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OCT 16 2007

Scott W. Moore, Deputy Director
Division Materials Safety and State Agreements
Office of Federal and State Materials and
Environmental Management Programs
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Dear Mr. Moore:

Enclosed is a copy of the proposed revisions to the Maryland Radiological Health Program Rules (COMAR 26.12.01.01 "Regulations for the Control of Ionizing Radiation). Maryland is requesting NRC review of these proposed revisions. The proposed regulations are identified by line-in/line out text and correspond to the following equivalent amendment(s) to NRC's regulations. (RATS ID):

2004-1	Compatibility with IAEA Transportation Safety Standards and Other Transportation Amendments – Part 71

We believe that the adoption of these revisions satisfies the compatibility and health and safety categories established in STP Procedure SA-200. Current Maryland Radiation regulations can be found on-line at http://www.mde.state.md.us/Programs/AirPrograms/Radiological_Health/Regulations/index.asp . If you have any questions, please feel free to contact Ray Manley of my staff at (410) 537-3300 or at e-mail address rmanley@mde.state.md.us .

Sincerely,

Roland G. Fletcher, Manager
Radiological Health Program
Air and Radiation Management
Administration

RGF/rem

Enclosures: Proposed Revisions

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

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

"License" means a license to possess or use radioactive material, including a license amendment, issued by the Agency.

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

"Licensee" means any person who is licensed by the Agency in accordance with these regulations.

"Licensing State" means any State with regulations equivalent to the Suggested State Regulations for Control of Radiation relating to, and an effective program for, the regulatory control of NARM and which has been granted final designation by the Conference of Radiation Control Program Directors, Inc.

"Limits" [See "Dose Limits"]

"Lost or missing licensed material" means licensed material whose location is unknown. This definition includes licensed material that has been shipped but has not reached its planned destination and whose location cannot be readily traced in the transportation system.

"Major processor" means a user processing, handling, or manufacturing radioactive material exceeding Type A quantities as unsealed sources or material, or exceeding 4 times Type B quantities as sealed sources, but does not include nuclear medicine programs, universities, industrial radiographers, or small industrial programs. Type A and B quantities are defined in Section 71.4 of 10 CFR Part 71.

“Medical use” means the intentional internal or external administration of radioactive material, or the radiation therefrom, to patients or human research subjects in the practice of the healing arts.

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

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

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

"NARM" means any naturally occurring or accelerator-produced radioactive material. It does not include byproduct, source, or special nuclear material.

"Natural radioactivity" means radioactivity of naturally occurring nuclides.

"Normal form radioactive material" means radioactive material that has not been demonstrated to qualify as "special form radioactive material."

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

"Occupational dose" means the dose received by an individual in the course of employment in which the individual's assigned duties involved exposure to sources of radiation, whether in the possession of the licensee, registrant, or other person. This includes exposure to radiation from registered and unregistered radiation machines or exposure to radioactive material from licensed and unlicensed sources of radiation. Occupational dose does not include dose received from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released in accordance with Sec. G.75, from voluntary participation in medical research programs, or as a member of the public.

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

"Particle accelerator" means any machine capable of accelerating electrons, protons, deuterons, or other charged particles in a vacuum and of discharging the resultant particulate or other radiation into a medium at energies usually in excess of 1 MeV.

"Person" means an individual, receiver, trustee, guardian, personal representative, fiduciary, or representative of any kind and any partnership, firm, association, corporation, or other entity. "Person" includes any public or municipal corporation and any agency, bureau, department, or instrumentality of state or local government and, to the extent authorized by federal law, federal government.

"Personnel monitoring equipment" [See "Individual monitoring devices"]

"Pharmacist" 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 pharmacy.

"Physician" means an individual who is authorized under the Maryland Medical Practice Act to practice medicine in this State.

"Prescribed dose" means:

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

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

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

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

"Source material milling" means any activity that results in the production of byproduct material as defined by definition (2) of byproduct material.

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

"Special form radioactive material" means radioactive material ~~which~~that satisfies the following conditions:

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

(2) ___The piece or capsule has at least one dimension not less than 5 ~~millimeters~~m (0.~~197~~2 in~~ch~~); and

(3) ___It satisfies the ~~test~~ requirements ~~specified by the U.S. Nuclear Regulatory Commission~~ of 10 CFR 71.75. A special form encapsulation designed in accordance with the ~~U.S. Nuclear Regulatory Commission~~ requirements of 10 CFR 71.4 in effect on June 30, 1983 (see 10 CFR Part 71, revised as of January 1, 1983), and constructed ~~prior to~~ before July 1, 1985, and a special form encapsulation designed in accordance with the requirements of 10 CFR 71.4 in effect on March 31, 1996 (see 10 CFR Part 71, revised as of January 1, 1983), and constructed before April 1, 1998, may continue to be used. Any other~~A~~ special form encapsulation ~~either designed or constructed after June 30, 1985,~~ must meet the ~~requirements~~ specifications of this definition ~~applicable at the time of its design or construction~~.

"Special nuclear material" means:

(1) Plutonium, uranium-233, uranium enriched in the isotope 233 or in the isotope 235, and any other material that the U.S. Nuclear Regulatory Commission, pursuant to the provisions of section 51 of the Atomic Energy Act of 1954, as amended, determines to be special nuclear material, but does not include source material; or,

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

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

$$\frac{175(\text{grams contained U-235})}{350} + \frac{50(\text{grams U-233})}{200} + \frac{50(\text{grams Pu})}{200} = 1$$

"Survey" means an evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of sources of radiation. When appropriate, such evaluation includes, but is not limited to, tests, physical examinations, and measurements of levels of radiation or concentrations of radioactive material present.

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

"Temporary jobsite" means any location where a portable source of radiation is used or stored, other than a location listed in a specific license or registration, for a period of no longer than 365 continuous days.

"Test" means the process of verifying compliance with an applicable regulation.

"These regulations" mean all parts of COMAR 26.12 "Radiation Management".

"Total effective dose equivalent" [See "Dose"]

"Total organ dose equivalent" [See "Dose"]

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

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

"Unrestricted area" means any area, access to which is not limited by the licensee or registrant.

"Very high radiation area" means an area, accessible to individuals, in which radiation levels could result in an individual receiving an absorbed dose in excess of 5 Gy (500 rad) in 1 hour at 1 meter from a source of radiation or from any surface that the radiation penetrates.[3]

"Waste" means a radioactive material, or substance contaminated with radioactive material, that is useless and has no demonstrated economic value. In addition, the definition of waste shall include those radioactive wastes controlled under the low level Radioactive Waste Policy Act, P.L. 96-573 as amended by P.L. 99-240, effective January 15, 1986; that is, radioactive waste (a) not classified as low-level radioactive waste, spent nuclear fuel, or

[3] At very high doses received at high dose rates, units of absorbed dose, gray and rad, are appropriate, rather than units of dose equivalent, sievert and rem.

d. Containers when they are in transport and packaged and labeled in accordance with the regulations of the U.S. Department of Transportation[1]; or

e. Containers that are accessible only to individuals authorized to handle or use them, or to work in the vicinity of the containers, if the contents are identified to those individuals by a readily available written record. Examples of containers of this type are containers in locations such as water-filled canals, storage vaults, or hot cells. The record shall be retained as long as the containers are in use for the purpose indicated on the record; or

f. Installed manufacturing or process equipment, such as chemical process equipment, piping and tanks.

Sec. D.906 Procedures for Receiving and Opening Packages.

a. Each licensee who expects to receive a package containing quantities of radioactive material in excess of a Type A quantity, as defined in T.2 and Appendix A of Part T of these regulations, shall make arrangements to receive:

   i. The package when the carrier offers it for delivery; or

   ii. The notification of the arrival of the package at the carrier's terminal and to take possession of the package expeditiously.

b. Each licensee shall:

   i. Monitor the external surfaces of a labeled[2] package for radioactive contamination unless the package contains only radioactive material in the form of gas or in special form as defined in A.2 of these regulations; and

   ii. Monitor the external surfaces of a labeled[3] package for radiation levels unless the package contains quantities of radioactive material that are less than or equal to the Type A quantity, as defined in T.2 and Appendix A to Part T of these regulations.

[2] Labeling of packages containing radioactive materials is required by the U.S. Department of Transportation if the amount and type of radioactive material exceeds the limits for an expected quantity or article as defined and limited by the U.S. Dept. of Transportation regulations 49 CFR 173.403 (m) and (w) and 173.421-424.

[3] Labeled with a Radioactive White I, Yellow II, or Yellow III label as specified in U.S. Department of Transportation regulations, 49 CFR 172.403 and 172.436-440.

iii. Monitor all packages known to contain radioactive material for radioactive contamination and radiation levels if there is evidence of package degradation, such as packages that are crushed, wet, or damaged.

c. The licensee shall perform the monitoring required by D.906b. as soon as practicable after receipt of the package, but not later than 3 hours after the package is received at the licensee's facility if it is received during the licensee's normal working hours, or not later than 3 hours from the beginning of the next working day if it is received after working hours.

d. The licensee shall immediately notify the final delivery carrier and the Agency by telephone and telegram, mailgram, or facsimile, when:

i. Removable radioactive surface contamination exceeds the limits of T.~~1587h.~~(i) of these regulations; or

ii. External radiation levels and surface temperatures exceed the limits of T.~~15i. and j.~~87(j) and (k) of these regulations.

e. Each licensee shall:

i. Establish, maintain, and retain written procedures for safely opening packages in which radioactive material is received; and

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

f. Licensees transferring special form sources in vehicles owned or operated by the licensee to and from a work site are exempt from the contamination monitoring requirements of D.906b., but are not exempt from the monitoring requirement in D.906b. for measuring radiation levels that ensures that the source is still properly lodged in its shield.

PART T

PACKAGING AND TRANSPORTATION OF RADIOACTIVE MATERIAL

GENERAL PROVISIONS

Sec. T.1 Purpose and Scope. The regulations in this ~~p~~Part establish requirements for packaging, preparation for shipment, and transportation of radioactive material and apply to any licensee authorized by specific or general license issued by the Agency to receive, possess, use or transfer radioactive material, if the licensee delivers that material to a carrier for transport, transports the material outside the site of usage as specified in the Agency license, or transports that material on public highways~~person who transports radioactive material or delivers radioactive material to a carrier for transport.~~. No provision of this Part authorizes possession of licensed material.

Sec. T.~~2~~3 Requirement for License. Except as authorized in a general license or a specific license issued by the ~~Department~~Agency, or as exempted in this Part, no licensee may –

(a) Deliver licensed material to a carrier for transport; or

(b) Transport licensed material.

Sec. T.~~4~~3 Definitions. To ensure compatibility with international transportation standards, all limits in this P~~p~~art 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 P~~p~~art, either unit may be used. As used in this P~~p~~art, the following definitions apply:

"A_1" means the maximum activity of special form radioactive material permitted in a Type A package. "A_2" means the maximum activity of radioactive material, other than special form, LSA and SCO material, permitted in a Type A package. These values are either listed in Appendix A of this P~~p~~art, Table A-1, or may be derived in accordance with the procedures prescribed in Appendix A of this P~~p~~art.

"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.

"Certificate holder" means a person who has been issued a certificate of compliance or other package approval by the U.S. Nuclear Regulatory Commission.

"Certificate of Compliance (CoC)" means the certificate issued by the NRC which approves the design of a package for the transportation of radioactive material.

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

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

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

"Conveyance" means:

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

(2) "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

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(3) "For transport by aircraft" any aircraft.

"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 T.22, T.23, and 10 CFR 71.59.

"Deuterium" means, for the purposes of T.15 and T.22, deuterium and any deuterium compounds, including heavy water, in which the ratio of deuterium atoms to hydrogen atoms exceeds 1:5000.

"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.

"Fissile material" means the radionuclides ~~plutonium-238,~~ plutonium-239, plutonium-241, uranium-233, uranium-235, 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 ~~10 CFR 71.53~~T.15.

"Graphite" means, for the purposes of T.15 and T.22, graphite with a boron equivalent content less than 5 parts per million and density greater than 1.5 grams per cubic centimeter.

~~"Licensed material" means byproduct, source, or special nuclear material received, possessed, used, or transferred, or disposed of under a general or specific license issued by the Department pursuant to the regulations in this chapter~~COMAR 26.12.01.01~~.~~

"Low Specific Activity (LSA) material" means radioactive material with limited specific activity which is nonfissile or is excepted under T.15, and ~~that~~which satisfies the descriptions and limits set forth below. Shielding materials surrounding the LSA material may not be considered in determining the estimated average specific activity of the package contents. LSA material must be in one of three groups:

(1) LSA-I.

(i) Uranium and thorium o~~O~~res, concentrates of uranium and thorium ores, and other ores containing ~~only~~ naturally occurring radionuclides ~~(e.g., uranium, thorium) and uranium or thorium concentrates of such ores; or~~which are not intended to be processed for the use of these radionuclides;

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

(iii) Radioactive material for which the A_2 value is unlimited~~, other than fissile material, for which the A_2 value is unlimited~~; or

(iv) ~~Mill tailings, contaminated earth, concrete, rubble, other debris, and activated material in which the radioactive material is essentially uniformly distributed, and the average specific activity does not exceed 10^{-6} A_2/g.~~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.

(2) LSA-II.

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

(ii) Other m~~M~~aterial in which the ~~radioactive material~~activity is distributed throughout, and the average specific activity does not exceed 10^{-4} A_2/g for solids and gases, and 10^{-5} A_2/g for liquids.

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(3) LSA-III. Solids (e.g., consolidated wastes, activated materials), excluding powders, that satisfy the requirements of 10 CFR 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 7 days, would not exceed 0.1 A_2; and

(iii) The estimated average specific activity of the solid does not exceed 2×10^{-3} A_2/g.

"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 10 days.

~~"Maximum normal operating pressure" means the maximum gauge pressure that would develop in the containment system in a period of 1 year under the heat condition specified in 10 CFR 71.71(c)(1), in the absence of venting, external cooling by an ancillary system, or operational controls during transport.~~

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

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

~~"Optimum interspersed hydrogenous moderation" means the presence of hydrogenous material between packages to such an extent that the maximum nuclear reactivity results.~~

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

(1) "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.

(2) "Type A package" means a Type A packaging together with its radioactive contents. A Type A package is defined and must comply with the DOT regulations in 49 CFR Part 173.

(~~2~~3) "Type B package" means a Type B packaging together with its radioactive contents. On approval, a Type B package design is designated by the ~~Department~~ NRC as B(U) unless the package has a maximum normal operating pressure of more than 700 kPa (100 lb/in^2) gauge or a pressure relief device that would allow the release of radioactive material to the environment under the tests specified in 10 CFR 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 DOT regulations in 49 CFR Part 173. A Type B package approved before September 6, 1983, was designated only as Type B. Limitations on its use are specified in ~~T.13~~. 10 CFR Part 19.

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"Packaging" means the assembly of components necessary to ensure compliance with the packaging requirements of this Ppart. 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.

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

~~(1) It is either a single solid piece or is contained in a sealed capsule that can be opened only by destroying the capsule;~~

~~(2) The piece or capsule has at least one dimension not less than 5 mm (0.2 in); and~~

~~(3) It satisfies the requirements of 10 CFR 71.75. A special form encapsulation designed in accordance with the requirements of 10 CFR Part 71.4 in effect on June 30, 1983, (see 10 CFR Part 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 10 CFR Part 71 in effect on March 31, 1996 (see 10 CFR Part 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.~~

"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.

~~"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.~~

"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:

(1) SCO-I: A solid object on which:

(i) The non-fixed contamination on the accessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 4 Bq/cm^2 (10^{-4} microcurie/cm^2) for beta and gamma and low toxicity alpha emitters, or 0.4 Bq/cm^2 (10^{-5} microcurie/cm^2) for all other alpha emitters;

(ii) The fixed contamination on the accessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed $4x10^4$ Bq/cm^2 (1.0 microcurie/cm^2) for beta and gamma and low toxicity alpha emitters, or $4x10^3$ Bq/cm^2 (0.1 microcurie/cm^2) for all other alpha emitters; and

(iii) The non-fixed contamination plus the fixed contamination on the inaccessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 4 x 10^4 Bq/cm^2 (1 microcurie/cm^2) for beta and gamma and low toxicity alpha emitters, or 4 x 10^3 Bq/cm^2 (0.1 microcurie/cm^2) for all other alpha emitters.

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

(i) The non-fixed contamination on the accessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 400 Bq/cm^2 (10^{-2} microcurie/cm^2) for beta and gamma and low toxicity alpha emitters or 40 Bq/cm^2 (10^{-3} microcurie/cm^2) for all other alpha emitters;

(ii) The fixed contamination on the accessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 8 x 10^5 Bq/cm^2 (20 microcuries/cm^2) for beta and gamma and low toxicity alpha emitters, or 8 x 10^4 Bq/cm^2 (2 microcuries/cm^2) for all other alpha emitters; and

(iii) The non-fixed contamination plus the fixed contamination on the inaccessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 8 x 10^5 Bq/cm^2 (20 microcuries/cm^2) for beta and gamma and low toxicity alpha emitters, or 8 x 104^4 Bq/cm^2 (2 microcuries/cm^2) for all other alpha emitters.

