pu-236	Plutonium (94)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁴	2.7X10 ⁻⁷
Pu-237	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁷	2.7X10 ⁻⁴
Pu-238	-	1.0	2.7X10 ⁻¹¹	1.0X10 ⁴	2.7X10 ⁻⁷
Pu-239	-	1.0	2.7X10 ⁻¹¹	1.0X10 ⁴	2.7X10 ⁻⁷
Pu-240	-	1.0	2.7X10 ⁻¹¹	1.0X10 ³	2.7X10 ⁻⁸
Pu-241	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁵	2.7X10 ⁻⁶
Pu-242	-	1.0	2.7X10 ⁻¹¹	1.0X10 ⁴	2.7X10 ⁻⁷
Pu-244	-	1.0	2.7X10 ⁻¹¹	1.0X10 ⁴	2.7X10 ⁻⁷
Ra-223 (b)	Radium (88)	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁵	2.7X10 ⁻⁶
Ra-224 (b)	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶
Ra-225	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁵	2.7X10 ⁻⁶
Ra-226 (b)	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁴	2.7X10 ⁻⁷
Ra-228 (b)	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶
Rb-81	Rubidium (37)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Rb-83	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Rb-84	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Rb-86	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁵	2.7X10 ⁻⁶
Rb-87	-	1.0X10 ⁴	2.7X10 ⁻⁷	1.0X10 ⁷	2.7X10 ⁻⁴
Rb (nat)	-	1.0X10 ⁴	2.7X10 ⁻⁷	1.0X10 ⁷	2.7X10 ⁻⁴
Re-184	Rhenium (75)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Re-184m	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Re-186	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁶	2.7X10 ⁻⁵
Re-187	-	1.0X10 ⁶	2.7X10 ⁻⁵	1.0X10 ⁹	2.7X10 ⁻²
Re-188	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁵	2.7X10 ⁻⁶
Re-189	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Re (nat)	-	1.0X10 ⁶	2.7X10 ⁻⁵	1.0X10 ⁹	2.7X10 ⁻²
Rh-99	Rhodium (45)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Rh-101	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁷	2.7X10 ⁻⁴
Rh-102	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Rh-102m	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵

Symbol of radionuclide	Element and atomic number	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
Rh-103m	-	1.0X10 ⁴	2.7X10 ⁻⁷	1.0X10 ⁸	2.7X10 ⁻³
Rh-105	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁷	2.7X10 ⁻⁴
Rn-222 (b)	Radon (86)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁸	2.7X10 ⁻³
Ru-97	Ruthenium (44)	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁷	2.7X10 ⁻⁴
Ru-103	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Ru-105	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Ru-106 (b)	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁵	2.7X10 ⁻⁶
S-35	Sulphur (16)	1.0X10 ⁵	2.7X10 ⁻⁶	1.0X10 ⁸	2.7X10 ⁻³
Sb-122	Antimony (51)	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁴	2.7X10 ⁻⁷
Sb-124	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Sb-125	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Sb-126	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶
Sc-44	Scandium (21)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶
Sc-46	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Sc-47	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Sc-48	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶
Se-75	Selenium (34)	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Se-79	-	1.0X10 ⁴	2.7X10 ⁻⁷	1.0X10 ⁷	2.7X10 ⁻⁴
Si-31	Silicon (14)	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁶	2.7X10 ⁻⁵
Si-32	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁶	2.7X10 ⁻⁵
Sm-145	Samarium (62)	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁷	2.7X10 ⁻⁴
Sm-147	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁴	2.7X10 ⁻⁷
Sm-151	-	1.0X10 ⁴	2.7X10 ⁻⁷	1.0X10 ⁸	2.7X10 ⁻³
Sm-153	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Sn-113	Tin (50)	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁷	2.7X10 ⁻⁴
Sn-117m	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Sn-119m	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁷	2.7X10 ⁻⁴
Sn-121m	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁷	2.7X10 ⁻⁴
Sn-123	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁶	2.7X10 ⁻⁵
Sn-125	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁵	2.7X10 ⁻⁶
Sn-126	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶
Sr-82	Strontium (38)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶
Sr-85	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Sr-85m	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁷	2.7X10 ⁻⁴
Sr-87m	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Sr-89	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁶	2.7X10 ⁻⁵
Sr-90 (b)	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁴	2.7X10 ⁻⁷
Sr-91	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶
Sr-92	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
T(H-3)	Tritium (1)	1.0X10 ⁶	2.7X10 ⁻⁵	1.0X10 ⁹	2.7X10 ⁻²
Ta-178 (long-lived)	Tantalum (73)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Ta-179	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁷	2.7X10 ⁻⁴
Ta-182	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁴	2.7X10 ⁻⁷
Tb-157	Terbium (65)	1.0X10 ⁴	2.7X10 ⁻⁷	1.0X10 ⁷	2.7X10 ⁻⁴
Tb-158	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Tb-160	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵

Symbol of radionuclide	Element and atomic number	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
Tc-95m	Technetium (43)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Tc-96	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Tc-96m	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁷	2.7X10 ⁻⁴
Tc-97	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁸	2.7X10 ⁻³
Tc-97m	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁷	2.7X10 ⁻⁴
Tc-98	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Tc-99	-	1.0X10 ⁴	2.7X10 ⁻⁷	1.0X10 ⁷	2.7X10 ⁻⁴
Tc-99m	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁷	2.7X10 ⁻⁴
Te-121	Tellurium (52)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Te-121m	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁵	2.7X10 ⁻⁶
Te-123m	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁷	2.7X10 ⁻⁴
Te-125m	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁷	2.7X10 ⁻⁴
Te-127	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁶	2.7X10 ⁻⁵
Te-127m	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁷	2.7X10 ⁻⁴
Te-129	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Te-129m	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁶	2.7X10 ⁻⁵
Te-131m	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Te-132	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁷	2.7X10 ⁻⁴
Th-227	Thorium (90)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁴	2.7X10 ⁻⁷
Th-228 (b)	-	1.0	2.7X10 ⁻¹¹	1.0X10 ⁴	2.7X10 ⁻⁷
Th-229 (b)	-	1.0	2.7X10 ⁻¹¹	1.0X10 ³	2.7X10 ⁻⁸
Th-230	-	1.0	2.7X10 ⁻¹¹	1.0X10 ⁴	2.7X10 ⁻⁷
Th-231	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁷	2.7X10 ⁻⁴
Th-232	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁴	2.7X10 ⁻⁷
Th-234 (b)	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁵	2.7X10 ⁻⁶
Th (nat) (b)	-	1.0	2.7X10 ⁻¹¹	1.0X10 ³	2.7X10 ⁻⁸
Ti-44	Titanium (22)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶
Tl-200	Thallium (81)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Tl-201	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Tl-202	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Tl-204	-	1.0X10 ⁴	2.7X10 ⁻⁷	1.0X10 ⁴	2.7X10 ⁻⁷
Tm-167	Thulium (69)	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Tm-170	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁶	2.7X10 ⁻⁵
Tm-171	-	1.0X10 ⁴	2.7X10 ⁻⁷	1.0X10 ⁸	2.7X10 ⁻³
U-230 (fast lung absorption) (b), (d)	Uranium (92)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶
U-230 (medium lung absorption) (e)	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁴	2.7X10 ⁻⁷
U-230 (slow lung absorption) (f)	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁴	2.7X10 ⁻⁷
U-232 (fast lung absorption) (b), (d)	-	1.0	2.7X10 ⁻¹¹	1.0X10 ³	2.7X10 ⁻⁸
U-232 (medium lung absorption) (e)	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁴	2.7X10 ⁻⁷
U-232 (slow lung absorption) (f)	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁴	2.7X10 ⁻⁷
U-233 (fast lung absorption) (d)	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁴	2.7X10 ⁻⁷
U-233 (medium lung absorption) (e)	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁵	2.7X10 ⁻⁶
U-233 (slow lung absorption) (f)	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶
U-234 (fast lung absorption) (d)	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁴	2.7X10 ⁻⁷
U-234 (medium lung absorption) (e)	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁵	2.7X10 ⁻⁶
U-234 (slow lung absorption) (f)	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶

Symbol of radionuclide	Element and atomic number	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
U-235 (all lung absorption types) (b), (d), (e), (f)	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁴	2.7X10 ⁻⁷
U-236 (fast lung absorption) (d)	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁴	2.7X10 ⁻⁷
U-236 (medium lung absorption) (e)	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁵	2.7X10 ⁻⁶
U-236 (slow lung absorption) (f)	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁴	2.7X10 ⁻⁷
U-238 (all lung absorption types) (b), (d), (e), (f)	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁴	2.7X10 ⁻⁷
U (nat) (b)	-	1.0	2.7X10 ⁻¹¹	1.0X10 ³	2.7X10 ⁻⁸
U (enriched to 20% or less) (g)	-	1.0	2.7X10 ⁻¹¹	1.0X10 ³	2.7X10 ⁻⁸
U (dep)	-	1.0	2.7X10 ⁻¹¹	1.0X10 ³	2.7X10 ⁻⁸
V-48	Vanadium (23)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶
V-49	-	1.0X10 ⁴	2.7X10 ⁻⁷	1.0X10 ⁷	2.7X10 ⁻⁴
W-178	Tungsten (74)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
W-181	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁷	2.7X10 ⁻⁴
W-185	-	1.0X10 ⁴	2.7X10 ⁻⁷	1.0X10 ⁷	2.7X10 ⁻⁴
W-187	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
W-188	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁵	2.7X10 ⁻⁶
Xe-122	Xenon (54)	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁹	2.7X10 ⁻²
Xe-123	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁹	2.7X10 ⁻²
Xe-127	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁵	2.7X10 ⁻⁶
Xe-131m	-	1.0X10 ⁴	2.7X10 ⁻⁷	1.0X10 ⁴	2.7X10 ⁻⁷
Xe-133	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁴	2.7X10 ⁻⁷
Xe-135	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ¹⁰	2.7X10 ⁻¹
Y-87	Yttrium (39)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Y-88	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Y-90	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁵	2.7X10 ⁻⁶
Y-91	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁶	2.7X10 ⁻⁵
Y-91m	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Y-92	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁵	2.7X10 ⁻⁶
Y-93	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁵	2.7X10 ⁻⁶
Yb-169	Ytterbium (70)	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁷	2.7X10 ⁻⁴
Yb-175	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁷	2.7X10 ⁻⁴
Zn-65	Zinc (30)	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Zn-69	-	1.0X10 ⁴	2.7X10 ⁻⁷	1.0X10 ⁶	2.7X10 ⁻⁵
Zn-69m	-	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Zr-88	Zirconium (40)	1.0X10 ²	2.7X10 ⁻⁹	1.0X10 ⁶	2.7X10 ⁻⁵
Zr-93 (b)	-	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁷	2.7X10 ⁻⁴
Zr-95	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁶	2.7X10 ⁻⁵
Zr-97 (b)	-	1.0X10 ¹	2.7X10 ⁻¹⁰	1.0X10 ⁵	2.7X10 ⁻⁶

(a) (Reserved)

(b) Parent nuclides and their progeny included in secular equilibrium are listed in the following:

Sr-90	Y-90
Zr-93	Nb-93m
Zr-97	Nb-97
Ru-106	Rh-106
Cs-137	Ba-137m
Ce-134	La-134
Ce-144	Pr-144
Ba-140	La-140
Bi-212	Tl-208 (0.36), Po-212 (0.64)
Pb-210	Bi-210, Po-210
Pb-212	Bi-212, Tl-208 (0.36), Po-212 (0.64)

Rn-220	Po-216
Rn-222	Po-218, Pb-214, Bi-214, Po-214
Ra-223	Rn-219, Po-215, Pb-211, Bi-211, Tl-207
Ra-224	Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212 (0.64)
Ra-226	Rn-222, Po-218, Pb-214, Bi-214, Po-214, Pb-210, Bi-210, Po-210
Ra-228	Ac-228
Th-226	Ra-222, Rn-218, Po-214
Th-228	Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212 (0.64)
Th-229	Ra-225, Ac-225, Fr-221, At-217, Bi-213, Po-213, Pb-209
Th-nat	Ra-228, Ac-228, Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212 (0.64)
Th-234	Pa-234m
U-230	Th-226, Ra-222, Rn-218, Po-214
U-232	Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212 (0.64)
U-235	Th-231
U-238	Th-234, Pa-234m
U-nat	Th-234, Pa-234m, U-234, Th-230, Ra-226, Rn-222, Po-218, Pb-214, Bi-214, Po-214, Pb-210, Bi-210, Po-210
U-240	Np-240m
Np-237	Pa-233
Am-242m	Am-242
Am-243	Np-239

- (c) (Reserved)
- (d) These values apply only to compounds of uranium that take the chemical form of UF_6 , UO_2F_2 and $\text{UO}_2(\text{NO}_3)_2$ in both normal and accident conditions of transport.
- (e) These values apply only to compounds of uranium that take the chemical form of UO_3 , UF_4 , UCl_4 and hexavalent compounds in both normal and accident conditions of transport.
- (f) These values apply to all compounds of uranium other than those specified in notes (d) and (e) of this table.
- (g) These values apply to unirradiated uranium only.