"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)).~~as follows:~~

~~(1) For non-fissile material packages, the number determined by multiplying the maximum radiation level in millisievert (mSv) per hour at one meter (3.3 ft) from the external surface of the package by 100 (equivalent to the maximum radiation level in millirem per hour at one meter (3.3 ft)); or~~

~~(2) For fissile material packages, the number determined by multiplying the maximum radiation level in millisievert per hour at one meter (3.3 ft) from the external surface of the package by 100 (equivalent to the maximum radiation level in millirem per hour at one meter (3.3 ft)), or, for criticality control purposes, the number obtained as described in Sec. T.59, whichever is larger.~~

"Type A quantity" means a quantity of radioactive material, the aggregate radioactivity of which does not exceed A_1 for special form radioactive material, or A_2; for normal form radioactive material, where A_1 and A_2 are given in Table A-1 of this Ppart, or may be determined by procedures described in Appendix A of this Ppart.

"Type B quantity" means a quantity of radioactive material greater than a Type A quantity.

"Unirradiated uranium" means uranium containing not more than 2 x 10^3 Bq of plutonium per gram of uranium-235, not more than 9 x 10^6 Bq of fission products per gram of uranium-235, and not more than 5 x 10^{-3}g of uranium-236 per gram of uranium-235.

"Uranium-natural, depleted, enriched":

(1) "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).

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

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

Sec. T.5 Transportation of Licensed Material.

(a) Each licensee who transports licensed material outside the site of usage, as specified in the Department license, 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 DOT regulations in 49 CFR Parts 107, 171 through 180, and 390 through 397,~~170 through 189~~ appropriate to the mode of transport.

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

(i) Packaging--49 CFR Part 173: Subparts A,~~ and~~ B, and I.

(ii) Marking and labeling--49 CFR Part 172: Subpart D~~,~~; ~~Secs.~~and §§ 172.400 through 172.407~~, Secs.~~ and §§ 172.436 through 172.441~~0, and~~ of Subpart E.

(iii) Placarding--49 CFR Part 172: Subpart F, especially ~~Secs.~~§§ 172.500 through 172.519 and~~,~~ §172.556~~,~~; and Appendices B and C.

(iv) Accident reporting--49 CFR Part 171: ~~Secs.~~§§ 171.15 and 171.16.

(v) Shipping papers and emergency information--49 CFR Part 172: Subparts C and G.

(vi) Hazardous material employee training--49 CFR Part 172: Subpart H.

(vii) Security plans--49 CFR Part 172: Subpart I.

(viii) Hazardous material shipper/carrier registration--49 CFR Part 107: Subpart G.

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

(i) Rail--49 CFR Part 174: Subparts A through D and K.

(ii) Air--49 CFR Part 175.

(iii) Vessel--49 CFR Part 176: Subparts A through F and M.

(iv) Public Highway--49 CFR Part 177 and Parts 390 through 397.

(b) If DOT regulations are not applicable to a shipment of licensed material, the licensee shall conform to the standards and requirements of the DOT specified in paragraph (a) of this section to the same extent as if the shipment or transportation were subject to 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 Maryland Department of the Environment, Radiological Health Program, 1800 Washington Boulevard, Baltimore, Maryland 21230.

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EXEMPTIONS

Sec. T.13 Exemption of Physicians.

Any physician licensed by a State to dispense drugs in the practice of medicine is exempt from Sec. T.5 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 10 CFR Part 35 or the equivalent Maryland or other Agreement State regulations.

Sec. T.1~~0~~4 Exemption for Low-Level Materials.

~~(a)~~ A licensee is exempt from all requirements of this ~~p~~Part with respect to shipment or carriage of ~~a package containing radioactive material having a specific activity not greater than 70 Bq/g (0.002 µCi/g).~~the following low-level materials:

(1) 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 10 times the values specified in Appendix A, Table A-2, of this Part.

(2) Materials for which the activity concentration is not greater than the activity concentration values specified in Appendix A, Table A-2 of this Part, or for which the consignment activity is not greater than the limit for an exempt consignment found in Appendix A, Table A-2, of this Part.

~~(b) A licensee is exempt from all requirements of this part, other than Sec. T.5 and Sec. T.88, with respect to shipment or carriage of the following packages, provided the packages contain no fissile material, or the fissile material exemption standards of Sec. T.53 are satisfied:~~

~~(1) A package containing no more than a Type A quantity of radioactive material;~~

~~(2) A package in which the only radioactive material is low specific activity (LSA) material or surface contaminated objects (SCO), provided the external radiation level at 3 m from the unshielded material or objects does not exceed 10 mSv/h (1 rem/h); or~~

~~(3) A package transported within locations within the United States which contains only americium or plutonium in special form with an aggregate radioactivity not to exceed 20 curies.~~

~~(c) A licensee is exempt from all requirements of this part, other than Secs. 71.5 and 71.88, with respect to shipment or carriage of low-specific-activity (LSA) material in group LSA-I, or surface contaminated objects (SCOs) in group SCO-I.~~

Sec. T.15 Exemption from Classification as Fissile Material.

Fissile material meeting the requirements of at least one of the paragraphs (a) through (f) of this section are exempt from classification as fissile material and from the fissile material package standards of 10 CFR §71.55 and 71.59, but are subject to all other requirements of this Part, 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) (1) Low concentrations of solid fissile material commingled with solid nonfissile material, provided that:

(i) There is at least 2000 grams of solid nonfissile material for every gram of fissile material, and

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

(2) 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 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.

GENERAL LICENSES

Sec. T.~~1~~217 General License: Department-Approved Package.

(a) A general license is hereby issued to any licensee of the Department to transport, or to deliver to a carrier for transport, licensed material in a package for which a license, certificate of compliance (CoC), or other approval has been issued by the Department or NRC.

(b) This general license applies only to a licensee who has a quality assurance program approved by the Department as satisfying the provisions of T.101 through T.137 ~~of this part~~.

(c) This general license applies only to a licensee who -

(1) 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;

(2) Complies with the terms and conditions of the license, certificate, or other approval, as applicable, and the applicable requirements of T.1 – T.5, T.81 – T.97, and T.101 – T.137 ~~of this part~~; and

(3) Submits in writing to the Maryland Department of the Environment, Radiological Health Program, 1800 Washington Boulevard, Baltimore, Maryland 21230, before the licensee's first use of the package, the licensee's name and license number and the package identification number specified in the package approval.

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

(e) For a Type B or fissile material package, the design of which was approved by the NRC before April 1, 1996, the general license is subject to the additional restrictions of ~~Sec. T.13~~ 10 CFR 71.19.

~~Sec. T.13 Previously Approved Package.~~

~~(a) A Type B package previously approved by the NRC but not designated as B(U) or B(M) in the identification number of the Department Certificate of Compliance, may be used under the general license of Sec. T.12 with the following additional conditions:~~

~~(1) Fabrication of the packaging was satisfactorily completed by August 31, 1986, as demonstrated by application of its model number in accordance with Sec. T.85(c);~~

~~(2) A package used for a shipment to a location outside the United States is subject to multilateral approval, as defined in DOT regulations at 49 CFR 173.403; and~~

~~(3) A serial number that uniquely identifies each packaging which conforms to the approved design is assigned to, and legibly and durably marked on, the outside of each packaging.~~

~~(b) A Type B(U) package, a Type B(M) package, a low specific activity (LSA) material package or a fissile material package, previously approved by the Department but without the designation "-85" in the identification number of the Department Certificate of Compliance, may be used under the general license of Sec. T.12 with the following additional conditions:~~

~~(1) Fabrication of the package is satisfactorily completed by April 1, 1999 as demonstrated by application of its model number in accordance with Sec. T.85(c);~~

~~(2) A package used for a shipment to a location outside the United States is subject to multilateral approval as defined in DOT regulations at 49 CFR 173.403; and~~

~~(3) A serial number which uniquely identifies each packaging which conforms to the approved design is assigned to and legibly and durably marked on the outside of each packaging.~~

Sec. T.~~1~~420 General License: DOT Specification Container.

(a) A general license is issued to any licensee of the Department to transport, or to deliver to a carrier for transport, licensed material in a specification container for fissile material or for a Type B quantity of radioactive material as specified in DOT regulations at 49 CFR Parts 173 and 178.

(b) This general license applies only to a licensee who has a quality assurance program approved by the Department as satisfying the provisions of ~~Sections~~ T.101 through T.137~~ of this part~~.

(c) This general license applies only to a licensee who-

(1) Has a copy of the specification; and

(2) Complies with the terms and conditions of the specification and the applicable requirements of T.1 – T.5, T.81 – T.97, and ~~Sections 2, 5, 81-97, and~~T.101 – T.137~~ of this Part~~.

(d) This general license is subject to the limitation that the specification container may not be used for a shipment to a location outside the United States, except by multilateral approval, as defined in DOT regulations at 49 CFR 173.403.

(e) This section expires October 1, 2008.

Sec. T.~~16~~21 General License: Use of Foreign Approved Package.

(a) A general license is issued to any licensee of the Department 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 DOT as meeting the applicable requirements of 49 CFR 171.12.

(b) Except as otherwise provided in this section, the general license applies only to a licensee who has a quality assurance program approved by the Department as satisfying the applicable provisions of ~~Sections~~T.101 –through T.137~~ of this part~~.

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

(d) This general license applies only to a licensee who-

(1) 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

(2) Complies with the terms and conditions of the certificate and revalidation, and with the applicable requirements of T.1 through T.5, T.81 through T.97, and T.101 through T.137. ~~Sections 2, 5, 81 – 97, and 101 – 137 of this Part.~~ With respect to the quality assurance provisions of ~~Sections~~T.101 –through T.137~~ of this Part~~, the licensee is exempt from design, construction, and fabrication considerations.

Sec. T.22 General License: Fissile Material.

(a) A general license is issued to any licensee of the Department 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

T.47 and 10 CFR Part 71 Subparts E and F; however, the material must be contained in a Type A package. The Type A package must also meet the DOT requirements of 49 CFR 173.417(a).

(b) The general license applies only to a licensee who has a quality assurance program approved by the Department as satisfying the provisions of T.101 through T.137.

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

(1) Contain no more than ~~[MDK]~~a Type A quantity of radioactive material; and

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

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

(1) Has been determined in accordance with paragraph (e) of this section;

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

(3) 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).

(e) (1) The value for the CSI must be greater than or equal to the number calculated by the following equation:

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

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

(3) The values of X, Y, and Z used in the CSI equation must be taken from Tables T-1 or T-2, as appropriate;

(4) If Table T-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

(5) Table T-1 values 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 H_2O) (e.g., certain hydrocarbon oils or plastics) are present in any form, except as polyethylene used for packing or wrapping.

Table T.1 – Mass Limits for General License Packages Containing Mixed Quantities of Fissile Material or Uranium-235 of Unknown Enrichment per T.22(e)

Fissile material	Fissile material mass mixed with moderating substances having an average hydrogen density less than or equal to H_2O (grams)	Fissile material mass mixed with moderating substances having an average hydrogen density greater than H_2O[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 H_2O.

Table T.2 – Mass Limits for General License Packages Containing Uranium-235 of Known Enrichment per T.22(e)

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

Sec. T.23 General License: Plutonium-Beryllium Special Form Material.

(a) A general license is issued to any licensee of the Department 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 need not be contained in a package which meets the standards of T.47 and 10 CFR Part 71 Subparts E and F; however, the material must be contained in a Type A package. The Type A package must also meet the DOT requirements of 49 CFR 173.417(a).

(b) The general license applies only to a licensee who has a quality assurance program approved by the Department as satisfying the provisions of T.101 through T.137.

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

(1) Contain no more than [MDK2]a Type A quantity of radioactive material; and

(2) 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.

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

(1) Has been determined in accordance with paragraph (e) of this section;

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

(3) 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).

(e) (1) The value for the CSI must be greater than or equal to the number calculated by the following equation:

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

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

PACKAGE APPROVAL STANDARDS

Sec. T.47 External Radiation Standards for All Packages.

(a) Except as provided in paragraph (b) 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 (200 mrem/h) at any point on the external surface of the package, and the transport index does not exceed 10.

(b) A package that exceeds the radiation level limits specified in paragraph (a) 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:

(1) 2 mSv/h (200 mrem/h) on the external surface of the package, unless the following conditions are met, in which case the limit is 10 mSv/h (1000 mrem/h):

(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;

(2) 2 mSv/h (200 mrem/h) 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

(3) 0.1 mSv/h (10 mrem/h) 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

(4) 0.02 mSv/h (2 mrem/h) 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 Sec. D.502.

(c) For shipments made under the provisions of paragraph (b) 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.

(d) 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.

OPERATING CONTROLS AND PROCEDURES

Sec. T.81 Applicability of Operating Controls and Procedures.

A licensee subject to this part, who, under a general or specific license, transports licensed material or delivers licensed material to a carrier for transport, shall comply with the requirements of T.81 – T.97~~Sections 81 – 100 of this Part~~, with the quality assurance requirements of ~~Sections~~ T.101 - T.137~~ of this Part~~, and with the general provisions of ~~Sections~~ T.1 - T.5~~ of this Part~~.

Sec. T.83 Assumptions as to Unknown Properties.

When the isotropic abundance, mass, concentration, degree of irradiation, degree of moderation, or other pertinent property of fissile material in any package is not known, the licensee shall package the fissile material as if the unknown properties have credible values that will cause the maximum neutron multiplication.

Sec. T.85 Preliminary Determinations.

Before the first use of any packaging for the shipment of licensed material-

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

(b) Where the maximum normal operating pressure will exceed 35 kPa (5 lbf/in^2) gauge, the licensee shall test the containment system at an internal pressure at least 50 percent higher than the maximum normal operating pressure, to verify the capability of that system to maintain its structural integrity at that pressure; and

(c) 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 Department. Before applying the model number, the licensee shall determine that the packaging has been fabricated in accordance with the design approved by the Department.

Sec. T.87 Routine Determinations.

Before each shipment of licensed material, the licensee shall ensure that the package with its contents satisfies the applicable requirements of this Ppart and of the license. The licensee shall determine that-

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

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

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

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

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

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

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

(h) 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 CFR 71.45;

(i) The level of non-fixed (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 DOT regulations in 49 CFR 173.443;

(j) External radiation levels around the package and around the vehicle, if applicable, will not exceed the limits specified in ~~10 CFR 71.47~~T.47 at any time during transportation; and

(k) Accessible package surface temperatures will not exceed the limits specified in 10 CFR 71.43(g) at any time during transportation.

Sec. T.88 Air Transport of Plutonium.

(a) Notwithstanding the provisions of any general licenses and notwithstanding any exemptions stated directly in this Ppart or included indirectly by citation of 49 CFR 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:

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

(2) The plutonium is contained in a material in which the specific activity is ~~not greater than 0.002 Ci/g (70 Bq/g) of material~~ less than or equal to the activity concentration values for plutonium specified in Appendix A, Table A-2, of this Part, and in which the radioactivity is essentially uniformly distributed; or

(3) The plutonium is shipped in a single package containing no more than an A_2 quantity of plutonium in any isotope or form, and is shipped in accordance with ~~Sec.~~ T.5; or

(4) 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 ~~Commission~~NRC.

(b) Nothing in paragraph (a) of this section is to be interpreted as removing or diminishing the requirements of 10 CFR 73.24.

(c) For a shipment of plutonium by air which is subject to paragraph (a)(4) of this section, the licensee shall, through special arrangement with the carrier, require compliance with 49 CFR 175.704, U.S. Department of Transportation regulations applicable to the air transport of plutonium.

Sec. T.89 Opening Instructions.

Before delivery of a package to a carrier for transport, the licensee shall ensure that any special instructions needed to safely open the package have been sent to, or otherwise made available to, the consignee for the consignee's use in accordance with Sec.~~tion~~ D.906(e).

~~Sec. T.91 Records.~~

~~(a) Each licensee shall maintain, for a period of 3 years after shipment, a record of each shipment of licensed material not exempt under Sec. T.10, showing where applicable~~

~~(1) Identification of the packaging by model number and serial number;~~

~~(2) Verification that there are no significant defects in the packaging, as shipped;~~

~~(3) Volume and identification of coolant;~~

~~(4) Type and quantity of licensed material in each package, and the total quantity of each shipment;~~

~~(5) 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;~~

~~(6) Date of the shipment;~~

~~(7) For fissile packages and for Type B packages, any special controls exercised;~~

~~(8) Name and address of the transferee;~~

~~(9) Address to which the shipment was made; and~~

~~(10) Results of the determinations required by Sec. T.87 and by the conditions of the package approval.~~

~~(b) The licensee shall make available to the Department for inspection, upon reasonable notice, all records required by this part. Records are only valid if stamped, initialed, or signed and dated by authorized personnel or otherwise authenticated.~~

~~(c) The licensee 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 Sec. T.85; 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. The records must be retained for three years after the life of the packaging to which they apply.~~

~~Sec. T.93 Inspection and Tests.~~

~~(a) The licensee or certificate holder shall permit the Department, at all reasonable times, to inspect the licensed material, packaging, premises, and facilities in which the licensed material or packaging is used, provided, constructed, fabricated, tested, stored, or shipped.~~

~~(b) The licensee shall perform, and permit the Department to perform, any tests the Department deems necessary or appropriate for the administration of these regulations.~~

~~(c) The licensee shall notify the Agency at least 45 days before fabrication of a package to be used for the shipment of licensed material having a decay heat load in excess of 5 kW or with a maximum normal operating pressure in excess of 103 kPa (15 lbf/in^2) gauge.~~

~~Sec. T.95 Reports. The licensee shall report to the Maryland Department of the Environment, Radiological Health Program, 1800 Washington Boulevard, Baltimore, Maryland 21230 within 30 days -~~

~~(a) Any instance in which there is significant reduction in the effectiveness of any approved Type B, or fissile, packaging during use;~~

~~(b) Details of any defects with safety significance in Type B, or fissile, packaging after first use, with the means employed to repair the defects and prevent their recurrence; or~~

~~(c) Instances in which the conditions of approval in the certificate of compliance were not observed in making a shipment.~~

Sec. T.97 Advance Notification of Shipment of Irradiated Reactor Fuel and Nuclear Waste.