Table A-3. General Values for A1 and A2

Contents	A ₁		A ₂		Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limits for exempt consignments (Bq)	Activity limits for exempt consignments (Ci)
	(TBq)	(Ci)	(TBq)	(Ci)				
Only beta or gamma emitting radionuclides are known to be present	1×10^{-1}	2.7×10^0	2×10^{-2}	5.4×10^{-1}	1×10^1	2.7×10^{-10}	1×10^4	2.7×10^{-7}
Only alpha emitting radionuclides are known to be present	2×10^{-1}	5.4×10^0	9×10^{-5}	2.4×10^{-3}	1×10^{-1}	2.7×10^{-12}	1×10^3	2.7×10^{-8}
No relevant data are available	1×10^{-3}	2.7×10^{-2}	9×10^{-5}	2.4×10^{-3}	1×10^{-1}	2.7×10^{-12}	1×10^3	2.7×10^{-8}

Table A-4.
Activity-Mass Relationships for Uranium

Uranium Enrichment ¹ wt % U-235 present	Specific Activity	
	TBq/g	Ci/g
0.45	1.8×10^{-8}	5.0×10^{-7}
0.72	2.6×10^{-8}	7.1×10^{-7}
1	2.8×10^{-8}	7.6×10^{-7}
1.5	3.7×10^{-8}	1.0×10^{-6}
5	1.0×10^{-7}	2.7×10^{-6}
10	1.8×10^{-7}	4.8×10^{-6}
20	3.7×10^{-7}	1.0×10^{-5}
35	7.4×10^{-7}	2.0×10^{-5}
50	9.3×10^{-7}	2.5×10^{-5}
90	2.2×10^{-6}	5.8×10^{-5}
93	2.6×10^{-6}	7.0×10^{-5}

Uranium Enrichment ¹ wt % U-235 present	Specific Activity	
	TBq/g	Ci/g
95	3.4×10^{-6}	9.1×10^{-5}

¹ The figures for uranium include representative values for the activity of the uranium-234 that is concentrated during the enrichment process.

REPEALER

The following section of the Washington Administrative Code is repealed:

WAC 246-231-080 General license-DOT specification
container.

From: [Fordham, Earl W \(DOH\)](#)
To: [Schneider, Kathleen](#); [Henderson, Pamela](#)
Cc: [Austin, Michelle \(DOH\)](#)
Subject: Final Submission for 2009-1, Medical use of byproduct material – authorized user clarification
Date: Tuesday, February 25, 2014 3:46:38 PM
Attachments: [OTS-5556 3Final.pdf](#)
[OTS-5162 4final.pdf](#)

Dear Ms. Henderson:

RE: RATS ID 2009-1, Medical use of byproduct material – authorized user clarification

Attached is a copy of the final rule revisions to Washington's Radiological Health Rules, chapter 246-240 WAC, Radiation protection – medical use of radioactive material, for adopting RATS ID 2009-1, Medical use of byproduct material – authorized user clarification. Language or punctuation we are deleting has a solid line through it and new language or punctuation is underlined.

We believe the adoption of these rule revisions satisfies the compatibility and health and safety categories established in the Office of Federal and State Materials and Environmental Programs (FSME) Procedure SA-200.

If you have any questions, please contact Michelle Austin, Rules Coordinator, at (360) 236-3250 or by e-mail at michelle.austin@doh.wa.gov

Thanks,
Earl Fordham
Deputy Director, Office of Radiation Protection
Washington State Dept of Health

AMENDATORY SECTION (Amending WSR 11-03-068, filed 1/18/11, effective 2/18/11)

WAC 246-240-010 Definitions, abbreviations, and acronyms.
The definitions, abbreviations, and acronyms in this section and in WAC 246-220-010 apply throughout this chapter unless the context clearly indicates otherwise.

~~((1))~~ (1) **"Address of use"** means the building or buildings that are identified on the license and where radioactive material may be received, prepared, used, or stored.

~~((1))~~ (2) **"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 radioactive material.

~~((2))~~ (3) **"Attestation"** means written certification under oath.

(4) **"Authorized medical physicist"** means an individual who:

(a) Meets the requirements in WAC 246-240-072 and 246-240-081;
or

(b) Is identified as an authorized medical physicist or teletherapy physicist on:

(i) A specific medical use license issued by the department, ~~((the U.S. Nuclear Regulatory Commission))~~ NRC or an agreement state;

(ii) A medical use permit issued by a ~~((U.S.))~~ NRC master material licensee;

(iii) A permit issued by a ~~((U.S.))~~ NRC or agreement state broad scope medical use licensee; or

(iv) A permit issued by a ~~((U.S.))~~ NRC master material license broad scope medical use permittee.

~~((3))~~ (5) **"Authorized nuclear pharmacist"** means a pharmacist who:

(a) Meets the requirements in WAC 246-240-075 and 246-240-081;
or

(b) Is identified as an authorized nuclear pharmacist on:

(i) A specific license issued by the department, ~~((the U.S.))~~ NRC or an agreement state, that authorizes medical use or the practice of nuclear pharmacy;

(ii) A permit issued by a ~~((U.S.))~~ NRC master material licensee that authorizes medical use or the practice of nuclear pharmacy;

(iii) A permit issued by a ~~((U.S.))~~ NRC or agreement state broad scope medical use licensee that authorizes medical use or the practice of nuclear pharmacy; or

(iv) A permit issued by a ~~((U.S.))~~ NRC master material license broad scope medical use permittee that authorizes medical use or the practice of nuclear pharmacy; or

(c) Is identified as an authorized nuclear pharmacist by a

commercial nuclear pharmacy that has been authorized to identify authorized nuclear pharmacists; or

(d) Is designated as an authorized nuclear pharmacist in accordance with WAC 246-235-100(2).

~~((+4+))~~ (6) "Authorized user" means a physician, dentist, or podiatrist who:

(a) Meets the requirements in WAC 246-240-081 and 246-240-154, 246-240-163, 246-240-210, 246-240-213, 246-240-216, 246-240-278, 246-240-301, or 246-240-399; or

(b) Is identified as an authorized user on:

(i) A department, ~~((U.S.))~~ NRC, or agreement state license that authorizes the medical use of radioactive material; or

(ii) A permit issued by a ~~((U.S.))~~ NRC master material licensee that is authorized to permit the medical use of radioactive material; or

(iii) A permit issued by a department, ~~((U.S.))~~ NRC, or agreement state specific licensee of broad scope that is authorized to permit the medical use of radioactive material; or

(iv) A permit issued by a ~~((U.S.))~~ NRC master material license broad scope permittee that is authorized to permit the medical use of radioactive material.

~~((+5+))~~ (7) "Brachytherapy" means a method of radiation therapy in which sources are used to deliver a radiation dose at a distance of up to a few centimeters by surface, intracavitary, intraluminal, or interstitial application.

~~((+6+))~~ (8) "Brachytherapy source" means a radioactive source or a manufacturer-assembled source train or a combination of these sources that is designed to deliver a therapeutic dose within a distance of a few centimeters.

~~((+7+))~~ (9) "Client's address" means the area of use or a temporary job site for the purpose of providing mobile medical service in accordance with WAC 246-240-125.

~~((+8+))~~ (10) "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 10 mega-electron volts and is commonly used for production of short half-life radionuclides for medical use.

~~((+9+))~~ (11) "Dedicated check source" means a radioactive source that is used to assure the constant operation of a radiation detection or measurement device over several months or years.

~~((+10+))~~ (12) "Dentist" means an individual licensed by a state or territory of the United States, the District of Columbia, or the Commonwealth of Puerto Rico to practice dentistry.

~~((+11+))~~ (13) "FDA" means the U.S. Food and Drug Administration.

(14) "High dose-rate remote afterloader" ~~((, as used in this chapter,))~~ means a brachytherapy device that remotely delivers a dose rate in excess of 12 gray (1200 rads) per hour at the point or surface where the dose is prescribed.

~~((+12+))~~ (15) "Low dose-rate remote afterloader" ~~((, as used in this chapter,))~~ means a brachytherapy device that remotely delivers a dose rate of less than or equal to 2 gray (200 rads) per

hour at the point or surface where the dose is prescribed.

((+13+)) (16) "Management" means the chief executive officer or other individual having the authority to manage, direct, or administer the licensee's activities, or that person's delegate or delegates.

((+14+)) (17) "Manual brachytherapy" ~~((, as used in this chapter,))~~ means a type of brachytherapy in which the brachytherapy sources (e.g., seeds, ribbons) are manually placed topically on or inserted either into the body cavities that are in close proximity to a treatment site or directly into the tissue volume.

((+15+)) (18) "Medical event" means an event that meets the criteria in WAC 246-240-651.

((+16+)) (19) "Medical institution" means an organization in which more than one medical discipline is practiced.

((+17+)) (20) "Medical use" means the intentional internal or external administration of radioactive material or the radiation from radioactive material to patients or human research subjects under the supervision of an authorized user.

((+18+)) (21) "Medium dose-rate remote afterloader" ~~((, as used in this chapter,))~~ means a brachytherapy device that remotely delivers a dose rate of greater than 2 gray (200 rads), but less than or equal to 12 grays (1200 rads) per hour at the point or surface where the dose is prescribed.

((+19+)) (22) "Mobile medical service" means the transportation of radioactive material to and its medical use at the client's address.

((+20+)) (23) "Output" means the exposure rate, dose rate, or a quantity related in a known manner to these rates from a brachytherapy source or a teletherapy, remote afterloader, or gamma stereotactic radiosurgery unit for a specified set of exposure conditions.

((+21+)) (24) "Patient intervention" means actions by the patient or human research subject, whether intentional or unintentional, such as dislodging or removing treatment devices or prematurely terminating the administration.