(a) As specified in paragraphs (b), (c) and (d) 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, 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) Advance notification is required under this section for shipments of irradiated reactor fuel in quantities less than that subject to advance notification requirements of 10 CFR 7~~1~~3.37(f). Advance notification is also required under this section for shipment of licensed material, other than irradiated fuel, meeting the following three conditions:

(1) The licensed material is required by this P~~p~~art to be in Type B packaging for transportation;

(2) 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

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

(i) 3000 times the A_1 value of the radionuclides as specified in Appendix A, Table A-1 for special form radioactive material;

(ii) 3000 times the A_2 value of the radionuclides as specified in Appendix A, Table A-1 for normal form radioactive material; or

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

(c) Procedures for submitting advance notification.

(1) The notification must be made in writing to the office of each appropriate governor or governor's designee and to the ~~Administrator of the appropriate NRC Regional Office listed in Appendix A to 10 CFR 73~~Director, Division of Nuclear Security, Office of Nuclear Security and Incident Response, U.S. Nuclear Regulatory Commission.

(2) A notification delivered by mail must be postmarked at least 7 days before the beginning of the 7-day period during which departure of the shipment is estimated to occur.

(3) A notification delivered by ~~messenger~~any other means than mail must reach the office of the governor or of the governor's designee at least 4 days before the beginning of the 7-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 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 is available on request from the Director, Office of State Programs, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001.

(4) The licensee shall retain a copy of the notification as a record for 3 years.

(d) 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:

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

(2) A description of the irradiated reactor fuel or nuclear waste contained in the shipment, as specified in the regulations of DOT in 49 CFR 172.202 and 172.203(d);

(3) The point of origin of the shipment and the 7-day period during which departure of the shipment is estimated to occur;

(4) The 7-day period during which arrival of the shipment at State boundaries is estimated to occur;

(5) The destination of the shipment, and the 7-day period during which arrival of the shipment is estimated to occur; and

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

(e) Revision notice. A licensee who finds that schedule information previously furnished to a governor or governor'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 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 3 years.

(f) Cancellation notice.

(1) 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, and to the Director, Division of Nuclear Security, Office of Nuclear Security and Incident Response, U.S. Nuclear Regulatory Commission~~Administrator of the appropriate NRC Regional Office listed in Appendix A of Part 73 of this chapter~~.

(2) 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 3 years.

QUALITY ASSURANCE

Sec. T.101 Quality Assurance Requirements.

(a) Purpose. Secs. T.101 through T.137~~This subpart~~ describes quality assurance requirements applying 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 these sections~~subpart~~, "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 is 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 a packaging for the shipment of licensed material subject to these sections.

(b) Establishment of program. Each licensee shall establish, maintain, and execute a quality assurance program satisfying each of the applicable criteria of Secs. T.101 through T.137 and satisfying any specific provisions that are applicable to the licensee's activities including procurement of packaging. The licensee shall apply each of the applicable criteria in a graded approach, i.e., to an extent that is consistent with its importance to safety.

(c) Approval of program. Before the use of any package for the shipment of licensed material subject to~~this subpart~~ Secs. T.101 through T.137, each licensee shall obtain Department approval of its quality assurance program. Each licensee shall file a description of its quality assurance program, including a discussion of which requirements of ~~this subpart~~Secs. T.101 through T.137 are applicable and how they will be satisfied, with the Maryland Department of

the Environment, Radiological Health Program, 1800 Washington Boulevard, Baltimore, Maryland 21230.

~~(d) Existing package designs. The provisions of this paragraph deal with packages that have been approved for use in accordance with this part before January 1, 1979, and which have been designed in accordance with the provisions of this part in effect at the time of application for package approval. Those packages will be accepted as having been designed in accordance with a quality assurance program that satisfies the provisions of paragraph (b) of this section.~~

~~(e) Existing packages. The provisions of this paragraph deal with packages that have been approved for use in accordance with this part before January 1, 1979; have been at least partially fabricated prior to that date; and for which the fabrication is in accordance with the provisions of this part in effect at the time of application for approval of package design. These packages will be accepted as having been fabricated and assembled in accordance with a quality assurance program that satisfies the provisions of paragraph (b) of this section.~~

~~(f) Previously approved programs. A Department-approved quality assurance program that satisfies the applicable criteria of T.101 - T.137, 10 CFR 50 Appendix B, or 10 CFR 72 Subpart G, and that is established, maintained, and executed with regard to transport packages, will be accepted as satisfying the requirements of T.101(b). Before first use, the licensee shall notify the Maryland Department of the Environment, Radiological Health Program, 1800 Washington Boulevard, Baltimore, Maryland 21230, of its intent to apply its previously approved T.101 - T.137, 10 CFR 50 Appendix B, or 10 CFR 72 Subpart G quality assurance program to transportation activities. The licensee shall identify the program by date of submittal to the U.S. Nuclear Regulatory Commission, Docket Number, and date of NRC approval.~~

(~~g~~d) 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 Sec. E.31(b) of this regulation or equivalent NRC or Agreement State requirement, is deemed to satisfy the requirements of ~~Sec.~~ T.1~~2~~7(b) and T.101(b)~~ of this chapter~~.

Sec. T.103 Quality Assurance Organization.

(a) The licensee/[1] shall be responsible for the establishment and execution of the quality assurance program. The licensee may delegate to others, such as contractors, agents, or consultants, the work of establishing and executing the quality assurance program, or any part of the quality assurance program, but shall retain responsibility for the program. The licensee shall clearly establish and delineate, in writing, the authority and duties of persons and organizations performing activities affecting the safety-related functions of structures, systems, and components. These activities include performing the functions associated with attaining quality objectives and the quality assurance functions.

(b) The quality assurance functions are -

(1) Assuring that an appropriate quality assurance program is established and effectively executed; and

[1] While the term "licensee" is used in these criteria, the requirements are applicable to whatever design, fabrication, assembly, and testing of the package is accomplished with respect to a package prior to the time a package approval is issued.

(2) Verifying, by procedures such as checking, auditing, and inspection, that activities affecting the safety-related functions have been performed correctly.

(c) The persons and organizations performing quality assurance functions must have sufficient authority and organizational freedom to-

(1) Identify quality problems;

(2) Initiate, recommend, or provide solutions; and

(3) Verify implementation of solutions.

(d) The persons and organizations performing quality assurance functions shall report to a management level that assures that the required authority and organizational freedom, including sufficient independence from cost and schedule, when opposed to safety considerations, are provided.

(e) Because of the many variables involved, such as the number of personnel, the type of activity being performed, and the location or locations where activities are performed, the organizational structure for executing the quality assurance program may take various forms, provided that the persons and organizations assigned the quality assurance functions have the required authority and organizational freedom.

(f) Irrespective of the organizational structure, the individual(s) assigned the responsibility for assuring effective execution of any portion of the quality assurance program, at any location where activities subject to this section are being performed, must have direct access to the levels of management necessary to perform this function.

Sec. T.105 Quality Assurance Program.

(a) The licensee 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 Secs. T.101 through T.137. The licensee 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 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.

(b) The licensee, 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 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 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.

(c) The licensee 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:

(1) The impact of malfunction or failure of the item to safety;

(2) The design and fabrication complexity or uniqueness of the item;

(3) The need for special controls and surveillance over processes and equipment;

(4) The degree to which functional compliance can be demonstrated by inspection or test; and

(5) The quality history and degree of standardization of the item.

(d) The licensee 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 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 which they are executing.

~~Sec. T.107 Package Design Control.~~

~~(a) The licensee shall establish measures to assure that applicable regulatory requirements and the package design, as specified in the license for those materials and components to which this section applies, are correctly translated into specifications, drawings, procedures, and instructions. These measures must include provisions to assure that appropriate quality standards are specified and included in design documents and that deviations from standards are controlled. Measures must be established for the selection and review for suitability of application of materials, parts, equipment, and processes that are essential to the safety-related functions of the materials, parts, and components of the packaging.~~

~~(b) The licensee shall establish measures for the identification and control of design interfaces and for coordination among participating design organizations. These measures must include the establishment of written procedures, among participating design organizations, for the review, approval, release, distribution, and revision of documents involving design interfaces. The design control measures must provide for verifying or checking the adequacy of design, by methods such as design reviews, alternate or simplified calculational methods, or by a suitable testing program. For the verifying or checking process, the licensee shall designate individuals or groups other than those who were responsible for the original design, but who may be from the same organization. Where a test program is used to verify the adequacy of a specific design feature in lieu of other verifying or checking processes, the licensee shall include suitable qualification testing of a prototype or sample unit under the most adverse design conditions. The licensee shall apply design control measures to items such as the following:~~

~~(1) Criticality physics, radiation shielding, stress, thermal, hydraulic, and accident analyses;~~

~~(2) Compatibility of materials;~~

~~(3) Accessibility for inservice inspection, maintenance, and repair;~~

~~(4) Features to facilitate decontamination; and~~

~~(5) Delineation of acceptance criteria for inspections and tests.~~

~~(c) The licensee shall subject design changes, including field changes, to design control measures commensurate with those applied to the original design. Changes in the conditions specified in the package approvalrequire NRC approval.~~

~~Sec. T.109 Procurement Document Control. The licensee shall establish measures to assure that adequate quality is required in the documents for procurement of material, equipment, and services, whether purchased by the licensee or by its contractors or subcontractors. To the extent necessary, the licensee shall require contractors or subcontractors to provide a quality assurance program consistent with the applicable provisions of this part.~~

~~Sec. T.111 Instructions, Procedures, and Drawings. The licensee shall prescribe activities affecting quality by documented instructions, procedures, or drawings of a type appropriate to the circumstances and shall require that these instructions, procedures, and drawings be followed. The instructions, procedures, and drawings must include appropriate quantitative or qualitative acceptance criteria for determining that important activities have been satisfactorily accomplished.~~

~~Sec. T.113 Document Control. The licensee shall establish measures to control the issuance of documents such as instructions, procedures, and drawings, including changes, which prescribe all activities affecting quality. These measures must assure that documents, including changes, are reviewed for adequacy, approved for release by authorized personnel, and distributed and used at the location where the prescribed activity is performed. These measures must assure that changes to documents are reviewed and approved.~~

~~Sec. T.115 Control of Purchased Material, Equipment, and Services.~~

~~(a) The licensee shall establish measures to assure that purchased material, equipment, and services, whether purchased directly or through contractors and subcontractors, conform to the procurement documents. These measures must include provisions, as appropriate, for source evaluation and selection, objective evidence of quality furnished by the contractor or subcontractor, inspection at the contractor or subcontractor source, and examination of products on delivery.~~

~~(b) The licensee shall have available documentary evidence that material and equipment conform to the procurement specifications before installation or use of the material and equipment. The licensee shall retain, or have available, this documentary evidence for the life of the package to~~

~~which it applies. The licensee shall assure that the evidence is sufficient to identify the specific requirements met by the purchased material and equipment.~~

~~(c) The licensee shall assess the effectiveness of the control of quality by contractors and subcontractors at intervals consistent with the importance, complexity, and quantity of the product or services.~~

~~Sec. T.117 Identification and Control of Materials, Parts, and Components. The licensee shall establish measures for the identification and control of materials, parts, and components. These measures must assure that identification of the item is maintained by heat number, part number, or other appropriate means, either on the item or on records traceable to the item, as required throughout fabrication, installation, and use of the item. These identification and control measures must be designed to prevent the use of incorrect or defective materials, parts, and components.~~

~~Sec. T.119 Control of Special Processes. The licensee shall establish measures to assure that special processes, including welding, heat treating, and nondestructive testing, are controlled and accomplished by qualified personnel using qualified procedures in accordance with applicable codes, standards, specifications, criteria, and other special requirements.~~

~~Sec. T.121 Internal Inspection. The licensee shall establish and execute a program for inspection of activities affecting quality by or for the organization performing the activity, to verify conformance with the documented instructions, procedures, and drawings for accomplishing the activity. The inspection must be performed by individuals other than those who performed the activity being inspected. Examination, measurements, or tests of material or products processed must be performed for each work operation where necessary to assure quality. If direct inspection of processed material or products is not carried out, indirect control by monitoring processing methods, equipment, and personnel must be provided. Both inspection and process monitoring must be provided when quality control is inadequate without both. If mandatory inspection hold points, which require witnessing or inspecting by the licensee's designated representative and beyond which work should not proceed without the consent of its designated representative, are required, the specific hold points must be indicated in appropriate documents.~~

~~Sec. T.123 Test Control. The licensee shall establish a test program to assure that all testing required to demonstrate that the packaging components will perform satisfactorily in service is identified and performed in accordance with written test procedures that incorporate the requirements of this part and the requirements and acceptance limits contained in the package approval. The test procedures must include provisions for assuring that all prerequisites for the given test are met, that adequate test instrumentation is available and used, and that the test is performed under suitable environmental conditions. The licensee shall document and evaluate the test results to assure that test requirements have been satisfied.~~

~~Sec. T.125 Control of Measuring and Test Equipment. The licensee shall establish measures to assure that tools, gauges, instruments, and other measuring and testing devices used in activities affecting quality are properly controlled, calibrated, and adjusted at specified times to maintain accuracy within necessary limits.~~

1327 effectiveness of the program. The audits must be performed in accordance with written procedures
1328 or checklists by appropriately trained personnel not having direct responsibilities in the areas being
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1330 T21 Supp. ~~6~~16
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Sec. T.127 Handling, Storage, and Shipping Control. The licensee shall establish measures to control, in accordance with instructions, the handling, storage, shipping, cleaning, and preservation of materials and equipment to be used in packaging to prevent damage or deterioration. When necessary for particular products, special protective environments, such as inert gas atmosphere, and specific moisture content and temperature levels must be specified and provided.

Sec. T.129 Inspection, Test, and Operating Status.

(a) The licensee shall establish measures to indicate, by the use of markings such as stamps, tags, labels, routing cards, or other suitable means, the status of inspections and tests performed upon individual items of the packaging. These measures must provide for the identification of items that have satisfactorily passed required inspections and tests, where necessary to preclude inadvertent bypassing of the inspections and tests.

(b) The licensee shall establish measures to identify the operating status of components of the packaging, such as tagging valves and switches, to prevent inadvertent operation.

Sec. T.131 Nonconforming Materials, Parts, or Components. The licensee shall establish measures to control materials, parts, or components that do not conform to the licensee's requirements to prevent their inadvertent use or installation. These measures must include, as appropriate, procedures for identification, documentation, segregation, disposition, and notification to affected organizations. Nonconforming items must be reviewed and accepted, rejected, repaired, or reworked in accordance with documented procedures.

Sec. T.133 Corrective Action. The licensee shall establish measures to assure that conditions adverse to quality, such as deficiencies, deviations, defective material and equipment, and nonconformances, are promptly identified and corrected. In the case of a significant condition adverse to quality, the measures must assure that the cause of the condition is determined and corrective action taken to preclude repetition. The identification of the significant condition adverse to quality, the cause of the condition, and the corrective action taken must be documented and reported to appropriate levels of management.

Sec. T.135 Quality Assurance Records. The licensee shall maintain sufficient written records to describe the activities affecting quality. The records must include ~~the~~documented instructions, procedures, or~~and~~ drawings of a type appropriate to the circumstances~~required by Sec. T.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 shall retain these records for 3 years beyond the date when the licensee last engages in the activity for which the quality assurance program was developed. If any portion of the written procedures or instructions is superseded, the licensee shall retain the superseded material for 3 years after it is superseded.

Sec. T.137 Audits. The licensee shall carry out a comprehensive system of planned and periodic audits, to verify compliance with all aspects of the quality assurance program, and to determine the

audited. Audited results must be documented and reviewed by management having responsibility in the area audited. Follow-up action, including reaudit of deficient areas, must be taken where indicated.

Part T
Appendix A
Determination of A_1 and A_2

I. Values of A_1 and A_2 for individual radionuclides, which are the bases for many activity limits elsewhere in these regulations, are given in Table A-1. The curie (Ci) values specified are obtained by converting from the Terabecquerel (TBq) ~~figure~~value. The Terabecquerel values are the regulatory standard. The curie values are for information only and are not intended to be the regulatory standard.~~expressed to three significant figures to assure that the difference in the TBq and Ci quantities is one tenth of one percent or less.~~ Where values of A_1 or A_2 are unlimited, it is for radiation control purposes only. For nuclear criticality safety, some materials are subject to controls placed on fissile material.