((+22+)) (25) "Podiatrist" means an individual licensed by a state or territory of the United States, the District of Columbia, or the Commonwealth of Puerto Rico to practice podiatry.

((+23+)) (26) "Positron emission tomography ((+PET+)) radionuclide production facility" means a facility operating an accelerator for the purpose of producing ((PET)) positron emission tomography radionuclides.

((+24+)) (27) "Preceptor" means an individual who provides, directs, or verifies training and experience required for an individual to become an authorized user, an authorized medical physicist, an authorized nuclear pharmacist, or ((a)) an authorized radiation safety officer.

((+25+)) (28) "Prescribed dosage" means the specified activity or range of activity of unsealed radioactive material as documented:

(a) In a written directive; or

(b) In accordance with the directions of the authorized user for procedures performed under WAC 246-240-151 and 246-240-157.

~~((26))~~ (29) "Prescribed dose" means:

(a) For gamma stereotactic radiosurgery, the total dose as documented in the written directive;

(b) For teletherapy, the total dose and dose per fraction as documented in the written directive;

(c) For manual brachytherapy, either the total source strength and exposure time or the total dose, as documented in the written directive; or

(d) For remote brachytherapy afterloaders, the total dose and dose per fraction as documented in the written directive.

~~((27))~~ (30) "Pulsed dose-rate remote afterloader"~~((, as used in this chapter,))~~ means a special type of remote afterloading brachytherapy device that uses a single source capable of delivering dose rates in the "high dose-rate" range, but:

(a) Is approximately one-tenth of the activity of typical high dose-rate remote afterloader sources; and

(b) Is used to simulate the radiobiology of a low dose-rate treatment by inserting the source for a given fraction of each hour.

~~((28) "Radiation safety officer" means an individual who:~~

~~(a) Meets the requirements in WAC 246-240-069 and 246-240-081; or~~

~~(b) Is identified as a radiation safety officer on a specific medical use license issued by the department prior to October 5, 2005, the U.S. NRC or an agreement state; or~~

~~(c) A medical use permit issued by a commission master material licensee.~~

~~(29))~~ (31) "Sealed source and device registry" means the national registry that contains all the registration certificates, generated by ~~((both the U.S.))~~ NRC 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.

~~((30))~~ (32) "Stereotactic radiosurgery" means the use of external radiation in conjunction with a stereotactic guidance device to very precisely deliver a therapeutic dose to a tissue volume.

~~((31))~~ (33) "Structured educational program" means an educational program designed to impart particular knowledge and practical education through interrelated studies and supervised training.

~~((32))~~ (34) "Teletherapy"~~((, as used in this chapter,))~~ means a method of radiation therapy in which collimated gamma rays are delivered at a distance from the patient or human research subject.

~~((33))~~ (35) "Temporary job site" means a location where mobile medical services are conducted at other than those fixed location(s) of use authorized ~~((on))~~ by the license.

~~((34))~~ (36) "Therapeutic dosage" means a dosage of unsealed radioactive material that is intended to deliver a radiation dose

to a patient or human research subject for palliative or curative treatment.

((~~(35)~~)) (37) "Therapeutic dose" means a radiation dose delivered from a source containing radioactive material to a patient or human research subject for palliative or curative treatment.

((~~(36)~~)) (38) "Treatment site" means the anatomical description of the tissue intended to receive a radiation dose, as described in a written directive.

((~~(37)~~)) (39) "Type of use" means use of radioactive material under WAC 246-240-151, 246-240-157, 246-240-201, 246-240-251, 246-240-301, 246-240-351, or 246-240-501.

((~~(38)~~)) (40) "Unit dosage" means a dosage prepared for medical use for administration as a single dosage to a patient or human research subject without any further manipulation of the dosage after it is initially prepared.

((~~(39)~~)) (41) "Written directive" means an authorized user's written order for the administration of radioactive material or radiation from radioactive material to a specific patient or human research subject, as specified in WAC 246-240-060.

AMENDATORY SECTION (Amending WSR 06-05-019, filed 2/6/06, effective 3/9/06)

WAC 246-240-016 License required. (1) 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 department, ((~~the U.S.~~)) NRC or an agreement state, or as allowed in subsection (2)(a) or (b) of this section.

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

(a) Receives, possesses, uses, or transfers radioactive material in accordance with these rules under the supervision of an authorized user under ((~~in~~)) WAC 246-240-057, unless prohibited by license condition; or

(b) Prepares unsealed radioactive material for medical use in accordance with these rules under the supervision of an authorized nuclear pharmacist or authorized user under WAC 246-240-057, unless prohibited by license condition.

WAC 246-240-022 License amendments. A licensee shall apply for and must receive a license amendment before the licensee:

(1) Receives, prepares, or uses radioactive material for a type of use that is permitted under this chapter, but that is not authorized on the licensee's current license issued under this chapter;

(2) Permits anyone to work as an authorized user, authorized nuclear pharmacist, or authorized medical physicist under the license, except:

(a) For an authorized user, an individual who meets the requirements in WAC 246-240-154, 246-240-163, 246-240-210, 246-240-213, 246-240-216, 246-240-278, or 246-240-399;

(b) For an authorized nuclear pharmacist, an individual who meets the requirements in WAC 246-240-075 and 246-240-081;

(c) For an authorized medical physicist, an individual who meets the requirements in WAC 246-240-072 and 246-240-081; or

(d) An individual who is identified as an authorized user, an authorized nuclear pharmacist, or authorized medical physicist:

(i) On an agreement state or ~~((U.S.))~~ NRC license or other equivalent license recognized by the department that authorizes the use of radioactive material in medical use or in the practice of nuclear pharmacy; or

(ii) On a permit issued by ~~((a commission))~~ NRC or an agreement state specific license of broad scope ~~((that))~~ which is ~~((authorized))~~ licensed to ~~((permit))~~ authorize the use of ~~((by-product))~~ radioactive material in medical use or in the practice of nuclear pharmacy;

(iii) On a permit issued by ~~((a commission))~~ NRC master material licensee that is ~~((authorized))~~ licensed to ~~((permit))~~ authorize the use of ~~((by-product))~~ radioactive material in medical use or in the practice of nuclear pharmacy; or

(iv) By a commercial nuclear pharmacy that has been ~~((authorized))~~ licensed to ~~((identify authorized))~~ authorize nuclear pharmacists.

(3) Changes radiation safety officers, except as provided in WAC 246-240-051;

(4) Receives radioactive material in excess of the amount or in a different form, or receives a different radionuclide than is authorized on the license;

(5) Adds to or changes the areas of use identified in the application or on the license, except for areas of use where radioactive material is used only in accordance with either WAC 246-240-151 or 246-240-157;

(6) Changes the address(es) of use identified in the application or on the license; and

(7) Revises procedures required by WAC 246-240-360, 246-240-378, 246-240-381, and 246-240-384, as applicable, where the revision reduces radiation safety.

AMENDATORY SECTION (Amending WSR 06-05-019, filed 2/6/06, effective 3/9/06)

WAC 246-240-051 Authority and responsibilities for the radiation protection program. (1) In addition to the radiation protection program requirements of WAC 246-221-005, a licensee's management shall approve in writing:

(a) Requests for a license application, renewal, or amendment before submittal to the department;

(b) Any individual before allowing that individual to work as an authorized user, authorized nuclear pharmacist, or authorized medical physicist; and

(c) Radiation protection program changes that do not require a license amendment and are permitted under WAC 246-240-054;

(2) A licensee's management shall appoint a radiation safety officer, who agrees, in writing, to be responsible for implementing the radiation protection program. The licensee, through the radiation safety officer, shall ensure that radiation safety activities are being performed in accordance with licensee-approved procedures and regulatory requirements.

(3) For up to sixty days each year, a licensee may permit an authorized user or an individual qualified to be a radiation safety officer, under WAC 246-240-069 and 246-240-081, to function as a temporary radiation safety officer and to perform the functions of a radiation safety officer, under subsection (7) of this section, if the licensee takes the actions required in subsections (2), (5), (7), and (8) of this section and notifies the department in accordance with WAC 246-240-025.

(4) A licensee may simultaneously appoint more than one temporary radiation safety officer under subsection (3) of this section, if needed to ensure that the licensee has a temporary radiation safety officer that satisfies the requirements to be a radiation safety officer for each of the different types of uses of radioactive material permitted by the license.

(5) A licensee shall establish the authority, duties, and responsibilities of the radiation safety officer in writing.

(6) Licensees that are authorized for two or more different types of use of radioactive material under WAC 246-240-201, 246-240-251, ~~((and/))~~ or 246-240-351, shall establish a radiation safety committee to oversee all uses of radioactive material permitted by the license. The committee must include an authorized user of each type of use permitted by the license, the radiation safety officer, a representative of the nursing service, and a representative of management who is neither an authorized user nor a radiation safety officer. The committee may include other members the licensee considers appropriate.

(7) A licensee shall provide the radiation safety officer sufficient authority, organizational freedom, time, resources, and management prerogative, to:

(a) Identify radiation safety problems;

(b) Initiate, recommend, or provide corrective actions;

(c) Stop unsafe operations; and

(d) Verify implementation of corrective actions.

(8) A licensee shall retain a record of actions taken under subsections (1), (2), and (5) of this section in accordance with WAC 246-240-551.

AMENDATORY SECTION (Amending WSR 07-14-131, filed 7/3/07, effective 8/3/07)

WAC 246-240-066 Suppliers for sealed sources or devices for medical use. For medical use, a licensee may only use:

(1) Sealed sources or devices manufactured, labeled, packaged, and distributed in accordance with a license issued under WAC 246-235-102.

(2) Sealed sources or devices noncommercially transferred from ~~((a U.S.))~~ NRC or an agreement state medical use licensee; or

(3) Teletherapy sources manufactured and distributed in accordance with a license issued under chapter 246-232 WAC.