II. a. For individual radionuclides whose identities are known, but which are not listed in Table A-1, the ~~determination of the values of~~ A_1 and A_2 values contained in Table A-3 may be used. Otherwise, the licensee shall obtain prior Department approval of ~~requires Commission approval, except that the values of~~ the A_1 and A_2 values for radionuclides not listed in Table A-1, before shipping the material.~~in Table A-2 may be used without obtaining Commission approval.~~

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

c. The licensee shall submit requests for prior approval, described under paragraphs II.a. and II.b. of this Appendix, to the Department, in accordance with T.1.

III. In the calculations of A_1 and A_2 for a radionuclide not in 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 10 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 A_1 or A_2 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 10 days, or greater than that of the parent radionuclide, the parent and those daughter radionuclides shall be considered as mixtures of different radionuclides.

IV. 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 is as follows:

$$\sum_{I} \frac{B(i)}{A_1(i)} \text{ less than or equal to } 1$$

where B(i) is the activity of radionuclide i, and $A_1(i)$ is the A_1 value for radionuclide i.

~~(~~b.~~)~~ For normal form radioactive material, the maximum quantity transported in a Type A package is as follows:

$$\Sigma B(i)/A_2(i) \leq 1$$

$$\sum_{I} \frac{B(i)}{A_2(i)} \text{ ~~less than or equal to 1~~}$$

w~~W~~here B(i) is the activity of radionuclide i~~I~~, and $A_{1}2(i)$ ~~and $A_2(i)$ are~~is the ~~A_1 and~~ A_2 values for radionuclide i ~~I, respectively~~.

c. Alternatively, the~~an~~ A_1 value for mixtures of special form material may be determined as follows:

$$A_1 \text{ for mixture} = \frac{1}{\sum_I \frac{f(i)}{A_1(i)}}$$

wWhere ff(i) is the fraction of activity offor radionuclide Ii in the mixture, and $A_1(i)$ is the appropriate A_1 value for radionuclide Ii.

d. Alternatively, theAn A_2 value for mixtures of normal form material may be determined as follows:

$$A_2 \text{ for mixture} = \frac{1}{\sum_I \frac{f(i)}{A_2(i)}}$$

wWhere ff(i) is the fraction of activity forof radionuclide Ii in the mixture, and $A_2(i)$ is the appropriate A_2 value for radionuclide I 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 for exempt 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.

V. 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 A_1 or A_2 value, as appropriate, for the radionuclides in each group may be used in applying the formulas in paragraph IV. Groups may be based on the total alpha activity and the total beta/gamma activity when these are known, using the lowest A_1 or A_2 values for the alpha emitters and beta/gamma emitters.

~~Table A-1. — A_1 and A_2 Values for Radionuclides~~

~~SYMBOL OF RADIO-NUCLIDE~~	~~ELEMENT AND ATOMIC NUMBER~~	~~A_1 (TBq)~~	~~A_1 (Ci)~~	~~A_2 (TBq)~~	~~A_2 (Ci)~~	~~SPECIFIC ACTIVITY (TBq/g)~~	~~SPECIFIC ACTIVITY (Ci/g)~~
~~Ac-225~~	~~Actinium(89)~~	~~0.6~~	~~16.2~~	~~$1x10^{-2}$~~	~~0.270~~	~~$2.1x10^{3}$~~	~~$5.8x10^{4}$~~
~~Ac-227~~		~~40~~	~~1080~~	~~$2x10^{-5}$~~	~~$5.41x10^{-4}$~~	~~2.7~~	~~$7.2x10^{1}$~~
~~Ac-228~~		~~0.6~~	~~16.2~~	~~0.4~~	~~10.8~~	~~$8.4x10^{4}$~~	~~$2.2x10^{6}$~~
~~Ag-105~~	~~Silver(47)~~	~~2~~	~~54.1~~	~~2~~	~~54.1~~	~~$1.1x10^{3}$~~	~~$3.0x10^{4}$~~
~~Ag-108m~~		~~0.6~~	~~16.2~~	~~0.6~~	~~16.2~~	~~$9.7x10^{-1}$~~	~~$2.6x10^{1}$~~
~~Ag-110m~~		~~0.4~~	~~10.8~~	~~0.4~~	~~10.8~~	~~$1.8x10^{2}$~~	~~$4.7x10^{3}$~~
~~Ag-111~~		~~0.6~~	~~16.2~~	~~0.5~~	~~13.5~~	~~$5.8x10^{3}$~~	~~$1.6x10^{5}$~~
~~Al-26~~	~~Aluminum(13)~~	~~0.4~~	~~10.8~~	~~0.4~~	~~10.8~~	~~$7.0x10^{-4}$~~	~~$1.9x10^{-2}$~~
~~Am-241~~	~~Americium(95)~~	~~2~~	~~54.1~~	~~$2x10^{-4}$~~	~~$5.41x10^{-3}$~~	~~$1.3x10^{-1}$~~	~~3.4~~
~~Am-242m~~		~~2~~	~~54.1~~	~~$2x10^{-4}$~~	~~$5.41x10^{-3}$~~	~~$3.6x10^{-1}$~~	~~$1.0x10^{1}$~~
~~Am-243~~		~~2~~	~~54.1~~	~~$2x10^{-4}$~~	~~$5.41x10^{-3}$~~	~~$7.4x10^{-3}$~~	~~$2.0x10^{-1}$~~
~~Ar-37~~	~~Argon(18)~~	~~40~~	~~1080~~	~~40~~	~~1080~~	~~$3.7x10^{3}$~~	~~$9.9x10^{4}$~~
~~Ar-39~~		~~20~~	~~541~~	~~20~~	~~541~~	~~1.3~~	~~$3.4x10^{1}$~~
~~Ar-41~~		~~0.6~~	~~16.2~~	~~0.6~~	~~16.2~~	~~$1.5x10^{6}$~~	~~$4.2x10^{7}$~~
~~Ar-42~~		~~0.2~~	~~5.41~~	~~0.2~~	~~5.41~~	~~9.6~~	~~$2.6x10^{2}$~~
~~As-72~~	~~Arsenic(33)~~	~~0.2~~	~~5.41~~	~~0.2~~	~~5.41~~	~~$6.2x10^{4}$~~	~~$1.7x10^{6}$~~
~~As-73~~		~~40~~	~~1080~~	~~40~~	~~1080~~	~~$8.2x10^{2}$~~	~~$2.2x10^{4}$~~
~~As-74~~		~~1~~	~~27.0~~	~~0.5~~	~~13.5~~	~~$3.7x10^{3}$~~	~~$9.9x10^{4}$~~
~~As-76~~		~~0.2~~	~~5.41~~	~~0.2~~	~~5.41~~	~~$5.8x10^{4}$~~	~~$1.6x10^{6}$~~
~~As-77~~		~~20~~	~~541~~	~~0.5~~	~~13.5~~	~~$3.9x10^{4}$~~	~~$1.0x10^{6}$~~
~~At-211~~	~~Astatine(85)~~	~~30~~	~~811~~	~~2~~	~~54.1~~	~~$7.6x10^{4}$~~	~~$2.1x10^{6}$~~
~~Au-193~~	~~Gold(79)~~	~~6~~	~~162~~	~~6~~	~~162~~	~~$3.4x10^{4}$~~	~~$9.2x10^{5}$~~
~~Au-194~~		~~1~~	~~27.0~~	~~1~~	~~27.0~~	~~$1.5x10^{4}$~~	~~$4.1x10^{5}$~~
~~Au-195~~		~~10~~	~~270~~	~~10~~	~~270~~	~~$1.4x10^{2}$~~	~~$3.7x10^{3}$~~
~~Au-196~~		~~2~~	~~54.1~~	~~2~~	~~54.1~~	~~$4.0x10^{3}$~~	~~$1.1x10^{5}$~~
~~Au-198~~		~~3~~	~~81.1~~	~~0.5~~	~~13.5~~	~~$9.0x10^{3}$~~	~~$2.4x10^{5}$~~
~~Au-199~~		~~10~~	~~270~~	~~0.9~~	~~24.3~~	~~$7.7x10^{3}$~~	~~$2.1x10^{5}$~~
~~Ba-131~~	~~Barium(56)~~	~~2~~	~~54.1~~	~~2~~	~~54.1~~	~~$3.1x10^{3}$~~	~~$8.4x10^{4}$~~

~~Table A-1. — A_1 and A_2 Values For Radionuclides~~

~~SYMBOL OF RADIO-NUCLIDE~~	~~ELEMENT AND ATOMIC NUMBER~~	~~A_1 (TBq)~~	~~A_1 (Ci)~~	~~A_2 (TBq)~~	~~A_2 (Ci)~~	~~SPECIFIC ACTIVITY (TBq/g)~~	~~SPECIFIC ACTIVITY (Ci/g)~~
~~Ba-133m~~		~~10~~	~~270~~	~~0.9~~	~~24.3~~	~~$2.2x10^4$~~	~~$6.1x10^5$~~
~~Ba-133~~		~~3~~	~~81.1~~	~~3~~	~~81.1~~	~~9.4~~	~~$2.6x10^4$~~
~~Ba-140~~		~~0.4~~	~~10.8~~	~~0.4~~	~~10.8~~	~~$2.7x10^3$~~	~~$7.3x10^4$~~
~~Be-7~~	~~Beryllium(4)~~	~~20~~	~~541~~	~~20~~	~~541~~	~~$1.3x10^4$~~	~~$3.5x10^5$~~
~~Be-10~~		~~20~~	~~541~~	~~0.5~~	~~13.5~~	~~$8.3x10^{-4}$~~	~~$2.2x10^{-2}$~~
~~Bi-205~~	~~Bismuth(83)~~	~~0.6~~	~~16.2~~	~~0.6~~	~~16.2~~	~~$1.5x10^{-2}$~~	~~$4.2x10^4$~~
~~Bi-206~~		~~0.3~~	~~8.11~~	~~0.3~~	~~8.11~~	~~$3.8x10^3$~~	~~$1.0x10^5$~~
~~Bi-207~~		~~0.7~~	~~18.9~~	~~0.7~~	~~18.9~~	~~1.9~~	~~$5.2x10^1$~~
~~Bi-210m~~		~~0.3~~	~~8.11~~	~~$3x10^{-2}$~~	~~0.811~~	~~$2.1x10^{-5}$~~	~~$5.7x10^{-4}$~~
~~Bi-210~~		~~0.6~~	~~16.2~~	~~0.5~~	~~13.5~~	~~$4.6x10^3$~~	~~$1.2x10^5$~~
~~Bi-212~~		~~0.3~~	~~8.11~~	~~0.3~~	~~8.11~~	~~$5.4x10^5$~~	~~$1.5x10^7$~~
~~Bk-247~~	~~Berkelium(97)~~	~~2~~	~~54.1~~	~~$2x10^{-4}$~~	~~$5.41x10^{-3}$~~	~~$3.8x10^{-2}$~~	~~1.0~~
~~Bk-249~~		~~40~~	~~1080~~	~~$8x10^{-2}$~~	~~2.16~~	~~$6.1x10^1$~~	~~$1.6x10^3$~~
~~Br-76~~	~~Bromine(35)~~	~~0.3~~	~~8.11~~	~~0.3~~	~~8.11~~	~~$9.4x10^4$~~	~~$2.5x10^6$~~
~~Br-77~~		~~3~~	~~81.1~~	~~3~~	~~81.1~~	~~$2.6x10^4$~~	~~$7.1x10^5$~~
~~Br-82~~		~~0.4~~	~~10.8~~	~~0.4~~	~~10.8~~	~~$4.0x10^4$~~	~~$1.1x10^6$~~
~~C-11~~	~~Carbon(6)~~	~~1~~	~~27~~	~~0.5~~	~~13.5~~	~~$3.1x10^7$~~	~~$8.4x10^8$~~
~~C-14~~		~~40~~	~~1080~~	~~2~~	~~54.1~~	~~$1.6x10^{-1}$~~	~~4.5~~
~~Ca-41~~	~~Calcium(20)~~	~~40~~	~~1080~~	~~40~~	~~1080~~	~~$3.1x10^{-3}$~~	~~$8.5x10^{-2}$~~
~~Ca-45~~		~~40~~	~~1080~~	~~0.9~~	~~24.3~~	~~$6.6x10^2$~~	~~$1.8x10^4$~~
~~Ca-47~~		~~0.9~~	~~24.3~~	~~0.5~~	~~13.5~~	~~$2.3x10^4$~~	~~$6.1x10^5$~~
~~Cd-109~~	~~Cadmium(48)~~	~~40~~	~~1080~~	~~1~~	~~27.0~~	~~$9.6x10^1$~~	~~$2.6x10^3$~~
~~Cd-113m~~		~~20~~	~~541~~	~~$9x10^{-2}$~~	~~2.43~~	~~8.3~~	~~$2.2x10^2$~~
~~Cd-115m~~		~~0.3~~	~~8.11~~	~~0.3~~	~~8.11~~	~~$9.4x10^2$~~	~~$2.5x10^4$~~
~~Cd-115~~		~~4~~	~~108~~	~~0.5~~	~~13.5~~	~~$1.9x10^4$~~	~~$5.1x10^5$~~
~~Ce-139~~	~~Cerium(58)~~	~~6~~	~~162~~	~~6~~	~~162~~	~~$2.5x10^2$~~	~~$6.8x10^3$~~
~~Ce-141~~		~~10~~	~~270~~	~~0.5~~	~~13.5~~	~~$1.1x10^3$~~	~~$2.8x10^4$~~
~~Ce-143~~		~~0.6~~	~~16.2~~	~~0.5~~	~~13.5~~	~~$2.5x10^4$~~	~~$6.6x10^5$~~

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~~Table A-1. — A_1 and A_2 Values For Radionuclides~~

~~SYMBOL OF RADIO-NUCLIDE~~	~~ELEMENT AND ATOMIC NUMBER~~	~~A_1 (TBq)~~	~~A_1 (Ci)~~	~~A_2 (TBq)~~	~~A_2 (Ci)~~	~~SPECIFIC ACTIVITY (TBq/g)~~	~~(Ci/g)~~
~~Ce-144~~		~~0.2~~	~~5.41~~	~~0.2~~	~~5.41~~	~~$1.2x10^{2}$~~	~~$3.2x10^{3}$~~
~~Cf-248~~	~~Californium(98)~~	~~30~~	~~811~~	~~$3x10^{-3}$~~	~~$8.11x10^{-2}$~~	~~$5.8x10^{1}$~~	~~$1.6x10^{3}$~~
~~Cf-249~~		~~2~~	~~54.1~~	~~$2x10^{-4}$~~	~~$5.41x10^{-3}$~~	~~$1.5x10^{-1}$~~	~~4.1~~
~~Cf-250~~		~~5~~	~~135~~	~~$5x10^{-4}$~~	~~$1.35x10^{-2}$~~	~~4.0~~	~~$1.1x10^{2}$~~
~~Cf-251~~		~~2~~	~~54.1~~	~~$2x10^{-4}$~~	~~$5.41x10^{-3}$~~	~~$5.9x10^{-2}$~~	~~1.6~~
~~Cf-252~~		~~0.1~~	~~2.70~~	~~$1x10^{-3}$~~	~~$2.70x10^{-2}$~~	~~$2.0x10^{1}$~~	~~$5.4x10^{2}$~~
~~Cf-253~~		~~40~~	~~1080~~	~~$6x10^{-2}$~~	~~1.62~~	~~$1.1x10^{3}$~~	~~$2.9x10^{4}$~~
~~Cf-254~~		~~$3x10^{-3}$~~	~~$8.11x10^{-2}$~~	~~$6x10^{-4}$~~	~~$1.62x10^{-2}$~~	~~$3.1x10^{2}$~~	~~$8.5x10^{3}$~~
~~Cl-36~~	~~Chlorine(17)~~	~~20~~	~~541~~	~~0.5~~	~~13.5~~	~~$1.2x10^{-3}$~~	~~$3.3x10^{-2}$~~
~~Cl-38~~		~~0.2~~	~~5.41~~	~~0.2~~	~~5.41~~	~~$4.9x10^{6}$~~	~~$1.3x10^{8}$~~
~~Cm-240~~	~~Curium(96)~~	~~40~~	~~1080~~	~~$2x10^{-2}$~~	~~0.541~~	~~$7.5x10^{2}$~~	~~$2.0x10^{4}$~~
~~Cm-241~~		~~2~~	~~54.1~~	~~0.9~~	~~24.3~~	~~$6.1x10^{2}$~~	~~$1.7x10^{4}$~~
~~Cm-242~~		~~40~~	~~1080~~	~~$1x10^{-2}$~~	~~0.270~~	~~$1.2x10^{2}$~~	~~$3.3x10^{3}$~~
~~Cm-243~~		~~3~~	~~81.1~~	~~$3x10^{-4}$~~	~~$8.11x10^{-3}$~~	~~1.9~~	~~$5.2x10^{1}$~~
~~Cm-244~~		~~4~~	~~108~~	~~$4x10^{-4}$~~	~~$1.08x10^{-2}$~~	~~3.0~~	~~$8.1x10^{1}$~~
~~Cm-245~~		~~2~~	~~54.1~~	~~$2x10^{-4}$~~	~~$5.41x10^{-3}$~~	~~$6.4x10^{-3}$~~	~~$1.7x10^{-1}$~~
~~Cm-246~~		~~2~~	~~54.1~~	~~$2x10^{-4}$~~	~~$5.41x10^{-3}$~~	~~$1.1x10^{-2}$~~	~~$3.1x10^{-1}$~~
~~Cm-247~~		~~2~~	~~54.1~~	~~$2x10^{-4}$~~	~~$5.41x10^{-3}$~~	~~$3.4x10^{-6}$~~	~~$9.3x10^{-5}$~~
~~Cm-248~~		~~$4x10^{-2}$~~	~~1.08~~	~~$5x10^{-5}$~~	~~$1.35x10^{-3}$~~	~~$1.6x10^{-4}$~~	~~$4.2x10^{-3}$~~
~~Co-55~~	~~Cobalt(27)~~	~~0.5~~	~~13.5~~	~~0.5~~	~~13.5~~	~~$1.1x10^{5}$~~	~~$3.1x10^{6}$~~
~~Co-56~~		~~0.3~~	~~8.11~~	~~0.3~~	~~8.11~~	~~$1.1x10^{3}$~~	~~$3.0x10^{4}$~~
~~Co-57~~		~~8~~	~~216~~	~~8~~	~~216~~	~~$3.1x10^{2}$~~	~~$8.4x10^{3}$~~
~~Co-58m~~		~~40~~	~~1080~~	~~40~~	~~1080~~	~~$2.2x10^{5}$~~	~~$5.9x10^{6}$~~
~~Co-58~~		~~1~~	~~27.0~~	~~1~~	~~27.0~~	~~$1.2x10^{3}$~~	~~$3.2x10^{4}$~~
~~Co-60~~		~~0.4~~	~~10.8~~	~~0.4~~	~~10.8~~	~~$4.2x10^{1}$~~	~~$1.1x10^{3}$~~
~~Cr-51~~	~~Chromium(24)~~	~~30~~	~~811~~	~~30~~	~~811~~	~~$3.4x10^{3}$~~	~~$9.2x10^{4}$~~
~~Cs-129~~	~~Cesium(55)~~	~~4~~	~~108~~	~~4~~	~~108~~	~~$2.8x10^{4}$~~	~~$7.6x10^{5}$~~
~~Cs-131~~		~~40~~	~~1080~~	~~40~~	~~1080~~	~~$3.8x10^{3}$~~	~~$1.0x10^{5}$~~

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~~Table A-1. — A_1 and A_2 Values For Radionuclides~~

~~SYMBOL OF RADIO-NUCLIDE~~	~~ELEMENT AND ATOMIC NUMBER~~	~~A_1 (TBq)~~	~~A_1 (Ci)~~	~~A_2 (TBq)~~	~~A_2 (Ci)~~	~~SPECIFIC ACTIVITY (TBq/g)~~	~~SPECIFIC ACTIVITY (Ci/g)~~
~~Cs-132~~		~~1~~	~~27.0~~	~~1~~	~~27.0~~	~~$5.7x10^3$~~	~~$1.5x10^5$~~
~~Cs-134m~~		~~40~~	~~1080~~	~~9~~	~~243~~	~~$3.0x10^5$~~	~~$8.0x10^6$~~
~~Cs-134~~		~~0.6~~	~~16.2~~	~~0.5~~	~~13.5~~	~~$4.8x10^1$~~	~~$1.3x10^3$~~
~~Cs-135~~		~~40~~	~~1080~~	~~0.9~~	~~24.3~~	~~$4.3x10^{-5}$~~	~~$1.2x10^{-3}$~~
~~Cs-136~~		~~0.5~~	~~13.5~~	~~0.5~~	~~13.5~~	~~$2.7x10^3$~~	~~$7.3x10^4$~~
~~Cs-137~~		~~2~~	~~54.1~~	~~0.5~~	~~13.5~~	~~3.2~~	~~$8.7x10^1$~~
~~Cu-64~~	~~Copper(29)~~	~~5~~	~~135~~	~~0.9~~	~~24.3~~	~~$1.4x10^5$~~	~~$3.9x10^6$~~
~~Cu-67~~		~~9~~	~~243~~	~~0.9~~	~~24.3~~	~~$2.8x10^4$~~	~~$7.6x10^5$~~
~~Dy-159~~	~~Dysprosium(66)~~	~~20~~	~~541~~	~~20~~	~~541~~	~~$2.1x10^2$~~	~~$5.7x10^3$~~
~~Dy-165~~		~~0.6~~	~~16.2~~	~~0.5~~	~~13.5~~	~~$3.0x10^5$~~	~~$8.2x10^6$~~
~~Dy-166~~		~~0.3~~	~~8.11~~	~~0.3~~	~~8.11~~	~~$8.6x10^3$~~	~~$2.3x10^5$~~
~~Er-169~~	~~Erbium(68)~~	~~40~~	~~1080~~	~~0.9~~	~~24.3~~	~~$3.1x10^3$~~	~~$8.3x10^4$~~
~~Er-171~~		~~0.6~~	~~16.2~~	~~0.5~~	~~13.5~~	~~$9.0x10^4$~~	~~$2.4x10^6$~~
~~Es-253~~	~~Einsteinium(99)[a]~~	~~200~~	~~5400~~	~~$2x10^{-2}$~~	~~$5.41x10^{-1}$~~		
~~Es-254~~		~~30~~	~~811~~	~~$3x10^{-3}$~~	~~$8.11x10^{-2}$~~		
~~Es-254m~~		~~0.6~~	~~16.2~~	~~0.4~~	~~10.8~~		
~~Es-255~~							
~~Eu-147~~	~~Europium(63)~~	~~2~~	~~54.1~~	~~2~~	~~54.1~~	~~$1.4x10^3$~~	~~$3.7x10^4$~~
~~Eu-148~~		~~0.5~~	~~13.5~~	~~0.5~~	~~13.5~~	~~$6.0x10^2$~~	~~$1.6x10^4$~~
~~Eu-149~~		~~20~~	~~541~~	~~20~~	~~541~~	~~$3.5x10^2$~~	~~$9.4x10^3$~~
~~Eu-150~~		~~0.7~~	~~18.9~~	~~0.7~~	~~18.9~~	~~$6.1x10^4$~~	~~$1.6x10^6$~~
~~Eu-152m~~		~~0.6~~	~~16.2~~	~~0.5~~	~~13.5~~	~~$8.2x10^4$~~	~~$2.2x10^6$~~
~~Eu-152~~		~~0.9~~	~~24.3~~	~~0.9~~	~~24.3~~	~~6.5~~	~~$1.8x10^2$~~
~~Eu-154~~		~~0.8~~	~~21.6~~	~~0.5~~	~~13.5~~	~~9.8~~	~~$2.6x10^2$~~
~~Eu-155~~		~~20~~	~~541~~	~~2~~	~~54.1~~	~~$1.8x10^1$~~	~~$4.9x10^2$~~
~~Eu-156~~		~~0.6~~	~~16.2~~	~~0.5~~	~~13.5~~	~~$2.0x10^3$~~	~~$5.5x10^4$~~
~~F-18~~	~~Flourine(9)~~	~~1~~	~~27.0~~	~~0.5~~	~~13.5~~	~~$3.5x10^6$~~	~~$9.5x10^7$~~
~~Fe-52~~	~~Iron(26)~~	~~0.2~~	~~5.41~~	~~0.2~~	~~5.41~~	~~$2.7x10^5$~~	~~$7.3x10^6$~~

~~Table A-1. A_1 and A_2 Values for Radionuclides~~

~~Symbol of radio-nuclide~~	~~Element and atomic number~~	~~A_1 (TBq)~~	~~A_1 (Ci)~~	~~A_2 (TBq)~~	~~A_2 (Ci)~~	~~Specific Activity (TBq/g)~~	~~(Ci/g)~~
~~Fe-55~~		~~40~~	~~1080~~	~~40~~	~~1080~~	~~8.8×10^{1}~~	~~2.4×10^{3}~~
~~Fe-59~~		~~0.8~~	~~21.6~~	~~0.8~~	~~21.6~~	~~1.8×10^{3}~~	~~5.0×10^{4}~~
~~Fe-60~~		~~40~~	~~1080~~	~~0.2~~	~~5.41~~	~~7.4×10^{-4}~~	~~2.0×10^{-2}~~
~~Fm-225~~	~~Fermium(100)[b]~~	~~40~~	~~1080~~	~~0.8~~	~~21.6~~		
~~Fm-257~~		~~10~~	~~270~~	~~8×10^{-3}~~	~~2.16×10^{-1}~~		
~~Ga-67~~	~~Gallium(31)~~	~~6~~	~~162~~	~~6~~	~~162~~	~~2.2×10^{4}~~	~~6.0×10^{5}~~
~~Ga-68~~		~~0.3~~	~~8.11~~	~~0.3~~	~~8.11~~	~~1.5×10^{6}~~	~~4.1×10^{7}~~
~~Ga-72~~		~~0.4~~	~~10.8~~	~~0.4~~	~~10.8~~	~~1.1×10^{5}~~	~~3.1×10^{6}~~
~~Gd-146~~	~~Gadolinium(64)~~	~~0.4~~	~~10.8~~	~~0.4~~	~~10.8~~	~~6.9×10^{2}~~	~~1.9×10^{4}~~
~~Gd-148~~		~~3~~	~~81.1~~	~~3×10^{-4}~~	~~8.11×10^{-3}~~	~~1.2~~	~~3.2×10^{1}~~
~~Gd-153~~		~~10~~	~~270~~	~~5~~	~~135~~	~~1.3×10^{2}~~	~~3.5×10^{3}~~
~~Gd-159~~		~~4~~	~~108~~	~~0.5~~	~~13.5~~	~~3.9×10^{4}~~	~~1.1×10^{6}~~
~~Ge-68~~	~~Germanium(32)~~	~~0.3~~	~~8.11~~	~~0.3~~	~~8.11~~	~~2.6×10^{2}~~	~~7.1×10^{3}~~
~~Ge-71~~		~~40~~	~~1080~~	~~40~~	~~1080~~	~~5.8×10^{3}~~	~~1.6×10^{5}~~
~~Ge-77~~		~~0.3~~	~~8.11~~	~~0.3~~	~~8.11~~	~~1.3×10^{5}~~	~~3.6×10^{6}~~
~~H-3~~	~~Hydrogen(1)~~	~~See T-tritium~~					
~~Hf-172~~	~~Halfnium(72)~~	~~0.5~~	~~13.5~~	~~0.3~~	~~8.11~~	~~4.1×10^{1}~~	~~1.1×10^{3}~~
~~Hf-175~~		~~3~~	~~81.1~~	~~3~~	~~81.1~~	~~3.9×10^{2}~~	~~1.1×10^{4}~~
~~Hf-181~~		~~2~~	~~54.1~~	~~0.9~~	~~24.3~~	~~6.3×10^{2}~~	~~1.7×10^{4}~~
~~Hf-182~~		~~4~~	~~108~~	~~3×10^{-2}~~	~~0.811~~	~~8.1×10^{-6}~~	~~2.2×10^{-4}~~
~~Hg-194~~	~~Mercury(80)~~	~~1~~	~~27.0~~	~~1~~	~~27.0~~	~~1.3×10^{-1}~~	~~3.5~~
~~Hg-195m~~		~~5~~	~~135~~	~~5~~	~~135~~	~~1.5×10^{4}~~	~~4.0×10^{5}~~
~~Hg-197m~~		~~10~~	~~270~~	~~0.9~~	~~24.3~~	~~2.5×10^{4}~~	~~6.7×10^{5}~~
~~Hg-197~~		~~10~~	~~270~~	~~10~~	~~270~~	~~9.2×10^{3}~~	~~2.5×10^{5}~~
~~Hg-203~~		~~4~~	~~108~~	~~0.9~~	~~24.3~~	~~5.1×10^{2}~~	~~1.4×10^{4}~~
~~Ho-163~~	~~Holmium(67)~~	~~40~~	~~1080~~	~~40~~	~~1080~~	~~2.7~~	~~7.6×10^{1}~~
~~Ho-166m~~		~~0.6~~	~~16.2~~	~~0.3~~	~~8.11~~	~~6.6×10^{-2}~~	~~1.8~~
~~Ho-166~~		~~0.3~~	~~8.11~~	~~0.3~~	~~8.11~~	~~2.6×10^{4}~~	~~7.0×10^{5}~~

~~Table A-1. A_1 and A_2 Values for Radionuclides~~

~~Symbol of radio-nuclide~~	~~Element and atomic number~~	~~A_1 (TBq)~~	~~A_1 (Ci)~~	~~A_2 (TBq)~~	~~A_2 (Ci)~~	~~Specific Activity (TBq/g)~~	~~Specific Activity (Ci/g)~~
~~I-123~~	~~Iodine(53)~~	~~6~~	~~162~~	~~6~~	~~162~~	~~$7.1x10^4$~~	~~$1.9x10^6$~~
~~I-124~~		~~0.9~~	~~24.3~~	~~0.9~~	~~24.3~~	~~$9.3x10^3$~~	~~$2.5x10^5$~~
~~I-125~~		~~20~~	~~541~~	~~2~~	~~54.1~~	~~$6.4x10^2$~~	~~$1.7x10^4$~~
~~I-126~~		~~2~~	~~54.1~~	~~0.9~~	~~24.3~~	~~$2.9x10^3$~~	~~$8.0x10^4$~~
~~I-129~~		~~Unlimited~~	~~Unlimited~~	~~Unlimited~~	~~Unlimited~~	~~$6.5x10^{-6}$~~	~~$1.8x10^{-4}$~~
~~I-131~~		~~3~~	~~81.1~~	~~0.5~~	~~13.5~~	~~$4.6x10^3$~~	~~$1.2x10^5$~~
~~I-132~~		~~0.4~~	~~10.8~~	~~0.4~~	~~10.8~~	~~$3.8x10^5$~~	~~$1.0x10^7$~~
~~I-133~~		~~0.6~~	~~16.2~~	~~0.5~~	~~13.5~~	~~$4.2x10^4$~~	~~$1.1x10^6$~~
~~I-134~~		~~0.3~~	~~8.11~~	~~0.3~~	~~8.11~~	~~$9.9x10^5$~~	~~$2.7x10^7$~~
~~I-135~~		~~0.6~~	~~16.2~~	~~0.5~~	~~13.5~~	~~$1.3x10^5$~~	~~$3.5x10^6$~~
~~In-111~~	~~Indium(49)~~	~~2~~	~~54.1~~	~~2~~	~~54.1~~	~~$1.5x10^4$~~	~~$4.2x10^5$~~
~~In-113m~~		~~4~~	~~108~~	~~4~~	~~108~~	~~$6.2x10^5$~~	~~$1.7x10^7$~~
~~In-114m~~		~~0.3~~	~~8.11~~	~~0.3~~	~~8.11~~	~~$8.6x10^2$~~	~~$2.3x10^4$~~
~~In-115m~~		~~6~~	~~162~~	~~0.9~~	~~24.3~~	~~$2.2x10^5$~~	~~$6.1x10^6$~~
~~Ir-189~~	~~Iridium(77)~~	~~10~~	~~270~~	~~10~~	~~270~~	~~$1.9x10^3$~~	~~$5.2x10^4$~~
~~Ir-190~~		~~0.7~~	~~18.9~~	~~0.7~~	~~18.9~~	~~$2.3x10^3$~~	~~$6.2x10^4$~~
~~Ir-192~~		~~1~~	~~27~~	~~0.5~~	~~13.5~~	~~$3.4x10^2$~~	~~$9.2x10^3$~~
~~Ir-193m~~		~~10~~	~~270~~	~~10~~	~~270~~	~~$2.4x10^3$~~	~~$6.4x10^4$~~
~~Ir-194~~		~~0.2~~	~~5.41~~	~~0.2~~	~~5.41~~	~~$3.1x10^4$~~	~~$8.4x10^5$~~
~~K-40~~	~~Potassium(19)~~	~~0.6~~	~~16.2~~	~~0.6~~	~~16.2~~	~~$2.7x10^{-7}$~~	~~$6.4x10^{-6}$~~
~~K-42~~		~~0.2~~	~~5.41~~	~~0.2~~	~~5.41~~	~~$2.2x10^5$~~	~~$6.0x10^6$~~
~~K-43~~		~~1.0~~	~~27.0~~	~~0.5~~	~~13.5~~	~~$1.2x10^5$~~	~~$3.3x10^6$~~
~~Kr-81~~	~~Krypton(36)~~	~~40~~	~~1080~~	~~40~~	~~1080~~	~~$7.8x10^{-4}$~~	~~$2.1x10^{-2}$~~
~~Kr-85m~~		~~6~~	~~162~~	~~6~~	~~162~~	~~$3.0x10^5$~~	~~$8.2x10^6$~~
~~Kr-85~~		~~20~~	~~541~~	~~10~~	~~270~~	~~$1.5x10^1$~~	~~$3.9x10^2$~~
~~Kr-87~~		~~0.2~~	~~5.41~~	~~0.2~~	~~5.41~~	~~$1.0x10^6$~~	~~$2.8x10^7$~~
~~La-137~~	~~Lanthanum(57)~~	~~40~~	~~1080~~	~~2~~	~~54.1~~	~~$1.6x10^{-3}$~~	~~$4.4x10^{-2}$~~
~~La-140~~		~~0.4~~	~~10.8~~	~~0.4~~	~~10.8~~	~~$2.1x10^4$~~	~~$5.6x10^5$~~