AMENDATORY SECTION (Amending WSR 11-03-068, filed 1/18/11, effective 2/18/11)

WAC 246-240-069 Training for radiation safety officer. Except as provided in WAC 246-240-078, the licensee shall require an individual fulfilling the responsibilities of the radiation safety officer under WAC 246-240-051 to be an individual who:

(1) Is certified by a specialty board whose certification process has been recognized by the department, ~~((the U.S.))~~ NRC, or an agreement state, and who meets the requirements of subsections (4) and (5) of this section. (Specialty boards whose certification process has been recognized by the department, ~~((the U.S. Nuclear Regulatory Commission))~~ NRC, or an agreement state will be posted on ~~((the))~~ NRC's web page, at ~~((http://www.nrc.gov.))~~ http://www.nrc.gov/materials/miau/med-use-toolkit/spec-board-cert.html.) To be recognized, a specialty board shall require all candidates for certification to:

(a) Hold a bachelor's or graduate degree from an accredited college or university in physical science or engineering or biological science with a minimum of twenty college credits in physical science;

(b) Have five or more years of professional experience in health physics (graduate training may be substituted for no more than two years of the required experience) including at least three years in applied health physics; and

(c) Pass an examination administered by diplomates of the

specialty board, which evaluates knowledge and competence in radiation physics and instrumentation, radiation protection, mathematics pertaining to the use and measurement of radioactivity, radiation biology, and radiation dosimetry; or

(i) Hold a master's or doctor's degree in physics, medical physics, other physical science, engineering, or applied mathematics from an accredited college or university;

(ii) Have two years of full-time practical training (~~(and/)~~) or supervised experience in medical physics:

(A) Under the supervision of a medical physicist who is certified in medical physics by a specialty board recognized by (~~the commission~~) NRC or an agreement state; or

(B) In clinical nuclear medicine facilities providing diagnostic (~~(and/)~~) or therapeutic services under the direction of physicians who meet the requirements for authorized users in WAC 246-240-078, 246-240-163 or 246-240-210; and

(iii) Pass an examination, administered by diplomates of the specialty board, that assesses knowledge and competence in clinical diagnostic radiological or nuclear medicine physics and in radiation safety; or

(d) Obtain written (~~(certification under oath)~~) attestation signed by a preceptor radiation safety officer that the individual has achieved a level of radiation safety knowledge sufficient to function independently as a radiation safety officer for a medical use licensee; or

(2)(a) Has completed a structured educational program consisting of both:

(i) Two hundred hours of classroom and laboratory training in the following areas:

(A) Radiation physics and instrumentation;

(B) Radiation protection;

(C) Mathematics pertaining to the use and measurement of radioactivity;

(D) Radiation biology; and

(E) Radiation dosimetry; and

(ii) One year of full-time radiation safety experience under the supervision of the individual identified as the radiation safety officer on a department or agreement state license or license issued by (~~the U.S.~~) NRC that authorizes similar type(s) of use(s) of radioactive material involving the following:

(A) Shipping, receiving, and performing related radiation surveys;

(B) Using and performing checks for proper operation of instruments used to determine the activity of dosages, survey meters, and instruments used to measure radionuclides;

(C) Securing and controlling radioactive material;

(D) Using administrative controls to avoid mistakes in the administration of radioactive material;

(E) Using procedures to prevent or minimize radioactive contamination and using proper decontamination procedures;

(F) Using emergency procedures to control radioactive material; and

(G) Disposing of radioactive material; or

(b) Is a medical physicist who has been certified by a specialty board whose certification process has been recognized by the department, (~~((the U.S.))~~) NRC, or an agreement state under WAC 246-240-072 and has experience in radiation safety for similar types of use of radioactive material for which the licensee is seeking the approval of the individual as radiation safety officer and who meets the requirements in subsections (4) and (5) of this section; or

(3) Is an authorized user, authorized medical physicist, or authorized nuclear pharmacist identified on the licensee's license or a medical physicist who has been certified by a specialty board whose certification process has been recognized by the department, (~~((the U.S. Nuclear Regulatory Commission))~~) NRC or an agreement state under WAC 246-240-072 and has experience with the radiation safety aspects of similar types of use of radioactive material for which the individual has radiation safety officer responsibilities; and

(4) Has obtained written (~~((certification under oath))~~) attestation, signed by a preceptor radiation safety officer, that the individual has satisfactorily completed the requirements in subsection (5) of this section, and in subsection (1)(a) and (b), or (c)(i) and (ii) of this section, or subsection (2)(a) or (b) of this section, or subsection (3) of this section and has achieved a level of radiation safety knowledge sufficient to function independently as a radiation safety officer for a medical use licensee; and

(5) Has training in the radiation safety, regulatory issues, and emergency procedures for the types of use for which a licensee seeks approval. This training requirement may be satisfied by completing training that is supervised by an authorized medical physicist, authorized user, authorized nuclear pharmacist, or radiation safety officer, as appropriate, who is authorized for the type(s) of use for which the licensee is seeking approval.

AMENDATORY SECTION (Amending WSR 11-03-068, filed 1/18/11, effective 2/18/11)

WAC 246-240-072 Training for an authorized medical physicist.

Except as provided in WAC 246-240-078, the licensee shall require the authorized medical physicist to be an individual who:

(1) Is certified by a specialty board whose certification process has been recognized by the department, (~~((the U.S. Nuclear Regulatory Commission))~~) NRC or an agreement state and who meets the requirements in subsections (2)(b) and (3) of this section. (Specialty boards whose certification process has been recognized by (~~((the commission))~~) NRC or an agreement state will be posted on (~~((the))~~) NRC's web page at (~~((http://www.nrc.gov-))~~) http://www.nrc.gov/materials/miau/med-use-toolkit/spec-board-cert.html.) To be recognized, a specialty board shall require all

candidates for certification to:

(a) Hold a master's or doctor's degree in physics, medical physics, other physical science, engineering, or applied mathematics from an accredited college or university;

(b) Have two years of full-time practical training (~~((and/))~~) or supervised experience in medical physics:

(i) Under the supervision of a medical physicist who is certified in medical physics by a specialty board recognized by (~~((the commission))~~) NRC or an agreement state; or

(ii) In clinical radiation facilities providing high energy, external beam therapy (photons and electrons with energies greater than or equal to one million electron volts) and brachytherapy services under the direction of physicians who meet the requirements for authorized users in WAC 246-240-078, 246-240-278 or 246-240-399;

(c) Pass an examination, administered by diplomates of the specialty board, which assesses knowledge and competence in clinical radiation therapy, radiation safety, calibration, quality assurance, and treatment planning for external beam therapy, brachytherapy, and stereotactic radiosurgery; or

(2)(a) Holds a master's or doctor's degree in physics, medical physics, other physical science, engineering, or applied mathematics from an accredited college or university; and has completed one year of full-time training in medical physics and an additional year of full-time work experience under the supervision of an individual who meets the requirements for an authorized medical physicist for the type(s) of use modalities for which the individual is seeking authorization. This training and work experience must be conducted in clinical radiation facilities that provide high energy, external beam therapy and brachytherapy services and must include:

(i) Performing sealed source leak tests and inventories;

(ii) Performing decay corrections;

(iii) Performing full calibration and periodic spot checks of external beam treatment units, stereotactic radiosurgery units, and remote afterloading units as applicable; and

(iv) Conducting radiation surveys around external beam treatment units, stereotactic radiosurgery units, and remote afterloading units as applicable; and

(b) Has obtained written (~~((certification under oath))~~) attestation that the individual has satisfactorily completed the requirements in subsections (1)(a) and (b) and (3), or (2)(a) and (3) of this section, and has achieved a level of competency sufficient to function independently as an authorized medical physicist for each type of therapeutic medical unit for which the individual is requesting authorized medical physicist status. The written (~~((certification under oath))~~) attestation must be signed by a preceptor authorized medical physicist who meets the requirements in WAC 246-240-072, 246-240-078, or equivalent (~~((U.S.))~~) NRC or agreement state requirements for an authorized medical physicist for each type of therapeutic medical unit for which the individual is requesting authorized medical physicist status; and

(3) Has training for the type(s) of use in the modalities for

which authorization is sought that includes hands-on device operation, safety procedures, clinical use, and the operation of a treatment planning system. This training requirement may be satisfied by satisfactorily completing either a training program provided by the vendor or by training supervised by an authorized medical physicist authorized for the type(s) of use for which the individual is seeking authorization.

AMENDATORY SECTION (Amending WSR 11-03-068, filed 1/18/11, effective 2/18/11)

WAC 246-240-075 Training for an authorized nuclear pharmacist. Except as provided in WAC 246-240-078, the licensee shall require the authorized nuclear pharmacist to be a pharmacist who:

(1) Is certified by a specialty board whose certification process has been recognized by the department, (~~((the U.S. Nuclear Regulatory Commission))~~) NRC or an agreement state and who meets the requirements in subsection (2)(b) of this section. (Specialty boards whose certification process has been recognized by (~~((the commission))~~) NRC or an agreement state will be posted on (~~((the))~~) NRC's web page at (~~((http://www.nrc.gov.))~~) <http://www.nrc.gov/materials/miau/med-use-toolkit/spec-board-cert.html>.) To be recognized, a specialty board shall require all candidates for certification to:

(a) Have graduated from a pharmacy program accredited by the American Council on Pharmaceutical Education (~~((ACPE))~~) or have passed the Foreign Pharmacy Graduate Examination Committee (~~((FPGEC))~~) examination;

(b) Hold a current, active license to practice pharmacy;

(c) Provide evidence of having acquired at least four thousand hours of training/experience in nuclear pharmacy practice. Academic training may be substituted for no more than two thousand hours of the required training and experience; and

(d) Pass an examination in nuclear pharmacy administered by diplomates of the specialty board, which assesses knowledge and competency in procurement, compounding, quality assurance, dispensing, distribution, health and safety, radiation safety, provision of information and consultation, monitoring patient outcomes, research and development; or

(2)(a) Has completed two hundred hours in a structured educational program consisting of both:

(i) Didactic training in the following areas:

(A) Radiation physics and instrumentation;

(B) Radiation protection;

(C) Mathematics pertaining to the use and measurement of radioactivity;

(D) Chemistry of radioactive material for medical use; and

- (E) Radiation biology; and
- (ii) Supervised practical experience in a nuclear pharmacy involving:
 - (A) Shipping, receiving, and performing related radiation surveys;
 - (B) Using and performing checks for proper operation of instruments used to determine the activity of dosages, survey meters, and, if appropriate, instruments used to measure alpha-or beta-emitting radionuclides;
 - (C) Calculating, assaying, and safely preparing dosages for patients or human research subjects;
 - (D) Using administrative controls to avoid medical events in the administration of radioactive material; and
 - (E) Using procedures to prevent or minimize radioactive contamination and using proper decontamination procedures; and
- (b) Has obtained written (~~(certification under oath)~~) attestation, signed by a preceptor authorized nuclear pharmacist, that the individual has satisfactorily completed the requirements in subsections (1)(a), (b), and (c) or (2)(a) of this section and has achieved a level of competency sufficient to function independently as an authorized nuclear pharmacist.

AMENDATORY SECTION (Amending WSR 11-03-068, filed 1/18/11, effective 2/18/11)

WAC 246-240-078 Training for experienced radiation safety officer, teletherapy or medical physicist, authorized user, and nuclear pharmacist. (1) An individual identified as a radiation safety officer, a teletherapy or medical physicist, or a nuclear pharmacist on a department, (~~(U.S.)~~) NRC, or agreement state license, or a permit issued by an agreement state or (~~(U.S.)~~) NRC broad scope licensee or master material license permit, or by a master material license permittee of broad scope before October 24, 2006, need not comply with the training requirements of WAC 246-240-278, 246-240-072, or 246-240-075, respectively.

(2) Physicians, dentists, or podiatrists identified as authorized users for the medical use of radioactive material on a license issued by the department or agreement state, or (~~(U.S.)~~) NRC broad scope license, or license issued before October 24, 2006, who perform only those medical uses for which they were authorized on that date need not comply with the training requirements of WAC 246-240-151 and 246-240-399.

(3) 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 state of Washington radioactive materials licenses for the same uses for which these individuals are authorized.

AMENDATORY SECTION (Amending WSR 09-06-003, filed 2/18/09, effective 3/21/09)

WAC 246-240-107 Determination of dosages of unsealed radioactive material for medical use. (1) A licensee shall determine and record the activity of each dosage before medical use.

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

(a) Direct measurement of radioactivity; or

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

(i) A manufacturer, producer, or preparer licensed under WAC 246-235-100 or equivalent ((~~U.S.~~)) NRC or agreement state requirements; or

(ii) An agreement state or ((~~U.S.~~)) NRC licensee for use in research in accordance with a radioactive drug research committee-approved protocol or an investigational new drug ((~~IND~~)) protocol accepted by FDA.

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

(a) Direct measurement of radioactivity;

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

(c) Combination of volumetric measurements and mathematical calculations, based on the measurement made by a manufacturer, producer, or preparer licensed under WAC 246-235-100 or equivalent agreement state requirements.

(4) 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.

(5) A licensee shall retain a record of the dosage determination required by this section in accordance with WAC 246-240-569.

AMENDATORY SECTION (Amending WSR 09-06-003, filed 2/18/09, effective 3/21/09)

WAC 246-240-110 Authorization for calibration, transmission, and reference sources. Any person authorized by WAC 246-240-016 for medical use of radioactive material may receive, possess, and use any of the following radioactive material for check, calibration, transmission, and reference use:

(1) Sealed sources, not exceeding 1.11 gigabecquerels (30 millicuries) each, manufactured and distributed by a person licensed under WAC 246-235-102 or equivalent agreement state or ((~~U.S.~~)) NRC regulations.

(2) Sealed sources, not exceeding 1.11 gigabecquerels (30

millicuries) each, redistributed by a licensee authorized to redistribute the sealed sources manufactured and distributed by a person licensed under WAC 246-235-102, or equivalent agreement state or ((U.S.)) NRC regulations if the redistributed sealed sources are in the original packaging and shielding and are accompanied by the manufacturer's approved instructions.

(3) Any radioactive material with a half-life not longer than one hundred twenty days in individual amounts not to exceed 0.56 gigabecquerels (15 millicuries).

(4) Any radioactive material with a half-life longer than one hundred twenty days in individual amounts not to exceed the smaller of 7.4 megabecquerels (200 microcuries) or 1000 times the quantities in Schedule B of WAC 246-232-120.

(5) Technetium-99m in amounts as needed.

AMENDATORY SECTION (Amending WSR 09-06-003, filed 2/18/09, effective 3/21/09)

WAC 246-240-113 Requirements for possession of sealed sources and brachytherapy sources. (1) A licensee in possession of any sealed source or brachytherapy source shall follow the radiation safety and handling instructions supplied by the manufacturer.

(2) A licensee in possession of a sealed source shall:

(a) Test the source for leakage before its first use unless the licensee has a certificate from the supplier indicating that the source was tested within six months before transfer to the licensee; and

(b) Test the source for leakage at intervals not to exceed six months or at other intervals approved by the department, ((the U.S.)) NRC, or an agreement state in the sealed source and device registry.

(3) To satisfy the leak test requirements of this section, the licensee shall ensure the sample is analyzed by such method that the leak test can detect the presence of 185 becquerels (0.005 microcuries) of radioactive material in the sample.

(4) A licensee shall retain leak test records in accordance with WAC 246-240-572(1).

(5) If the leak test reveals the presence of 185 becquerels (0.005 microcurie((s))) or more of removable contamination, the licensee shall:

(a) Immediately withdraw the sealed source from use and store, dispose, or cause it to be repaired in accordance with the requirements in chapters 246-221 and 246-232 WAC; and

(b) File a report within five days of the leak test in accordance with WAC 246-240-657.

(6) A licensee need not perform a leak test on the following sources:

(a) Sources containing only radioactive material with a half-

life of less than thirty days;

(b) Sources containing only radioactive material as a gas;

(c) Sources containing 3.7 megabecquerels (100 microcuries) or less of beta- or gamma-emitting material or 0.37 megabecquerel ~~((5))~~ (10 microcuries) or less of alpha-emitting material;

(d) Seeds of iridium-192 encased in nylon ribbon; and

(e) Sources stored and not being used. However, the licensee shall test each source for leakage before any use or transfer unless it has been leak tested within six months before the date of use or transfer.

(7) A licensee in possession of sealed sources or brachytherapy sources, except for gamma stereotactic radiosurgery sources, shall conduct a physical inventory of all the sources in its possession at intervals not to exceed six months. The licensee shall retain each inventory record in accordance with WAC 246-240-572.

AMENDATORY SECTION (Amending WSR 09-06-003, filed 2/18/09, effective 3/21/09)

WAC 246-240-151 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 WAC 246-240-060(2), a licensee may use any unsealed radioactive material prepared for medical use for uptake, dilution, or excretion studies that is:

(1) Obtained from a manufacturer, producer, or preparer licensed under WAC 246-235-100(1) or equivalent ~~((U.S.))~~ NRC or agreement state requirements; or

(2) Prepared by an authorized nuclear pharmacist, or a physician who is an authorized user and who meets the requirements specified in WAC 246-240-163, or 246-240-210 and 246-240-163 (3)(a)(ii)(G), or an individual under the supervision of either as specified in WAC 246-240-057; or

(3) Obtained from and prepared by an agreement state or ~~((U.S.))~~ NRC licensee for use in research in accordance with a radioactive drug research committee-approved protocol or an investigational new drug ~~((IND))~~ protocol accepted by FDA; or

(4) 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 FDA.

AMENDATORY SECTION (Amending WSR 11-03-068, filed 1/18/11, effective 2/18/11)

WAC 246-240-154 Training for uptake, dilution, and excretion studies. Except as provided in WAC 246-240-078, the licensee shall require an authorized user of unsealed radioactive material for the uses authorized under WAC 246-240-151 to be a physician who:

(1) Is certified by a medical specialty board whose certification process has been recognized by the department, (~~the U.S. Nuclear Regulatory Commission~~) NRC or an agreement state and who meets the requirements of subsection (3)(b) of this section. (Specialty boards whose certification process has been recognized by the department, the (~~U.S.~~) NRC or an agreement state will be posted on (~~the~~) NRC's web page at (~~http://www.nrc.gov~~) <http://www.nrc.gov/materials/miau/med-use-toolkit/spec-board-cert.html>.) To be recognized, a specialty board shall require all candidates for certification to:

(a) Meet the requirements in subsection (3)(a) of this section; and

(b) Pass an examination, administered by diplomates of the specialty board, which assesses knowledge and competence in radiation safety, radionuclide handling, and quality control; or

(2) Is an authorized user under WAC 246-240-163 or 246-240-210 or equivalent agreement state or (~~U.S.~~) NRC requirements; or subsection (3)(a) of this section; or

(3)(a) Has completed sixty hours of training and experience, including a minimum of eight hours of classroom and laboratory training, in basic radionuclide handling techniques applicable to the medical use of unsealed radioactive material for uptake, dilution, and excretion studies. The training and experience must include:

(i) Classroom and laboratory training in the following areas:

(A) Radiation physics and instrumentation;

(B) Radiation protection;

(C) Mathematics pertaining to the use and measurement of radioactivity;

(D) Chemistry of radioactive material for medical use; and

(E) Radiation biology; and

(ii) Work experience, under the supervision of an authorized user who meets the requirements in WAC 246-240-078, 246-240-154, 246-240-163, or 246-240-210 or equivalent (~~U.S.~~) NRC or agreement state requirements, involving:

(A) Ordering, receiving, and unpacking radioactive materials safely and performing the related radiation surveys;

(B) Performing quality control procedures on instruments used to determine the activity of dosages and performing checks for proper operation of survey meters;

(C) Calculating, measuring, and safely preparing patient or human research subject dosages;

(D) Using administrative controls to prevent a medical event involving the use of unsealed radioactive material;

(E) Using procedures to contain spilled radioactive material

safely and using proper decontamination procedures; and

(F) Administering dosages of radioactive drugs to patients or human research subjects; and

(b) Has obtained written ~~((certification under oath))~~ attestation, signed by a preceptor authorized user who meets the requirements in WAC 246-240-078, 246-240-154, 246-240-163, or 246-240-210, or equivalent agreement state or ~~((U.S.))~~ NRC requirements, that the individual has satisfactorily completed the requirements in (a) of this subsection and has achieved a level of competency sufficient to function independently as an authorized user for the medical uses authorized under WAC 246-240-151.

AMENDATORY SECTION (Amending WSR 09-06-003, filed 2/18/09, effective 3/21/09)

WAC 246-240-157 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 WAC 246-240-060(2), a licensee may use any unsealed radioactive material prepared for medical use for imaging and localization studies that is:

(1) Obtained from a manufacturer, producer, or preparer licensed under WAC 246-235-100(1) or equivalent agreement state or ~~((U.S.))~~ NRC requirements; or

(2) Prepared by an authorized nuclear pharmacist, a physician who is an authorized user and who meets the requirements specified in WAC 246-240-163, or 246-240-210 and 246-240-163 (3)(a)(ii)(G), or an individual under the supervision of either as specified in WAC 246-240-057;

(3) Obtained from and prepared by an agreement state or ~~((U.S.))~~ NRC licensee for use in research in accordance with a radioactive drug research committee-approved protocol or an investigational new drug ~~((IND))~~ protocol accepted by FDA; or

(4) 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 FDA.

AMENDATORY SECTION (Amending WSR 11-03-068, filed 1/18/11, effective 2/18/11)

WAC 246-240-163 Training for imaging and localization studies. Except as provided in WAC 246-240-078, the licensee shall require an authorized user of unsealed radioactive material for the uses authorized under WAC 246-240-157 to be a physician who:

(1) Is certified by a medical specialty board whose certification process has been recognized by the department, (~~the U.S. Nuclear Regulatory Commission~~) NRC or an agreement state and who meets the requirements in subsection (3)(b) of this section. (Specialty boards whose certification process has been recognized by (~~the commission~~) NRC or an agreement state will be posted on (~~the U.S.~~) NRC's web page at (<http://www.nrc.gov>)) <http://www.nrc.gov/materials/miau/med-use-toolkit/spec-board-cert.html>.) To be recognized, a specialty board shall require all candidates for certification to:

(a) Satisfy the requirements in subsection (3)(a) of this section; and

(b) Pass an examination, administered by diplomates of the specialty board, which assesses knowledge and competence in radiation safety, radionuclide handling, and quality control; or

(2) Is an authorized user under WAC 246-240-210 and meets the requirements in WAC 246-240-163 (3)(a)(ii)(G) and 246-240-210 or equivalent agreement state or (~~U.S.~~) NRC requirements; or

(3)(a) Has completed seven hundred hours of training and experience, including a minimum of eighty hours of classroom and laboratory training, in basic radionuclide handling techniques applicable to the medical use of unsealed radioactive material for imaging and localization studies. The training and experience must include, at a minimum:

(i) Classroom and laboratory training in the following areas:

(A) Radiation physics and instrumentation;

(B) Radiation protection;

(C) Mathematics pertaining to the use and measurement of radioactivity;

(D) Chemistry of radioactive material for medical use;

(E) Radiation biology; and

(ii) Work experience, under the supervision of an authorized user, who meets the requirements in WAC 246-240-078, 246-240-163, or 246-240-210 and 246-240-163 (3)(a)(ii)(G), or equivalent agreement state or (~~U.S.~~) NRC requirements, involving:

(A) Ordering, receiving, and unpacking radioactive materials safely and performing the related radiation surveys;

(B) Performing quality control procedures on instruments used to determine the activity of dosages and performing checks for proper operation of survey meters;

(C) Calculating, measuring, and safely preparing patient or human research subject dosages;

(D) Using administrative controls to prevent a medical event involving the use of unsealed radioactive material;

(E) Using procedures to safely contain spilled radioactive material and using proper decontamination procedures;

(F) Administering dosages of radioactive drugs to patients or human research subjects; and

(G) Eluting generator systems appropriate for preparation of radioactive drugs for imaging and localization studies, measuring and testing the eluate for radionuclidic purity, and processing the eluate with reagent kits to prepare labeled radioactive drugs; and

(b) Has obtained written (~~certification under oath~~)

attestation, signed by a preceptor authorized user who meets the requirements in WAC 246-240-078, 246-240-163, or 246-240-210 and 246-240-163 (3)(a)(ii)(G) or equivalent agreement state or ~~((U.S.))~~ NRC requirements, that the individual has satisfactorily completed the requirements in (a) of this subsection and has achieved a level of competency sufficient to function independently as an authorized user for the medical uses authorized under WAC 246-240-151 and 246-240-157.