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~~Table A-1. A_1 and A_2 Values for Radionuclides~~

~~Symbol of radio-nuclide~~	~~Element and atomic number~~	~~A_1 (TBq)~~	~~A_1 (Ci)~~	~~A_2 (TBq)~~	~~A_2 (Ci)~~	~~Specific Activity (TBq/g)~~	~~Specific Activity (Ci/g)~~
~~Lu-172~~	~~Lutetium(71)~~	~~0.5~~	~~13.5~~	~~0.5~~	~~13.5~~	~~$4.2x10^3$~~	~~$1.1x10^5$~~
~~Lu-173~~		~~8~~	~~216~~	~~8~~	~~216~~	~~$5.6x10^1$~~	~~$1.5x10^3$~~
~~Lu-174m~~		~~20~~	~~541~~	~~8~~	~~216~~	~~$2.0x10^2$~~	~~$5.3x10^3$~~
~~Lu-174~~		~~8~~	~~216~~	~~4~~	~~108~~	~~$2.3x10^1$~~	~~$6.2x10^2$~~
~~Lu-177~~		~~30~~	~~811~~	~~0.9~~	~~24.3~~	~~$4.1x10^3$~~	~~$1.1x10^5$~~
~~MFP~~	~~For mixed fission products, use the formula for mixtures or Table A-2~~						
~~Mg-28~~	~~Magnesium(12)~~	~~0.2~~	~~5.41~~	~~0.2~~	~~5.41~~	~~$2.0x10^5$~~	~~$5.4x10^6$~~
~~Mn-52~~	~~Manganese(25)~~	~~0.3~~	~~8.11~~	~~0.3~~	~~8.11~~	~~$1.6x10^4$~~	~~$1.8x10^{-3}$~~
~~Mn-53~~		~~Unlimited~~	~~Unlimited~~	~~Unlimited~~	~~Unlimited~~	~~$6.8x10^{-5}$~~	~~$1.8x10^{-3}$~~
~~Mn-54~~		~~1~~	~~27.0~~	~~1~~	~~27.0~~	~~$2.9x10^2$~~	~~$7.7x10^3$~~
~~Mn-56~~		~~0.2~~	~~5.41~~	~~0.2~~	~~5.41~~	~~$8.0x10^5$~~	~~$2.2x10^7$~~
~~Mo-93~~	~~Molybdenum(42)~~	~~40~~	~~1080~~	~~7~~	~~189~~	~~$4.1x10^{-2}$~~	~~1.1~~
~~Mo-99~~		~~0.6~~	~~16.2~~	~~0.5~~	~~13.5[e]~~	~~$1.8x10^4$~~	~~$4.8x10^5$~~
~~N-13~~	~~Nitrogen(7)~~	~~0.6~~	~~16.2~~	~~0.5~~	~~13.5~~	~~$5.4x10^7$~~	~~$1.5x10^9$~~
~~Na-22~~	~~Sodium(11)~~	~~0.5~~	~~13.5~~	~~0.5~~	~~13.5~~	~~$2.3x10^2$~~	~~$6.3x10^3$~~
~~Na-24~~		~~0.2~~	~~5.41~~	~~0.2~~	~~5.41~~	~~$3.2x10^5$~~	~~$8.7x10^6$~~
~~Nb-92m~~	~~Niobium(41)~~	~~0.7~~	~~18.9~~	~~0.7~~	~~18.9~~	~~$5.2x10^3$~~	~~$1.4x10^5$~~
~~Nb-93m~~		~~40~~	~~1080~~	~~6~~	~~162~~	~~8.8~~	~~$2.4x10^2$~~
~~Nb-94~~		~~0.6~~	~~16.2~~	~~0.6~~	~~16.2~~	~~$6.9x10^{-3}$~~	~~$1.9x10^{-1}$~~
~~Nb-95~~		~~1~~	~~27.0~~	~~1~~	~~27.0~~	~~$1.5x10^3$~~	~~$3.9x10^4$~~
~~Nb-97~~		~~0.6~~	~~16.2~~	~~0.5~~	~~13.5~~	~~$9.9x10^5$~~	~~$2.7x10^7$~~
~~Nd-147~~	~~Neodymium(60)~~	~~4~~	~~108~~	~~0.5~~	~~13.5~~	~~$3.0x10^3$~~	~~$8.1x10^4$~~
~~Nd-149~~		~~0.6~~	~~16.2~~	~~0.5~~	~~13.5~~	~~$4.5x10^5$~~	~~$1.2x10^7$~~
~~Ni-59~~	~~Nickel(28)~~	~~40~~	~~1080~~	~~40~~	~~1080~~	~~$3.0x10^{-3}$~~	~~$8.0x10^{-2}$~~
~~Ni-63~~		~~40~~	~~1080~~	~~30~~	~~811~~	~~2.1~~	~~$5.7x10^1$~~
~~Ni-65~~		~~0.3~~	~~8.11~~	~~0.3~~	~~8.11~~	~~$7.1x10^5$~~	~~$1.9x10^7$~~
~~Np-235~~	~~Neptunium(93)~~	~~40~~	~~1080~~	~~40~~	~~1080~~	~~$5.2x10^1$~~	~~$1.4x10^3$~~
~~Np-236~~		~~7~~	~~189~~	~~$1x10^{-3}$~~	~~$2.70x10^{-2}$~~	~~$4.7x10^{-4}$~~	~~$1.3x10^{-2}$~~

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~~Table A-1. A_1 and A_2 Values for Radionuclides~~

~~Symbol of radio-nuclide~~	~~Element and atomic number~~	~~A_1 (TBq)~~	~~A_1 (Ci)~~	~~A_2 (TBq)~~	~~A_2 (Ci)~~	~~Specific Activity (TBq/g)~~	~~Specific Activity (Ci/g)~~
~~Np-237~~		~~2~~	~~54.1~~	~~$2x10^{-4}$~~	~~$5.41x10^{-3}$~~	~~$2.6x10^{-5}$~~	~~$7.1x10^{-1}$~~
~~Np-239~~		~~6~~	~~162~~	~~0.5~~	~~13.5~~	~~$8.6x10^{2}$~~	~~$2.3x10^{5}$~~
~~Os-185~~	~~Osmium(76)~~	~~1~~	~~27.0~~	~~1~~	~~27.0~~	~~$2.8x10^{2}$~~	~~$7.5x10^{3}$~~
~~Os-191m~~		~~40~~	~~1080~~	~~40~~	~~1080~~	~~$4.6x10^{4}$~~	~~$1.3x10^{6}$~~
~~Os-191~~		~~10~~	~~270~~	~~0.9~~	~~24.3~~	~~$1.6x10^{3}$~~	~~$4.4x10^{4}$~~
~~Os-193~~		~~0.6~~	~~16.2~~	~~0.5~~	~~13.5~~	~~$2.0x10^{4}$~~	~~$5.3x10^{5}$~~
~~Os-194~~		~~0.2~~	~~5.41~~	~~0.2~~	~~5.41~~	~~$1.1x10^{1}$~~	~~$3.1x10^{2}$~~
~~P-32~~	~~Phosphorus(15)~~	~~0.3~~	~~8.11~~	~~0.3~~	~~8.11~~	~~$1.1x10^{4}$~~	~~$2.9x10^{5}$~~
~~P-33~~		~~40~~	~~1080~~	~~0.9~~	~~24.3~~	~~$5.8x10^{3}$~~	~~$1.6x10^{5}$~~
~~Pa-230~~	~~Proactinium(91)~~	~~2~~	~~54.1~~	~~0.1~~	~~2.70~~	~~$1.2x10^{3}$~~	~~$3.3x10^{4}$~~
~~Pa-231~~		~~0.6~~	~~16.2~~	~~$6x10^{-5}$~~	~~$1.62x10^{-3}$~~	~~$1.7x10^{-3}$~~	~~$4.7x10^{-2}$~~
~~Pa-233~~		~~5~~	~~135~~	~~0.9~~	~~24.3~~	~~$7.7x10^{2}$~~	~~$2.1x10^{4}$~~
~~Pb-201~~	~~Lead(82)~~	~~1~~	~~27.0~~	~~1~~	~~27.0~~	~~$6.2x10^{4}$~~	~~$1.7x10^{6}$~~
~~Pb-202~~		~~40~~	~~1080~~	~~2~~	~~54.1~~	~~$1.2x10^{-4}$~~	~~$3.4x10^{-3}$~~
~~Pb-203~~		~~3~~	~~81.1~~	~~3~~	~~81.1~~	~~$1.1x10^{4}$~~	~~$3.0x10^{5}$~~
~~Pb-205~~		~~Unlimited~~	~~Unlimited~~	~~Unlimited~~	~~Unlimited~~	~~$4.5x10^{-6}$~~	~~$1.2x10^{-4}$~~
~~Pb-210~~		~~0.6~~	~~16.2~~	~~$9x10^{-3}$~~	~~0.243~~	~~2.8~~	~~$7.6x10^{1}$~~
~~Pb-212~~		~~0.3~~	~~8.11~~	~~0.3~~	~~8.11~~	~~$5.1x10^{4}$~~	~~$1.4x10^{6}$~~
~~Pd-103~~	~~Palladium(46)~~	~~40~~	~~1080~~	~~40~~	~~1080~~	~~$2.8x10^{3}$~~	~~$7.5x10^{4}$~~
~~Pd-107~~		~~Unlimited~~	~~Unlimited~~	~~Unlimited~~	~~Unlimited~~	~~$1.9x10^{-5}$~~	~~$5.1x10^{-4}$~~
~~Pd-109~~		~~0.6~~	~~16.2~~	~~0.5~~	~~13.5~~	~~$7.9x10^{4}$~~	~~$2.1x10^{6}$~~
~~Pm-143~~	~~Promethium(61)~~	~~3~~	~~81.1~~	~~3~~	~~81.1~~	~~$1.3x10^{2}$~~	~~$3.4x10^{3}$~~
~~Pm-144~~		~~0.6~~	~~16.2~~	~~0.6~~	~~16.2~~	~~$9.2x10^{1}$~~	~~$2.5x10^{3}$~~
~~Pm-145~~		~~30~~	~~811~~	~~7~~	~~189~~	~~5.2~~	~~$1.4x10^{2}$~~
~~Pm-147~~		~~40~~	~~1080~~	~~0.9~~	~~24.3~~	~~$3.4x10^{1}$~~	~~$9.3x10^{2}$~~
~~Pm-148m~~		~~0.5~~	~~13.5~~	~~0.5~~	~~13.5~~	~~$7.9x10^{2}$~~	~~$2.1x10^{4}$~~
~~Pm-149~~		~~0.6~~	~~16.2~~	~~0.5~~	~~13.5~~	~~$1.5x10^{4}$~~	~~$4.0x10^{5}$~~
~~Pm-151~~		~~3~~	~~81.1~~	~~0.5~~	~~13.5~~	~~$2.7x10^{4}$~~	~~$7.3x10^{5}$~~

~~Table A-1. A_1 and A_2 Values for Radionuclides~~

~~Symbol of Radionuclide~~	~~Element and atomic number~~	~~A_1 (TBq)~~	~~A_1 (Ci)~~	~~A_2 (TBq)~~	~~A_2 (Ci)~~	~~Specific Activity (TBq/g)~~	~~Specific Activity (Ci/g)~~
~~Po-208~~	~~Polonium(84)~~	~~40~~	~~1080~~	~~$2x10^{-2}$~~	~~0.541~~	~~$2.2x10^{1}$~~	~~$5.9x10^{2}$~~
~~Po-209~~		~~40~~	~~1080~~	~~$2x10^{-2}$~~	~~0.541~~	~~$6.2x10^{-1}$~~	~~$1.7x10^{1}$~~
~~Po-210~~		~~40~~	~~1080~~	~~$2x10^{-2}$~~	~~0.541~~	~~$1.7x10^{2}$~~	~~$4.5x10^{3}$~~
~~Pr-142~~	~~Praseodymium(59)~~	~~0.2~~	~~5.41~~	~~0.2~~	~~5.41~~	~~$4.3x10^{4}$~~	~~$1.2x10^{6}$~~
~~Pr-143~~		~~4~~	~~108~~	~~0.5~~	~~13.5~~	~~$2.5x10^{3}$~~	~~$6.7x10^{4}$~~
~~Pt-188~~	~~Platinum(78)~~	~~0.6~~	~~16.2~~	~~0.6~~	~~16.2~~	~~$2.5x10^{3}$~~	~~$6.8x10^{4}$~~
~~Pt-191~~		~~3~~	~~81.1~~	~~3~~	~~81.1~~	~~$8.7x10^{3}$~~	~~$2.4x10^{5}$~~
~~Pt-193m~~		~~40~~	~~1080~~	~~9~~	~~243~~	~~$5.8x10^{3}$~~	~~$1.6x10^{5}$~~
~~Pt-193~~		~~40~~	~~1080~~	~~40~~	~~1080~~	~~1.4~~	~~$3.7x10^{1}$~~
~~Pt-195m~~		~~10~~	~~270~~	~~2~~	~~54.1~~	~~$6.2x10^{3}$~~	~~$1.7x10^{5}$~~
~~Pt-197m~~		~~10~~	~~270~~	~~0.9~~	~~24.3~~	~~$3.7x10^{5}$~~	~~$1.0x10^{7}$~~
~~Pt-197~~		~~20~~	~~541~~	~~0.5~~	~~13.5~~	~~$3.2x10^{4}$~~	~~$8.7x10^{5}$~~
~~Pu-236~~	~~Plutonium(94)~~	~~7~~	~~189~~	~~$7x10^{-4}$~~	~~$1.89x10^{-2}$~~	~~$2.0x10^{1}$~~	~~$5.3x10^{2}$~~
~~Pu-237~~		~~20~~	~~541~~	~~20~~	~~541~~	~~$4.5x10^{2}$~~	~~$1.2x10^{4}$~~
~~Pu-238~~		~~2~~	~~54.1~~	~~$2x10^{-4}$~~	~~$5.41x10^{-3}$~~	~~$6.3x10^{-1}$~~	~~$1.7x10^{1}$~~
~~Pu-239~~		~~2~~	~~54.1~~	~~$2x10^{-4}$~~	~~$5.41x10^{-3}$~~	~~$2.3x10^{-3}$~~	~~$6.2x10^{-2}$~~
~~Pu-240~~		~~2~~	~~54.1~~	~~$2x10^{-4}$~~	~~$5.41x10^{-3}$~~	~~$8.4x10^{-3}$~~	~~$2.3x10^{-1}$~~
~~Pu-241~~		~~40~~	~~1080~~	~~$1x10^{-2}$~~	~~0.270~~	~~3.8~~	~~$1.0x10^{2}$~~
~~Pu-242~~		~~2~~	~~54.1~~	~~$2x10^{-4}$~~	~~$5.41x10^{-3}$~~	~~$1.5x10^{-4}$~~	~~$3.9x10^{-3}$~~
~~Pu-244~~		~~0.3~~	~~8.11~~	~~$2x10^{-4}$~~	~~$5.41x10^{-3}$~~	~~$6.7x10^{-7}$~~	~~$1.8x10^{-5}$~~
~~Ra-223~~	~~Radium(88)~~	~~0.6~~	~~16.2~~	~~$3x10^{-2}$~~	~~0.811~~	~~$1.9x10^{3}$~~	~~$5.1x10^{4}$~~
~~Ra-224~~		~~0.3~~	~~8.11~~	~~$6x10^{-2}$~~	~~1.62~~	~~$5.9x10^{3}$~~	~~$1.6x10^{5}$~~
~~Ra-225~~		~~0.6~~	~~16.2~~	~~$2x10^{-2}$~~	~~0.541~~	~~$1.5x10^{3}$~~	~~$3.9x10^{4}$~~
~~Ra-226~~		~~0.3~~	~~8.11~~	~~$2x10^{-2}$~~	~~0.541~~	~~$3.7x10^{-2}$~~	~~1.0~~
~~Ra-228~~		~~0.6~~	~~16.2~~	~~$4x10^{-2}$~~	~~1.08~~	~~$1.0x10^{1}$~~	~~$2.7x10^{2}$~~
~~Rb-81~~	~~Rubidium(37)~~	~~2~~	~~54.1~~	~~0.9~~	~~24.3~~	~~$3.1x10^{5}$~~	~~$8.4x10^{6}$~~
~~Rb-83~~		~~2~~	~~54.1~~	~~2~~	~~54.1~~	~~$6.8x10^{2}$~~	~~$1.8x10^{4}$~~
~~Rb-84~~		~~1~~	~~27.0~~	~~0.9~~	~~24.3~~	~~$1.8x10^{3}$~~	~~$4.7x10^{4}$~~

~~Table A-1. A_1 and A_2 Values for Radionuclides~~

~~Symbol of Radionuclide~~	~~Element and atomic number~~	~~A_1 (TBq)~~	~~A_1 (Ci)~~	~~A_2 (TBq)~~	~~A_2 (Ci)~~	~~Specific Activity (TBq/g)~~	~~(Ci/g)~~
~~Rb-86~~		~~0.3~~	~~8.11~~	~~0.3~~	~~8.11~~	~~$3.0x10^3$~~	~~$8.1x10^4$~~
~~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-183~~	~~Rhenium(75)~~	~~5~~	~~135~~	~~5~~	~~135~~	~~$3.8x10^2$~~	~~$1.0x10^4$~~
~~Re-184m~~		~~3~~	~~81.1~~	~~3~~	~~81.1~~	~~$1.6x10^2$~~	~~$4.3x10^3$~~
~~Re-184~~		~~1~~	~~27.0~~	~~1~~	~~27.0~~	~~$6.9x10^2$~~	~~$1.9x10^4$~~
~~Re-186~~		~~4~~	~~108~~	~~0.5~~	~~13.5~~	~~$6.9x10^3$~~	~~$1.9x10^5$~~
~~Re-187~~		~~Unlimited~~	~~Unlimited~~	~~Unlimited~~	~~Unlimited~~	~~$1.4x10^{-9}$~~	~~$3.8x10^{-8}$~~
~~Re-188~~		~~0.2~~	~~5.41~~	~~0.2~~	~~5.41~~	~~$3.4x10^4$~~	~~$9.8x10^5$~~
~~Re-189~~		~~4~~	~~108~~	~~0.5~~	~~13.5~~	~~$2.5x10^4$~~	~~$6.8x10^5$~~
~~Re (nat)~~		~~Unlimited~~	~~Unlimited~~	~~Unlimited~~	~~Unlimited~~	~~$8.9x10^6$~~	~~$2.4x10^8$~~
~~Rh-99~~	~~Rhodium(45)~~	~~2~~	~~54.1~~	~~2~~	~~54.1~~	~~$3.0x10^3$~~	~~$8.2x10^4$~~
~~Rh-101~~		~~4~~	~~108~~	~~4~~	~~108~~	~~$4.1x10^1$~~	~~$1.1x10^3$~~
~~Rh-102m~~		~~2~~	~~54.1~~	~~0.9~~	~~24.3~~	~~$2.3x10^2$~~	~~$6.2x10^3$~~
~~Rh-102~~		~~0.5~~	~~13.5~~	~~0.5~~	~~13.5~~	~~$4.5x10^1$~~	~~$1.2x10^3$~~
~~Rh-103m~~		~~40~~	~~1080~~	~~40~~	~~1080~~	~~$1.2x10^6$~~	~~$3.3x10^7$~~
~~Rh-105~~		~~10~~	~~270~~	~~0.9~~	~~24.3~~	~~$3.1x10^4$~~	~~$8.4x10^5$~~
~~Rn-222~~	~~Radon(86)~~	~~0.2~~	~~5.41~~	~~$4x10^{-3}$~~	~~0.108~~	~~$5.7x10^3$~~	~~$1.5x10^5$~~
~~Ru-97~~	~~Ruthenium(44)~~	~~4~~	~~108~~	~~4~~	~~108~~	~~$1.7x10^4$~~	~~$4.6x10^5$~~
~~Ru-103~~		~~2~~	~~54.1~~	~~0.9~~	~~24.3~~	~~$1.2x10^3$~~	~~$3.2x10^4$~~
~~Ru-105~~		~~0.6~~	~~16.2~~	~~0.5~~	~~13.5~~	~~$2.5x10^5$~~	~~$6.7x10^6$~~
~~Ru-106~~		~~0.2~~	~~5.41~~	~~0.2~~	~~5.41~~	~~$1.2x10^2$~~	~~$3.3x10^3$~~
~~S-35~~	~~Sulfur(16)~~	~~40~~	~~1080~~	~~2~~	~~54.1~~	~~$1.6x10^3$~~	~~$4.3x10^4$~~
~~Sb-122~~	~~Antimony(51)~~	~~0.3~~	~~8.11~~	~~0.3~~	~~8.11~~	~~$1.5x10^4$~~	~~$4.0x10^5$~~
~~Sb-124~~		~~0.6~~	~~16.2~~	~~0.5~~	~~13.5~~	~~$6.5x10^2$~~	~~$1.7x10^4$~~
~~Sb-125~~		~~2~~	~~54.1~~	~~0.9~~	~~24.3~~	~~$3.9x10^1$~~	~~$1.0x10^3$~~
~~Sb-126~~		~~0.4~~	~~10.8~~	~~0.4~~	~~10.8~~	~~$3.1x10^3$~~	~~$8.4x10^4$~~
~~Sc-44~~	~~Scandium(21)~~	~~0.5~~	~~13.5~~	~~0.5~~	~~13.5~~	~~$6.7x10^5$~~	~~$1.8x10^7$~~

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~~Table A-1. — A_1 and A_2 Values for Radionuclides~~

~~Symbol of Radionuclide~~	~~Element and atomic number~~	~~A_1 (TBq)~~	~~A_1 (Ci)~~	~~A_2 (TBq)~~	~~A_2 (Ci)~~	~~Specific Activity (TBq/g)~~	~~(Ci/g)~~
~~Sc-46~~		~~0.5~~	~~13.5~~	~~0.5~~	~~13.5~~	~~$1.3x10^3$~~	~~$3.4x10^4$~~
~~Sc-47~~		~~9~~	~~243~~	~~0.9~~	~~24.3~~	~~$3.1x10^4$~~	~~$8.3x10^5$~~
~~Sc-48~~		~~0.3~~	~~8.11~~	~~0.3~~	~~8.11~~	~~$5.5x10^4$~~	~~$1.5x10^6$~~
~~Se-75~~	~~Selenium(34)~~	~~3~~	~~81.1~~	~~3~~	~~81.1~~	~~$5.5x10^2$~~	~~$1.5x10^4$~~
~~Se-79~~		~~40~~	~~1080~~	~~2~~	~~54.1~~	~~$2.6x10^{-3}$~~	~~$7.0x10^{-2}$~~
~~Si-31~~	~~Silicon(14)~~	~~0.6~~	~~16.2~~	~~0.5~~	~~13.5~~	~~$1.4x10^6$~~	~~$3.9x10^7$~~
~~Si-32~~		~~40~~	~~1080~~	~~0.2~~	~~5.41~~	~~3.9~~	~~$1.1x10^2$~~
~~Sm-145~~	~~Samarium(62)~~	~~20~~	~~541~~	~~20~~	~~541~~	~~$9.8x10^1$~~	~~$2.6x10^3$~~
~~Sm-147~~		~~Unlimited~~	~~Unlimited~~	~~Unlimited~~	~~Unlimited~~	~~$8.5x10^{-1}$~~	~~$2.3x10^{-9}$~~
~~Sm-151~~		~~40~~	~~1080~~	~~4~~	~~108~~	~~$9.7x10^{-1}$~~	~~$2.6x10^1$~~
~~Sm-153~~		~~4~~	~~108~~	~~0.5~~	~~13.5~~	~~$1.6x10^4$~~	~~$4.4x10^5$~~
~~Sn-133~~	~~Tin(50)~~	~~4~~	~~108~~	~~4~~	~~108~~	~~$3.7x10^2$~~	~~$1.0x10^4$~~
~~Sn-117m~~		~~6~~	~~162~~	~~2~~	~~54.1~~	~~$3.0x10^3$~~	~~$8.2x10^4$~~
~~Sn-119m~~		~~40~~	~~1080~~	~~40~~	~~1080~~	~~$1.4x10^2$~~	~~$3.7x10^3$~~
~~Sn-121m~~		~~40~~	~~1080~~	~~0.9~~	~~24.3~~	~~2.0~~	~~$5.4x10^1$~~
~~Sn-123~~		~~0.6~~	~~16.2~~	~~0.5~~	~~13.5~~	~~$3.0x10^2$~~	~~$8.2x10^3$~~
~~Sn-125~~		~~0.2~~	~~5.41~~	~~0.2~~	~~5.41~~	~~$4.0x10^3$~~	~~$1.1x10^5$~~
~~Sn-126~~		~~0.3~~	~~8.11~~	~~0.3~~	~~8.11~~	~~$1.0x10^{-3}$~~	~~$2.8x10^{-2}$~~
~~Sr-82~~	~~Strontium(38)~~	~~0.2~~	~~5.41~~	~~0.2~~	~~5.41~~	~~$2.3x10^3$~~	~~$6.2x10^4$~~
~~Sr-85m~~		~~5~~	~~135~~	~~5~~	~~1.35~~	~~$1.2x10^6$~~	~~$3.3x10^7$~~
~~Sr-85~~		~~2~~	~~54.1~~	~~2~~	~~54.1~~	~~$8.8x10^2$~~	~~$2.4x10^4$~~
~~Sr-87m~~		~~3~~	~~81.1~~	~~3~~	~~81.1~~	~~$4.8x10^5$~~	~~$1.3x10^7$~~
~~Sr-89~~		~~0.6~~	~~16.2~~	~~0.5~~	~~13.5~~	~~$1.1x10^3$~~	~~$2.9x10^4$~~
~~Sr-90~~		~~0.2~~	~~5.41~~	~~0.1~~	~~2.70~~	~~5.1~~	~~$1.4x10^2$~~
~~Sr-91~~		~~0.3~~	~~8.11~~	~~0.3~~	~~8.11~~	~~$1.3x10^5$~~	~~$3.6x10^6$~~
~~Sr-92~~		~~0.8~~	~~21.6~~	~~0.5~~	~~13.5~~	~~$4.7x10^5$~~	~~$1.3x10^7$~~
~~T~~	~~Tritium(1)~~	~~40~~	~~1080~~	~~40~~	~~1080~~	~~$3.6x10^2$~~	~~$9.7x10^3$~~
~~Ta-178~~	~~Tantalum(73)~~	~~1~~	~~27.0~~	~~1~~	~~27.0~~	~~$4.2x10^6$~~	~~$1.1x10^8$~~

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~~Table A-1. A_1 and A_2 Values for Radionuclides~~

~~Symbol of Radionuclide~~	~~Element and atomic number~~	~~A_1 (TBq)~~	~~A_1 (Ci)~~	~~A_2 (TBq)~~	~~A_2 (Ci)~~	~~Specific Activity (TBq/g)~~	~~Specific Activity (Ci/g)~~
~~Ta-179~~		~~30~~	~~811~~	~~30~~	~~811~~	~~$4.1x10^{1}$~~	~~$1.1x10^{3}$~~
~~Ta-182~~		~~0.8~~	~~21.6~~	~~0.5~~	~~13.5~~	~~$2.3x10^{2}$~~	~~$6.2x10^{3}$~~
~~Tb-157~~	~~Terbium(65)~~	~~40~~	~~1080~~	~~10~~	~~270~~	~~$5.6x10^{-1}$~~	~~$1.5x10^{1}$~~
~~Tb-158~~		~~1~~	~~27.0~~	~~0.7~~	~~18.9~~	~~$5.6x10^{-1}$~~	~~$1.5x10^{1}$~~
~~Tb-160~~		~~0.9~~	~~24.3~~	~~0.5~~	~~13.5~~	~~$4.2x10^{2}$~~	~~$1.1x10^{4}$~~
~~Tc-95m~~	~~Technetium(43)~~	~~2~~	~~54.1~~	~~2~~	~~54.1~~	~~$8.3x10^{2}$~~	~~$2.2x10^{4}$~~
~~Tc-96m~~		~~0.4~~	~~10.8~~	~~0.4~~	~~10.8~~	~~$1.4x10^{6}$~~	~~$3.8x10^{7}$~~
~~Tc-96~~		~~0.4~~	~~10.8~~	~~0.4~~	~~10.8~~	~~$1.2x10^{4}$~~	~~$3.2x10^{5}$~~
~~Tc-97m~~		~~40~~	~~1080~~	~~40~~	~~1080~~	~~$5.6x10^{2}$~~	~~$1.5x10^{4}$~~
~~Tc-97~~		~~Unlimited~~	~~Unlimited~~	~~Unlimited~~	~~Unlimited~~	~~$5.2x10^{-5}$~~	~~$1.4x10^{-3}$~~
~~Tc-98~~		~~0.7~~	~~18.9~~	~~0.7~~	~~18.9~~	~~$3.2x10^{-5}$~~	~~$8.7x10^{-4}$~~
~~Tc-99m~~		~~8~~	~~216~~	~~8~~	~~216~~	~~$1.9x10^{5}$~~	~~$5.3x10^{6}$~~
~~Tc-99~~		~~40~~	~~1080~~	~~0.9~~	~~24.3~~	~~$6.3x10^{-4}$~~	~~$1.7x10^{-2}$~~
~~Te-118~~	~~Tellurium(52)~~	~~0.2~~	~~5.41~~	~~0.2~~	~~5.41~~	~~$6.8x10^{3}$~~	~~$1.8x10^{5}$~~
~~Te-121m~~		~~5~~	~~135~~	~~5~~	~~135~~	~~$2.6x10^{2}$~~	~~$7.0x10^{3}$~~
~~Te-121~~		~~2~~	~~54.1~~	~~2~~	~~54.1~~	~~$2.4x10^{3}$~~	~~$6.4x10^{4}$~~
~~Te-123m~~		~~7~~	~~189~~	~~7~~	~~189~~	~~$3.3x10^{2}$~~	~~$8.9x10^{3}$~~
~~Te-125m~~		~~30~~	~~811~~	~~9~~	~~243~~	~~$6.7x10^{2}$~~	~~$1.8x10^{4}$~~
~~Te-127m~~		~~20~~	~~541~~	~~0.5~~	~~13.5~~	~~$3.5x10^{2}$~~	~~$9.4x10^{3}$~~
~~Te-127~~		~~20~~	~~541~~	~~0.5~~	~~13.5~~	~~$9.8x10^{4}$~~	~~$2.6x10^{6}$~~
~~Te-129m~~		~~0.6~~	~~16.2~~	~~0.5~~	~~13.5~~	~~$1.1x10^{3}$~~	~~$3.0x10^{4}$~~
~~Te-129~~		~~0.6~~	~~16.2~~	~~0.5~~	~~13.5~~	~~$7.7x10^{5}$~~	~~$2.1x10^{7}$~~
~~Te-131m~~		~~0.7~~	~~18.9~~	~~0.5~~	~~13.5~~	~~$3.0x10^{4}$~~	~~$8.0x10^{5}$~~
~~Te-132~~		~~0.4~~	~~10.8~~	~~0.4~~	~~10.8~~	~~$1.1x10^{4}$~~	~~$3.0x10^{5}$~~
~~Th-227~~	~~Thorium(90)~~	~~9~~	~~243~~	~~$1x10^{-2}$~~	~~0.270~~	~~$1.1x10^{3}$~~	~~$3.1x10^{4}$~~
~~Th-228~~		~~0.3~~	~~8.11~~	~~$4x10^{-4}$~~	~~$1.08x10^{-2}$~~	~~$3.0x10^{1}$~~	~~$8.2x10^{2}$~~
~~Th-229~~		~~0.3~~	~~8.11~~	~~$3x10^{-5}$~~	~~$8.44x10^{-4}$~~	~~$7.9x10^{-3}$~~	~~$2.1x10^{-1}$~~
~~Th-230~~		~~2~~	~~54.1~~	~~$2x10^{-4}$~~	~~$5.41x10^{-3}$~~	~~$7.6x10^{-4}$~~	~~$2.1x10^{-2}$~~

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~~Table A-1. A_1 and A_2 Values for Radionuclides~~