AMENDATORY SECTION (Amending WSR 09-06-003, filed 2/18/09, effective 3/21/09)

WAC 246-240-201 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:

(1) Obtained from a manufacturer, producer, or preparer licensed under WAC 246-235-100(1) or equivalent agreement state or ~~((U.S.))~~ NRC requirements; or

(2) Prepared by an authorized nuclear pharmacist, a physician who is an authorized user and who meets the requirements specified in WAC 246-240-163 or 246-240-210, or an individual under the supervision of either as specified in WAC 246-240-057; or

(3) Obtained from and prepared by an agreement state or ~~((U.S.))~~ NRC licensee for use in research in accordance with an investigational new drug ~~((IND))~~ protocol accepted by FDA; or

(4) Prepared by the licensee for use in research in accordance with an investigational new drug ~~((IND))~~ protocol accepted by FDA.

AMENDATORY SECTION (Amending WSR 11-03-068, filed 1/18/11, effective 2/18/11)

WAC 246-240-210 Training for use of unsealed radioactive material for which a written directive is required. Except as provided in WAC 246-240-078, the licensee shall require an authorized user of unsealed radioactive material for the uses authorized under WAC 246-240-201 to be a physician who:

(1) Is certified by a medical specialty board whose certification process has been recognized by the department, ~~((the U.S. Nuclear Regulatory Commission))~~ NRC or an agreement state. (Specialty boards whose certification process has been recognized by ~~((the commission))~~ NRC or an agreement state will be posted on ~~((the))~~ NRC's web page at ~~((http://www.nrc.gov.))~~

<http://www.nrc.gov/materials/miau/med-use-toolkit/spec-board-cert.html>.) To be recognized, a specialty board shall require all candidates for certification to:

(a) Successfully complete a residency training in a radiation therapy or nuclear medicine training program or a program in a related medical specialty that includes seven hundred hours of training and experience as described in subsection (2) of this section. Eligible training programs must be approved by the Residency Review Committee of the Accreditation Council for Graduate Medical Education or Royal College of Physicians and Surgeons of Canada or the Committee on Postgraduate Training of the American Osteopathic Association;

(b) Pass an examination, administered by diplomates of the specialty board, which tests knowledge and competence in radiation safety, radionuclide handling, quality assurance, and clinical use of unsealed by-product material; and

(c) Obtain written (~~((certification under oath))~~) attestation that the individual has achieved a level of competency sufficient to function independently as an authorized user for the medical uses authorized under WAC 246-240-201. The written (~~((certification under oath))~~) attestation must be signed by a preceptor authorized user who meets the requirements in WAC 246-240-078, 246-240-210, or equivalent (~~((U.S.))~~) NRC or agreement state requirements. The preceptor authorized user, who meets the requirements in WAC 246-240-078 or 246-240-210 must have experience in administering dosages in the same dosage category or categories (i.e., this section) as the individual requesting authorized user status; or

(2) Has completed seven hundred hours of training and experience, including a minimum of two hundred hours of classroom and laboratory training, in basic radionuclide handling techniques applicable to the medical use of unsealed radioactive material requiring a written directive. The training and experience must include:

(a) Classroom and laboratory training in the following areas:

(i) Radiation physics and instrumentation;

(ii) Radiation protection;

(iii) Mathematics pertaining to the use and measurement of radioactivity;

(iv) Chemistry of radioactive material for medical use; and

(v) Radiation biology; and

(b) Work experience, under the supervision of an authorized user who meets the requirements in subsection (1) or (2) of this section, or equivalent (~~((U.S.))~~) NRC or agreement state requirements. A supervising authorized user, who meets the requirements in this subsection, must also have experience in administering dosages in the same dosage category or categories (i.e., this section) as the individual requesting authorized user status. The work experience must involve:

(i) Ordering, receiving, and unpacking radioactive materials safely and performing the related radiation surveys;

(ii) Performing quality control procedures on instruments used to determine the activity of dosages and performing checks for proper operation of survey meters;

(iii) Calculating, measuring, and safely preparing patient or human research subject dosages;

(iv) Using administrative controls to prevent a medical event involving the use of unsealed radioactive material;

(v) Using procedures to contain spilled radioactive material safely and using proper decontamination procedures;

(vi) Eluting generator systems, measuring and testing the eluate for radionuclidic purity, and processing the eluate with reagent kits to prepare labeled radioactive drugs; and

(vii) Administering dosages of radioactive drugs to patients or human research subjects involving a minimum of three cases in each of the following categories for which the individual is requesting authorized user status:

(A) Oral administration of less than or equal to 1.22 gigabecquerels (33 millicuries) of sodium iodide I-131 for which a written directive is required;

(B) Oral administration of greater than 1.22 gigabecquerels (33 millicuries) of sodium iodide I-131. Experience with at least three cases in this also satisfies the requirement in (b)(vii)(A) of this subsection;

(C) Parenteral administration of any beta emitter, or a photon-emitting radionuclide with a photon energy less than 150 keV for which a written directive is required; ~~((and/))~~ or

(D) Parenteral administration of any other radionuclide for which a written directive is required; and

(E) Has obtained written ~~((certification under oath))~~ attestation that the individual has satisfactorily completed the requirements in subsection (1)(a) and (2)(b)(vii) of this section, WAC 246-240-078, and has achieved a level of competency sufficient to function independently as an authorized user for the medical uses authorized under WAC 246-240-201. The written ~~((certification under oath))~~ attestation must be signed by a preceptor authorized user who meets the requirements in this section, or equivalent ~~((U.S.))~~ NRC or agreement state requirements. The preceptor authorized user, who meets the requirements in this subsection (2), must also have experience in administering dosages in the same dosage category or categories (i.e., this section) as the individual requesting authorized user status.

AMENDATORY SECTION (Amending WSR 11-03-068, filed 1/18/11, effective 2/18/11)

WAC 246-240-213 Training for the oral administration of sodium iodide I-131 requiring a written directive in quantities less than or equal to 1.22 gigabecquerels (33 millicuries). Except as provided in WAC 246-240-078, the licensee shall require an authorized user for the oral administration of sodium iodide I-131 requiring a written directive in quantities less than or equal to

1.22 gigabecquerels (33 millicuries), to be a physician who:

(1) Is certified by a medical specialty board whose certification process includes all of the requirements in subsection (3) of this section and whose certification has been recognized by the department, (~~((the U.S. Nuclear Regulatory Commission))~~) NRC or an agreement state. (Specialty boards whose certification process has been recognized by (~~((the commission))~~) NRC or an agreement state will be posted on (~~((the))~~) NRC's web page at (~~((http://www.nrc.gov.))~~) http://www.nrc.gov/materials/miau/med-use-toolkit/spec-board-cert.html.); or

(2) Is an authorized user under WAC 246-240-210 for uses listed in WAC 246-240-210 (2)(b)(vii)(A) and (B), 246-240-216, or equivalent agreement state or (~~((U.S.))~~) NRC requirements; or

(3)(a) Has successfully completed eighty hours of classroom and laboratory training, applicable to the medical use of sodium iodide I-131 for procedures requiring a written directive. The training must include:

(i) Radiation physics and instrumentation;

(ii) Radiation protection;

(iii) Mathematics pertaining to the use and measurement of radioactivity;

(iv) Chemistry of radioactive material for medical use; and

(v) Radiation biology; and

(b) Has work experience, under the supervision of an authorized user who meets the requirements in WAC 246-240-078, 246-240-210, 246-240-213, 246-240-216, or equivalent agreement state or (~~((U.S.))~~) NRC requirements. A supervising authorized user who meets the requirements in WAC 246-240-210(2), must also have experience in administering dosages as specified in WAC 246-240-210 (2)(b)(vii)(A) or (B). The work experience must involve:

(i) Ordering, receiving, and unpacking radioactive materials safely and performing the related radiation surveys;

(ii) Performing quality control procedures on instruments used to determine the activity of dosages and performing checks for proper operation of survey meters;

(iii) Calculating, measuring, and safely preparing patient or human research subject dosages;

(iv) Using administrative controls to prevent a medical event involving the use of radioactive material;

(v) Using procedures to contain spilled radioactive material safely and using proper decontamination procedures; and

(vi) Administering dosages to patients or human research subjects, that includes at least three cases involving the oral administration of less than or equal to 1.22 gigabecquerels (33 millicuries) of sodium iodide I-131; and

(c) Has obtained written (~~((certification under oath))~~) attestation that the individual has satisfactorily completed the requirements in (a) and (b) of this subsection and has achieved a level of competency sufficient to function independently as an authorized user for medical uses authorized under WAC 246-240-201. The written (~~((certification under oath))~~) attestation must be signed by a preceptor authorized user who meets the requirements in WAC 246-240-078, 246-240-210, 246-240-213, 246-240-216, or equivalent

agreement state or ((~~U.S.~~)) NRC requirements. A preceptor authorized user, who meets the requirement in WAC 246-240-210(2), must also have experience in administering dosages as specified in WAC 246-240-210 (2)(b)(vii)(A) or (B).

AMENDATORY SECTION (Amending WSR 11-03-068, filed 1/18/11, effective 2/18/11)

WAC 246-240-216 Training for the oral administration of sodium iodide I-131 requiring a written directive in quantities greater than 1.22 gigabecquerels (33 millicuries). Except as provided in WAC 246-240-078, the licensee shall require an authorized user for the oral administration of sodium iodide I-131 requiring a written directive in quantities greater than 1.22 gigabecquerels (33 millicuries), to be a physician who:

(1) Is certified by a medical specialty board whose certification process includes all of the requirements in subsection (3) of this section and whose certification has been recognized by the department, ((~~the U.S.~~)) NRC or an agreement state. (Specialty boards whose certification process has been recognized by ((~~the commission~~)) NRC or an agreement state will be posted on ((~~the~~)) NRC's web page at ((~~http://www.nrc.gov~~)) http://www.nrc.gov/materials/miau/med-use-toolkit/spec-board-cert.html); or

(2) Is an authorized user under WAC 246-240-210 for uses listed in WAC 246-240-210 (2)(b)(vii)(B), or equivalent agreement state or ((~~U.S.~~)) NRC requirements; or

(3)(a) Has successfully completed eighty hours of classroom and laboratory training, applicable to the medical use of sodium iodide I-131 for procedures requiring a written directive. The training must include:

(i) Radiation physics and instrumentation;
(ii) Radiation protection;
(iii) Mathematics pertaining to the use and measurement of radioactivity;

(iv) Chemistry of radioactive material for medical use; and
(v) Radiation biology; and

(b) Has work experience, under the supervision of an authorized user who meets the requirements in WAC 246-240-078, 246-240-210, 246-240-216, or equivalent agreement state or ((~~U.S.~~)) NRC requirements. A supervising authorized user, who meets the requirements in WAC 246-240-210(2), must also have experience in administering dosages as specified in WAC 246-240-210 (2)(b)(vii)(B).

The work experience must involve:

(i) Ordering, receiving, and unpacking radioactive materials safely and performing the related radiation surveys;

(ii) Performing quality control procedures on instruments used

to determine the activity of dosages and performing checks for proper operation of survey meters;

(iii) Calculating, measuring, and safely preparing patient or human research subject dosages;

(iv) Using administrative controls to prevent a medical event involving the use of radioactive material;

(v) Using procedures to contain spilled radioactive material safely and using proper decontamination procedures; and

(vi) Administering dosages to patients or human research subjects, that includes at least three cases involving the oral administration of greater than 1.22 gigabecquerels (33 millicuries) of sodium iodide I-131; and

(c) Has obtained written (~~((certification under oath))~~) attestation that the individual has satisfactorily completed the requirements in (a) and (b) of this subsection and has achieved a level of competency sufficient to function independently as an authorized user for medical uses authorized under WAC 246-240-201. The written (~~((certification under oath))~~) attestation must be signed by a preceptor authorized user who meets the requirements in WAC 246-240-078, 246-240-210, 246-240-216, or equivalent agreement state or (~~((U.S.))~~) NRC requirements. A preceptor authorized user, who meets the requirements in WAC 246-240-210(2), must have experience in administering dosages as specified in WAC 246-240-210 (2) (b) (vii) (B).

AMENDATORY SECTION (Amending WSR 11-03-068, filed 1/18/11, effective 2/18/11)

WAC 246-240-219 Training for the parenteral administration of unsealed radioactive material requiring a written directive. Except as provided in WAC 246-240-078, the licensee shall require an authorized user for the parenteral administration requiring a written directive, to be a physician who:

(1) Is an authorized user under WAC 246-240-210 for uses listed in WAC 246-240-210 (2) (b) (vii) (C) or (D), or equivalent agreement state or (~~((U.S.))~~) NRC requirements; or

(2) Is an authorized user under WAC 246-240-278 or 246-240-399, or equivalent agreement state or (~~((U.S.))~~) NRC requirements and who meets the requirements in subsection (4) of this section; or

(3) Is certified by a medical specialty board whose certification process has been recognized by the (~~((U.S.))~~) NRC or an agreement state under WAC 246-240-278 or 246-240-399, and who meets the requirements in subsection (4) of this section.

(4) (a) Has successfully completed eighty hours of classroom and laboratory training, applicable to parenteral administrations, for which a written directive is required, of any beta emitter or any photon-emitting radionuclide with a photon energy less than 150 keV, (~~((and/))~~) or parenteral administration of any other radionuclide

for which a written directive is required. The training must include:

- (i) Radiation physics and instrumentation;
- (ii) Radiation protection;
- (iii) Mathematics pertaining to the use and measurement of radioactivity;

- (iv) Chemistry of radioactive material for medical use; and
- (v) Radiation biology; and

(b) Has work experience, under the supervision of an authorized user who meets the requirements in WAC 246-240-078, 246-240-210, 246-240-219, or equivalent agreement state or ((U.S.)) NRC requirements, in the parenteral administration, for which a written directive is required, of any beta emitter or any photon-emitting radionuclide with a photon energy less than 150 keV, ((and/)) or parenteral administration of any other radionuclide for which a written directive is required. A supervising authorized user who meets the requirements in WAC 246-240-210 must have experience in administering dosages as specified in WAC 246-240-210 (2)(b)(vii)(C) ((and/)) or (D). The work experience must involve:

- (i) Ordering, receiving, and unpacking radioactive materials safely, and performing the related radiation surveys;

- (ii) Performing quality control procedures on instruments used to determine the activity of dosages, and performing checks for proper operation of survey meters;

- (iii) Calculating, measuring, and safely preparing patient or human research subject dosages;

- (iv) Using administrative controls to prevent a medical event involving the use of unsealed radioactive material;

- (v) Using procedures to contain spilled radioactive material safely, and using proper decontamination procedures; and

- (vi) Administering dosages to patients or human research subjects, that include at least three cases involving the parenteral administration, for which a written directive is required, of any beta emitter, or any photon-emitting radionuclide with a photon energy less than 150 keV ((and/)) or at least three cases involving the parenteral administration of any other radionuclide, for which a written directive is required; and

(5) Has obtained written ((~~certification under oath~~)) attestation that the individual has satisfactorily completed the requirements in subsection (2) or (3) of this section, and has achieved a level of competency sufficient to function independently as an authorized user for the parenteral administration of unsealed radioactive material requiring a written directive. The written ((~~certification under oath~~)) attestation must be signed by a preceptor authorized user who meets the requirements in WAC 246-240-078, 246-240-210, 246-240-219, or equivalent agreement state or ((U.S.)) NRC requirements. A preceptor authorized user, who meets the requirements in WAC 246-240-210, must have experience in administering dosages as specified in WAC 246-240-210 (2)(b)(vii)(C) ((and/)) or (D).

WAC 246-240-278 Training for use of manual brachytherapy sources. Except as provided in WAC 246-240-078, the licensee shall require an authorized user of a manual brachytherapy source for the uses authorized under WAC 246-240-251 to be a physician who:

(1) Is certified by a medical specialty board whose certification process has been recognized by the department, ~~((the U.S.))~~ NRC, or an agreement state. (Specialty boards whose certification process has been recognized by ~~((the commission))~~ NRC or an agreement state will be posted on ~~((the))~~ NRC's web page at ~~((http://www.nrc.gov.))~~ <http://www.nrc.gov/materials/miau/med-use-toolkit/spec-board-cert.html>.) To be recognized, a specialty board shall require all candidates for certification to:

(a) Successfully complete a minimum of three years of residency training in a radiation oncology program approved by the Residency Review Committee of the Accreditation Council for Graduate Medical Education or Royal College of Physicians and Surgeons of Canada or the Committee on Postgraduate Training of the American Osteopathic Association;

(b) Pass an examination, administered by diplomates of the specialty board, which tests knowledge and competence in radiation safety, radionuclide handling, treatment planning, quality assurance, and clinical use of high and low dose-rate brachytherapy; and

(c) Obtain written ~~((certification under oath))~~ attestation, signed by a preceptor authorized user who meets the requirements in WAC 246-240-278 or equivalent ~~((U.S.))~~ NRC or agreement state requirements, that the individual has achieved a level of competency sufficient to function independently as an authorized user of manual brachytherapy sources for the medical uses authorized in WAC 246-240-251; or

(2)(a) Has completed a structured educational program in basic radionuclide handling techniques applicable to the use of manual brachytherapy sources that includes:

(i) Two hundred hours of classroom and laboratory training in the following areas:

(A) Radiation physics and instrumentation;

(B) Radiation protection;

(C) Mathematics pertaining to the use and measurement of radioactivity; and

(D) Radiation biology; and

(ii) Five hundred hours of work experience, under the supervision of an authorized user who meets the requirements in WAC 246-240-078, 246-240-278 or equivalent agreement state or ~~((U.S.))~~ NRC requirements at a medical institution, involving:

(A) Ordering, receiving, and unpacking radioactive materials safely and performing the related radiation surveys;

(B) Checking survey meters for proper operation;

(C) Preparing, implanting, and removing brachytherapy sources;

(D) Maintaining running inventories of material on hand;

(E) Using administrative controls to prevent a medical event involving the use of radioactive material;

(F) Using emergency procedures to control radioactive material; and

(b) Has completed three years of supervised clinical experience in radiation oncology, under an authorized user who meets the requirements in WAC 246-240-078, 246-240-278 or equivalent (~~((U.S.))~~) NRC or agreement state requirements, as part of a formal training program approved by the Residency Review Committee for Radiation Oncology of the Accreditation Council for Graduate Medical Education or the Royal College of Physicians and Surgeons of Canada or the Committee on Postdoctoral Training of the American Osteopathic Association. This experience may be obtained concurrently with the supervised work experience required by (a)(ii) of this subsection; and

(c) Has obtained written (~~((certification under oath))~~) attestation, signed by a preceptor authorized user who meets the requirements in WAC 246-240-078, 246-240-278 or equivalent agreement state or (~~((U.S.))~~) NRC requirements, that the individual has satisfactorily completed the requirements in subsection (1)(a) of this section, or (a) and (b) of this subsection and has achieved a level of competency sufficient to function independently as an authorized user of manual brachytherapy sources for the medical uses authorized under WAC 246-240-251.

AMENDATORY SECTION (Amending WSR 11-03-068, filed 1/18/11, effective 2/18/11)

WAC 246-240-281 Training for ophthalmic use of strontium-90.

Except as provided in WAC 246-240-078, the licensee shall require the authorized user of strontium-90 for ophthalmic radiotherapy to be a physician who:

(1) Is an authorized user under WAC 246-240-278 or equivalent agreement state or (~~((U.S.))~~) NRC requirements; or

(2)(a) Has completed twenty-four hours of classroom and laboratory training applicable to the medical use of strontium-90 for ophthalmic radiotherapy. The training must include:

(i) Radiation physics and instrumentation;

(ii) Radiation protection;

(iii) Mathematics pertaining to the use and measurement of radioactivity; and

(iv) Radiation biology; and

(b) Supervised clinical training in ophthalmic radiotherapy under the supervision of an authorized user at a medical institution that includes the use of strontium-90 for the ophthalmic treatment of five individuals.

This supervised clinical training must involve:

(i) Examination of each individual to be treated;

(ii) Calculation of the dose to be administered;

(iii) Administration of the dose; and
(iv) Follow up and review of each individual's case history;
and

(c) Has obtained written (~~(certification under oath)~~) attestation, signed by a preceptor authorized user who meets the requirements in WAC 246-240-078, 246-240-278, 246-240-281, or equivalent agreement state or (~~(U.S.)~~) NRC requirements, that the individual has satisfactorily completed the requirements in subsections (1) and (2) of this section and has achieved a level of competency sufficient to function independently as an authorized user of strontium-90 for ophthalmic use.

AMENDATORY SECTION (Amending WSR 06-05-019, filed 2/6/06, effective 3/9/06)

WAC 246-240-304 Training for use of sealed sources for diagnosis. Except as provided in WAC 246-240-078, the licensee shall require the authorized user of a diagnostic sealed source for use in a device authorized under WAC 246-240-301 to be a physician, dentist, or podiatrist who:

(1) Is certified by a specialty board whose certification process includes all of the requirements in subsections (2) and (3) of this section and whose certification has been recognized by the department, (~~(the U.S.)~~) NRC, or an agreement state. (Specialty boards whose certification process has been recognized by (~~(the commission)~~) NRC or an agreement state will be posted on (~~(the)~~) NRC's web page at (~~(http://www.nrc.gov.)~~) http://www.nrc.gov/materials/miau/med-use-toolkit/spec-board-cert.html.); or

(2) Has completed eight hours of classroom and laboratory training in basic radionuclide handling techniques specifically applicable to the use of the device. The training must include:

(a) Radiation physics and instrumentation;

(b) Radiation protection;

(c) Mathematics pertaining to the use and measurement of radioactivity;

(d) Radiation biology; and

(3) Has completed training in the use of the device for the uses requested.

AMENDATORY SECTION (Amending WSR 06-05-019, filed 2/6/06, effective 3/9/06)

WAC 246-240-357 Installation, maintenance, adjustment, and repair. (1) Only a person specifically licensed by the department, (~~(the U.S.)~~) NRC, or an agreement state shall install, maintain, adjust, or repair a remote afterloader unit, teletherapy unit, or gamma stereotactic radiosurgery unit that involves work on the source(s) shielding, the source(s) driving unit, or other electronic or mechanical component that could expose the source(s), reduce the shielding around the source(s), or compromise the radiation safety of the unit or the source(s).

(2) Except for low dose-rate remote afterloader units, only a person specifically licensed by the department, (~~(the U.S.)~~) NRC, or an agreement state shall install, replace, relocate, or remove a sealed source or source contained in other remote afterloader units, teletherapy units, or gamma stereotactic radiosurgery units.

(3) For a low dose-rate remote afterloader unit, only a person specifically licensed by the department, (~~(the U.S.)~~) NRC, or an agreement state or an authorized medical physicist shall install, replace, relocate, or remove a sealed source(s) contained in the unit.

(4) A licensee shall retain a record of the installation, maintenance, adjustment, and repair of remote afterloader units, teletherapy units, and gamma stereotactic radiosurgery units in accordance with WAC 246-240-605.

AMENDATORY SECTION (Amending WSR 06-05-019, filed 2/6/06, effective 3/9/06)

WAC 246-240-393 Five-year inspection for teletherapy and gamma stereotactic radiosurgery units. (1) A licensee shall have each teletherapy unit and gamma stereotactic radiosurgery unit fully inspected and serviced during source replacement or at intervals not to exceed five years, whichever comes first, to assure proper functioning of the source exposure mechanism.

(2) This inspection and servicing may only be performed by persons specifically licensed to do so by the department, (~~(the U.S.)~~) NRC or an agreement state.

(3) A licensee shall keep a record of the inspection and servicing in accordance with WAC 246-240-632.

WAC 246-240-399 Training for use of remote afterloader units, teletherapy units, and gamma stereotactic radiosurgery units. Except as provided in WAC 246-240-078, the licensee shall require an authorized user of a sealed source for a use authorized under WAC 246-240-351 to be a physician who:

(1) Is certified by a medical specialty board whose certification process has been recognized by the department, ~~((the U.S.))~~ NRC, or an agreement state. (Specialty boards whose certification process has been recognized by ~~((the))~~ NRC or an agreement state will be posted on ~~((the))~~ NRC's web page at ~~((http://www.nrc.gov.))~~ <http://www.nrc.gov/materials/miau/med-use-toolkit/spec-board-cert.html>.) To be recognized, a specialty board shall require all candidates for certification to:

(a) Successfully complete a minimum of three years of residency training in a radiation therapy program approved by the Residency Review Committee of the Accreditation Council for Graduate Medical Education or Royal College of Physicians and Surgeons of Canada or the Committee on Postgraduate Training of the American Osteopathic Association; and

(b) Pass an examination, administered by diplomates of the specialty board, which tests knowledge and competence in radiation safety, radionuclide handling, treatment planning, quality assurance, and clinical use of stereotactic radiosurgery, high and low dose-rate brachytherapy, and external beam therapy; or

(2)(a) Has completed a structured educational program in basic radionuclide techniques applicable to the use of a sealed source in a therapeutic medical unit that includes:

(i) Two hundred hours of classroom and laboratory training in the following areas:

(A) Radiation physics and instrumentation;

(B) Radiation protection;

(C) Mathematics pertaining to the use and measurement of radioactivity; and

(D) Radiation biology; and

(ii) Five hundred hours of work experience, under the supervision of an authorized user who meets the requirements in WAC 246-240-078, 246-240-399 or equivalent agreement state or ~~((U.S.))~~ NRC requirements at a medical institution, involving:

(A) Reviewing full calibration measurements and periodic spot-checks;

(B) Preparing treatment plans and calculating treatment doses and times;

(C) Using administrative controls to prevent a medical event involving the use of radioactive material;

(D) Implementing emergency procedures to be followed in the event of the abnormal operation of the medical unit or console;

(E) Checking and using survey meters; and

(F) Selecting the proper dose and how it is to be administered; and

(b) Has completed three years of supervised clinical experience in radiation therapy, under an authorized user who meets the requirements in WAC 246-240-078, 246-240-399 or equivalent ((U.S.)) NRC or agreement state requirements, as part of a formal training program approved by the Residency Review Committee for Radiation Oncology of the Accreditation Council for Graduate Medical Education or Royal College of Physicians and Surgeons of Canada or the Committee on Postdoctoral Training of the American Osteopathic Association. This experience may be obtained concurrently with the supervised work experience required by (a)(ii) of this subsection; and

(c) Has obtained written ((~~certification under oath~~)) attestation that the individual has satisfactorily completed the requirements in subsection (1)(a) of this section, or (a) and (b), and (d) of this subsection and has achieved a level of competency sufficient to function independently as an authorized user of each type of therapeutic medical unit for which the individual is requesting authorized user status. The written ((~~certification under oath~~)) attestation must be signed by a preceptor authorized user who meets the requirements in WAC 246-240-078, 246-240-399 or equivalent ((U.S.)) NRC or agreement state requirements for an authorized user for each type of therapeutic medical unit for which the individual is requesting authorized user status; and

(d) Has received training in device operation, safety procedures, and clinical use for the type(s) of use for which authorization is sought. This training requirement may be satisfied by satisfactory completion of a training program provided by the vendor for new users or by receiving training supervised by an authorized user or authorized medical physicist, as appropriate, who is authorized for the type(s) of use for which the individual is seeking authorization.

AMENDATORY SECTION (Amending WSR 09-06-003, filed 2/18/09, effective 3/21/09)

WAC 246-240-587 Records of molybdenum-99, strontium-82, and strontium-85 concentrations. A licensee shall maintain a record of the molybdenum-99, strontium-82, ((and/)) or strontium-85 concentration tests required by WAC 246-240-160(2) for three years.

(1) The record must include, for each measured elution of technetium-99m, the ratio of the measures expressed as kilobecquerels of molybdenum-99 per megabecquerel of technetium-99m (or microcuries of molybdenum per millicurie of technetium), the time and date of the measurement, and the name of the individual who made the measurement.

(2) For each measured elution of rubidium-82, the ratio of the measures expressed as kilobecquerels of strontium-82 per megabecquerel of rubidium-82 (or microcuries of strontium-82 per

millicurie of rubidium), ~~((and/))~~ or kilobecquerels of strontium-85 per megabecquerel of rubidium-82 (or microcuries of strontium-85 per millicurie of rubidium), the time and date of the measurement, and the name of the individual who made the measurement.

WAC 246-240-210 Training for use of unsealed radioactive material for which a written directive is required. Except as provided in WAC 246-240-078, the licensee shall require an authorized user of unsealed radioactive material for the uses authorized under WAC 246-240-201 to be a physician who:

(1) Is certified by a medical specialty board whose certification process has been recognized by the department, NRC or an agreement state. (Specialty boards whose certification process has been recognized by NRC or an agreement state will be posted on NRC's web page at <http://www.nrc.gov/materials/miau/med-use-toolkit/spec-board-cert.html>.) To be recognized, a specialty board shall require all candidates for certification to:

(a) Successfully complete a residency training in a radiation therapy or nuclear medicine training program or a program in a related medical specialty that includes seven hundred hours of training and experience as described in subsection (2) of this section. Eligible training programs must be approved by the Residency Review Committee of the Accreditation Council for Graduate Medical Education or Royal College of Physicians and Surgeons of Canada or the Committee on Post-graduate Training of the American Osteopathic Association; and

(b) Pass an examination, administered by diplomates of the specialty board, which tests knowledge and competence in radiation safety, radionuclide handling, quality assurance, and clinical use of unsealed by-product material(~~(; and~~

~~(c) Obtain written attestation that the individual has achieved a level of competency sufficient to function independently as an authorized user for the medical uses authorized under WAC 246-240-201. The written attestation must be signed by a preceptor authorized user who meets the requirements in WAC 246-240-078, 246-240-210, or equivalent NRC or agreement state requirements. The preceptor authorized user, who meets the requirements in WAC 246-240-078 or 246-240-210 must have experience in administering dosages in the same dosage category or categories (i.e., this section) as the individual requesting authorized user status)); or~~

(2) Has completed seven hundred hours of training and experience, including a minimum of two hundred hours of classroom and laboratory training, in basic radionuclide handling techniques applicable to the medical use of unsealed radioactive material requiring a written directive. The training and experience must include:

(a) Classroom and laboratory training in the following areas:

(i) Radiation physics and instrumentation;

(ii) Radiation protection;

(iii) Mathematics pertaining to the use and measurement of radioactivity;

(iv) Chemistry of radioactive material for medical use; and

(v) Radiation biology; and

(b) Work experience, under the supervision of an authorized user who meets the requirements in WAC 246-240-078, or subsection (1) or (2) of this section, or equivalent NRC or agreement state requirements. A supervising authorized user, who meets the requirements in this subsection, must also have experience in administering dosages in the same dosage category or categories (i.e., this section) as the in-

dividual requesting authorized user status. The work experience must involve:

(i) Ordering, receiving, and unpacking radioactive materials safely and performing the related radiation surveys;

(ii) Performing quality control procedures on instruments used to determine the activity of dosages and performing checks for proper operation of survey meters;

(iii) Calculating, measuring, and safely preparing patient or human research subject dosages;

(iv) Using administrative controls to prevent a medical event involving the use of unsealed radioactive material;

(v) Using procedures to contain spilled radioactive material safely and using proper decontamination procedures; and

~~(vi) ((Eluting generator systems, measuring and testing the eluate for radionuclidic purity, and processing the eluate with reagent kits to prepare labeled radioactive drugs; and~~

~~(vii))~~ Administering dosages of radioactive drugs to patients or human research subjects involving a minimum of three cases in each of the following categories for which the individual is requesting authorized user status:

(A) Oral administration of less than or equal to 1.22 gigabecquerels (33 millicuries) of sodium iodide I-131 for which a written directive is required;

(B) Oral administration of greater than 1.22 gigabecquerels (33 millicuries) of sodium iodide I-131. Experience with at least three cases in this also satisfies the requirement in (b)((~~vii~~)) (vi)(A) of this subsection;

(C) Parenteral administration of any beta emitter, or a photon-emitting radionuclide with a photon energy less than 150 keV for which a written directive is required; or

(D) Parenteral administration of any other radionuclide for which a written directive is required; and

(E) Has obtained written attestation that the individual has satisfactorily completed the requirements in subsection (1)(a) and (2)(b)((~~vii~~)) (vi) of this section, ((~~WAC 246-240-078,~~)) and has achieved a level of competency sufficient to function independently as an authorized user for the medical uses authorized under WAC 246-240-201. The written attestation must be signed by a preceptor authorized user who meets the requirements in this section, WAC 246-240-078, or equivalent NRC or agreement state requirements. The preceptor authorized user, who meets the requirements in this subsection ((~~2~~)), must also have experience in administering dosages in the same dosage category or categories (i.e., this section) as the individual requesting authorized user status.