~~Symbol of Radionuclide~~	~~Element and atomic number~~	~~A_1 (TBq)~~	~~A_1 (Ci)~~	~~A_2 (TBq)~~	~~A_2 (Ci)~~	~~Specific Activity (TBq/g)~~	~~Specific Activity (Ci/g)~~
~~Th-231~~		~~40~~	~~1080~~	~~0.9~~	~~24.3~~	~~$2.0x10^4$~~	~~$5.3x10^5$~~
~~Th-232~~		~~Unlimited~~	~~Unlimited~~	~~Unlimited~~	~~Unlimited~~	~~$4.0x10^{-9}$~~	~~$1.1x10^{-7}$~~
~~Th-234~~		~~0.2~~	~~5.41~~	~~0.2~~	~~5.41~~	~~$8.6x10^2$~~	~~$2.3x10^4$~~
~~Th (nat)~~		~~Unlimited~~	~~Unlimited~~	~~Unlimited~~	~~Unlimited~~	~~$8.1x10^{-9}$~~	~~$2.2x10^{-7}$~~
~~Ti-44~~	~~Titanium(22)~~	~~0.5~~	~~13.5~~	~~0.2~~	~~5.41~~	~~6.4~~	~~$1.7x10^2$~~
~~Tl-200~~	~~Thallium(81)~~	~~0.8~~	~~21.6~~	~~0.8~~	~~21.6~~	~~$2.2x10^4$~~	~~$6.0x10^5$~~
~~Tl-201~~		~~10~~	~~270~~	~~10~~	~~270~~	~~$7.9x10^3$~~	~~$2.1x10^5$~~
~~Tl-202~~		~~2~~	~~54.1~~	~~2~~	~~54.1~~	~~$2.0x10^3$~~	~~$5.3x10^4$~~
~~Tl-204~~		~~4~~	~~108~~	~~0.5~~	~~13.5~~	~~$1.7x10^1$~~	~~$4.6x10^2$~~
~~Tm-167~~	~~Thulium(69)~~	~~7~~	~~189~~	~~7~~	~~189~~	~~$3.1x10^3$~~	~~$8.5x10^4$~~
~~Tm-168~~		~~0.8~~	~~21.6~~	~~0.8~~	~~21.6~~	~~$3.1x10^2$~~	~~$8.3x10^3$~~
~~Tm-170~~		~~4~~	~~108~~	~~0.5~~	~~13.5~~	~~$2.2x10^2$~~	~~$6.0x10^3$~~
~~Tm-171~~		~~40~~	~~1080~~	~~10~~	~~270~~	~~$4.0x10^1$~~	~~$1.1x10^3$~~
~~U-230~~	~~Uranium(92)~~	~~40~~	~~1080~~	~~$1x10^{-2}$~~	~~0.270~~	~~$1.0x10^3$~~	~~$2.7x10^4$~~
~~U-232~~		~~3~~	~~81.1~~	~~$3x10^{-4}$~~	~~$8.11x10^{-3}$~~	~~$8.3x10^{-1}$~~	~~$2.2x10^1$~~
~~U-233~~		~~10~~	~~270~~	~~$1x10^{-3}$~~	~~$2.70x10^{-2}$~~	~~$3.6x10^{-4}$~~	~~$9.7x10^{-3}$~~
~~U-234~~		~~10~~	~~270~~	~~$1x10^{-3}$~~	~~$2.70x10^{-2}$~~	~~$2.3x10^{-4}$~~	~~$6.2x10^{-3}$~~
~~U-235~~		~~Unlimited~~	~~Unlimited~~	~~Unlimited~~	~~Unlimited~~	~~$8.0x10^{-8}$~~	~~$2.2x10^{-6}$~~
~~U-236~~		~~10~~	~~270~~	~~$1x10^{-3}$~~	~~$2.70x10^{-2}$~~	~~$2.4x10^{-6}$~~	~~$6.5x10^{-5}$~~
~~U-238~~		~~Unlimited~~	~~Unlimited~~	~~Unlimited~~	~~Unlimited~~	~~$1.2x10^{-8}$~~	~~$3.4x10^{-7}$~~
~~U (nat)~~		~~Unlimited~~	~~Unlimited~~	~~Unlimited~~	~~Unlimited~~	~~$2.6x10^{-8}$~~	~~$7.1x10^{-7}$~~
~~U ≤ 5% (enriched)~~		~~Unlimited~~	~~Unlimited~~	~~Unlimited~~	~~Unlimited~~		~~(See Table A-3)~~
~~U > 5% (enriched)~~		~~10~~	~~270~~	~~$2.70x10^{-2}$~~	~~$2.70x10^{-2}$~~		~~(See Table A-3)~~
~~U (depleted)~~		~~Unlimited~~	~~Unlimited~~	~~Unlimited~~	~~Unlimited~~		~~(See Table A-3)~~
~~V-48~~	~~Vanadium(23)~~	~~0.3~~	~~8.11~~	~~0.3~~	~~8.11~~	~~$6.3x10^3$~~	~~$1.7x10^5$~~
~~V-49~~		~~40~~	~~1080~~	~~40~~	~~1080~~	~~$3.0x10^2$~~	~~$8.1x10^3$~~
~~W-178~~	~~Tungsten(74)~~	~~1~~	~~27.0~~	~~1~~	~~27.0~~	~~$1.3x10^3$~~	~~$3.4x10^4$~~

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60 **~~Table A-1. A_1 and A_2 Values for Radionuclides~~**
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~~Symbol of Radionuclide~~	~~Element and atomic number~~	~~A_1 (TBq)~~	~~A_1 (Ci)~~	~~A_2 (TBq)~~	~~A_2 (Ci)~~	~~Specific Activity (TBq/g)~~	~~(Ci/g)~~
~~W-181~~		~~30~~	~~811~~	~~30~~	~~811~~	~~$2.2x10^2$~~	~~$6.0x10^3$~~
~~W-185~~		~~40~~	~~1080~~	~~0.9~~	~~24.3~~	~~$3.5x10^2$~~	~~$9.4x10^3$~~
~~W-187~~		~~2~~	~~54.1~~	~~0.5~~	~~13.5~~	~~$2.6x10^4$~~	~~$7.0x10^5$~~
~~W-188~~		~~0.2~~	~~5.41~~	~~0.2~~	~~5.41~~	~~$3.7x10^2$~~	~~$1.0x10^4$~~
~~Xe-122~~	~~Xenon(54)~~	~~0.2~~	~~5.41~~	~~0.2~~	~~5.41~~	~~$4.8x10^4$~~	~~$1.3x10^6$~~
~~Xe-123~~		~~0.2~~	~~5.41~~	~~0.2~~	~~5.41~~	~~$4.4x10^5$~~	~~$1.2x10^7$~~
~~Xe-127~~		~~4~~	~~108~~	~~4~~	~~108~~	~~$1.0x10^3$~~	~~$2.8x10^4$~~
~~Xe-131m~~		~~40~~	~~1080~~	~~40~~	~~1080~~	~~$3.1x10^3$~~	~~$8.4x10^4$~~
~~Xe-133~~		~~20~~	~~541~~	~~20~~	~~541~~	~~$6.9x10^3$~~	~~$1.9x10^5$~~
~~Xe-135~~		~~4~~	~~108~~	~~4~~	~~108~~	~~$9.5x10^4$~~	~~$2.6x10^6$~~
~~Y-87~~	~~Yttrium(39)~~	~~2~~	~~54.1~~	~~2~~	~~54.1~~	~~$1.7x10^4$~~	~~$4.5x10^5$~~
~~Y-88~~		~~0.4~~	~~10.8~~	~~0.4~~	~~10.8~~	~~$5.2x10^2$~~	~~$1.4x10^4$~~
~~Y-90~~		~~0.2~~	~~5.41~~	~~0.2~~	~~5.41~~	~~$2.0x10^4$~~	~~$5.4x10^5$~~
~~Y-91m~~		~~2~~	~~54.1~~	~~2~~	~~54.1~~	~~$1.5x10^6$~~	~~$4.2x10^7$~~
~~Y-91~~		~~0.3~~	~~8.11~~	~~0.3~~	~~8.11~~	~~$9.1x10^2$~~	~~$2.5x10^4$~~
~~Y-92~~		~~0.2~~	~~5.41~~	~~0.2~~	~~5.41~~	~~$3.6x10^5$~~	~~$9.6x10^6$~~
~~Y-93~~		~~0.2~~	~~5.41~~	~~0.2~~	~~5.41~~	~~$1.2x10^5$~~	~~$3.3x10^6$~~
~~Yb-169~~	~~Ytterbium(70)~~	~~3~~	~~81.1~~	~~3~~	~~81.1~~	~~$8.9x10^2$~~	~~$2.4x10^4$~~
~~Yb-175~~		~~30~~	~~811~~	~~0.9~~	~~24.3~~	~~$6.6x10^3$~~	~~$1.8x10^5$~~
~~Zn-65~~	~~Zinc(30)~~	~~2~~	~~54.1~~	~~2~~	~~54.1~~	~~$3.0x10^2$~~	~~$8.2x10^3$~~
~~Zn-69m~~		~~2~~	~~54.1~~	~~0.5~~	~~13.5~~	~~$1.2x10^5$~~	~~$3.3x10^6$~~
~~Zn-69~~		~~4~~	~~108~~	~~0.5~~	~~13.5~~	~~$1.8x10^6$~~	~~$4.9x10^7$~~
~~Zr-88~~	~~Zirconium(40)~~	~~3~~	~~81.1~~	~~3~~	~~81.1~~	~~$6.6x10^2$~~	~~$1.8x10^4$~~
~~Zr-93~~		~~40~~	~~1080~~	~~0.2~~	~~5.41~~	~~$9.3x10^{-5}$~~	~~$2.5x10^{-3}$~~
~~Zr-95~~		~~1~~	~~27.0~~	~~0.9~~	~~24.3~~	~~$7.9x10^2$~~	~~$2.1x10^4$~~
~~Zr-97~~		~~0.3~~	~~8.11~~	~~0.3~~	~~8.11~~	~~$7.1x10^4$~~	~~$1.9x10^6$~~

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63 ~~[a] International shipments of Einsteinium require multilateral approval of A_1 and A_2 values.~~
64 ~~[b] International shipments of Fermium require multilateral approval of A_1 and A_2 values.~~
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[e] ~~20 Ci for Mo99 for domestic use.~~

~~Table A-2. General Values for A_1 and A_2~~

~~Contents~~	~~A_1~~		~~A_2~~	
	~~(TBq)~~	~~(Ci)~~	~~(TBq)~~	~~(Ci)~~
~~Only beta- or gamma-emitting nuclides are known to be present~~	~~0.2~~	~~5~~	~~0.02~~	~~0.5~~
~~Alpha-emitting nuclides are known to be present, or no relevant data are available~~	~~0.10~~	~~2.7~~	~~$2x10^{-5}$~~	~~$5.41x10^{-4}$~~

~~Table A-3. Activity - Mass Relationships for Uranium~~

~~Uranium Enrichment[1] wt % U-235 present~~	~~Specific Activity~~	
	~~TBq/g~~	~~Ci/g~~
~~0.45~~	~~$1.8x10^{-8}$~~	~~$5.0x10^{-7}$~~
~~0.72~~	~~$2.6x10^{-8}$~~	~~$7.1x10^{-7}$~~
~~1.0~~	~~$2.8x10^{-8}$~~	~~$7.6x10^{-7}$~~
~~1.5~~	~~$3.7x10^{-8}$~~	~~$1.0x10^{-6}$~~
~~5.0~~	~~$1.0x10^{-7}$~~	~~$2.7x10^{-6}$~~
~~10.0~~	~~$1.8x10^{-7}$~~	~~$4.8x10^{-6}$~~
~~20.0~~	~~$3.7x10^{-7}$~~	~~$1.0x10^{-5}$~~
~~35.0~~	~~$7.4x10^{-7}$~~	~~$2.0x10^{-5}$~~
~~50.0~~	~~$9.3x10^{-7}$~~	~~$2.5x10^{-5}$~~
~~90.0~~	~~$2.2x10^{-6}$~~	~~$5.8x10^{-5}$~~
~~93.0~~	~~$2.6x10^{-6}$~~	~~$7.0x10^{-5}$~~
~~95.0~~	~~$3.4x10^{-6}$~~	~~$9.1x10^{-5}$~~

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

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Table A-1—A_1 and A_2 VALUES FOR RADIONUCLIDES

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Symbol of radionuclide	Element and atomic number	A_1 (TBq)	A_1(Ci)[b]	A_2 (TBq)	A_2(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	$7.0X10^{-4}$	$1.9X10^{-2}$
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	_	$4.0X10^{1}$	$1.1X10^{3}$	$6.0X10^{-1}$	$1.6X10^{1}$	$8.3X10^{-4}$	$2.2X10^{-2}$

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Table A-1—A_1 and A_2 VALUES FOR RADIONUCLIDES

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Symbol of radionuclide	Element and atomic number	A_1 (TBq)	A_1(Ci)[b]	A_2 (TBq)	A_2(Ci)[b]	Specific activity	
						(TBq/g)	(Ci/g)
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	$1.2X10^{2}$	$3.2X10^{3}$
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	$1.1X10^{3}$	$2.9X10^{4}$

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136 **Table A-1—A_1 and A_2 VALUES FOR RADIONUCLIDES**

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Symbol of radionuclide	Element and atomic number	A_1 (TBq)	A_1(Ci)[b]	A_2 (TBq)	A_2(Ci)[b]	Specific activity	
						(TBq/g)	(Ci/g)
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)	$2.0X10^{1}$	$5.4X10^{2}$	$2.0X10^{1}$	$5.4X10^{2}$	$2.1X10^{2}$	$5.7X10^{3}$

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Table A-1—A_1 and A_2 VALUES FOR RADIONUCLIDES

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Symbol of radionuclide	Element and atomic number	A_1 (TBq)	A_1(Ci)[b]	A_2 (TBq)	A_2(Ci)[b]	Specific activity	
						(TBq/g)	(Ci/g)
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	-	$8.0X10^{-1}$	$2.2X10^{1}$	$8.0X10^{-1}$	$2.2X10^{1}$	$8.2X10^{4}$	$2.2X10^{6}$
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	$1.3X10^{5}$	$3.6X10^{6}$

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142 **Table A-1—A_1 and A_2 VALUES FOR RADIONUCLIDES**

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Symbol of radionuclide	Element and atomic number	A_1 (TBq)	A_1(Ci)[b]	A_2 (TBq)	A_2(Ci)[b]	Specific activity	
						(TBq/g)	(Ci/g)
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	$3.1X10^{4}$	$8.4X10^{5}$
K-40	Potassium (19)	$9.0X10^{-1}$	$2.4X10^{1}$	$9.0X10^{-1}$	$2.4X10^{1}$	$2.4X10^{-7}$	$6.4X10^{-6}$

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Table A-1—A_1 and A_2 VALUES FOR RADIONUCLIDES

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Symbol of radionuclide	Element and atomic number	A_1 (TBq)	A_1(Ci)[b]	A_2 (TBq)	A_2(Ci)[b]	Specific activity	
						(TBq/g)	(Ci/g)
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	$3.0X10^{-3}$	$8.0X10^{-2}$

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Table A-1—A_1 and A_2 VALUES FOR RADIONUCLIDES

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Symbol of radionuclide	Element and atomic number	A_1 (TBq)	A_1(Ci)[b]	A_2 (TBq)	A_2(Ci)[b]	Specific activity	
						(TBq/g)	(Ci/g)
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	$5.4X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$2.0X10^{4}$	$5.3X10^{5}$
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	$2.7X10^{1}$	$5.8X10^{3}$	$1.6X10^{5}$
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	$1.4X10^{2}$

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Table A-1—A_1 and A_2 VALUES FOR RADIONUCLIDES

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Symbol of radionuclide	Element and atomic number	A_1 (TBq)	A_1(Ci)[b]	A_2 (TBq)	A_2(Ci)[b]	Specific activity	
						(TBq/g)	(Ci/g)
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	$2.7X10^{1}$	$1.8X10^{3}$	$4.7X10^{4}$

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Table A-1—A_1 and A_2 VALUES FOR RADIONUCLIDES

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Symbol of radionuclide	Element and atomic number	A_1 (TBq)	A_1(Ci)[b]	A_2 (TBq)	A_2(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	$5.5X10^{4}$	$1.5X10^{6}$

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Table A-1—A_1 and A_2 VALUES FOR RADIONUCLIDES

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Symbol of radionuclide	Element and atomic number	A_1 (TBq)	A_1(Ci)[b]	A_2 (TBq)	A_2(Ci)[b]	Specific activity	
						(TBq/g)	(Ci/g)
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	$5.4X10^1$	$8.8X10^2$	$2.4X10^4$
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	$2.7X10^1$	$6.0X10^{-1}$	$1.6X10^1$	$4.2X10^2$	$1.1X10^4$

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Table A-1—A_1 and A_2 VALUES FOR RADIONUCLIDES

Symbol of radionuclide	Element and atomic number	A_1 (TBq)	A_1(Ci)[b]	A_2 (TBq)	A_2(Ci)[b]	Specific activity	
						(TBq/g)	(Ci/g)
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	$5.4X10^1$	$2.0X10^3$	$5.3X10^4$

163 **Table A-1—A_1 and A_2 VALUES FOR RADIONUCLIDES**

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Symbol of radionuclide	Element and atomic number	A_1 (TBq)	A_1(Ci)[b]	A_2 (TBq)	A_2(Ci)[b]	Specific activity	
						(TBq/g)	(Ci/g)
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	_	$4.0X10^1$	$1.1X10^3$	$4.0X10^1$	$1.1X10^3$	$4.0X10^1$	$1.1X10^3$
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)	_	$4.0X10^1$	$1.1X10^3$	$2.0X10^{-2}$	$5.4X10^{-1}$	$2.3X10^{-4}$	$6.2X10^{-3}$

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166 **Table A-1—A_1 and A_2 VALUES FOR RADIONUCLIDES**

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Symbol of radionuclide	Element and atomic number	A_1 (TBq)	A_1(Ci)[b]	A_2 (TBq)	A_2(Ci)[b]	Specific activity	
						(TBq/g)	(Ci/g)
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	_	$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	$3.1X10^{3}$	$8.4X10^{4}$

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Table A-1—A_1 and A_2 VALUES FOR RADIONUCLIDES

Symbol of radionuclide	Element and atomic number	A_1 (TBq)	A_1(Ci)[b]	A_2 (TBq)	A_2(Ci)[b]	Specific activity	
						(TBq/g)	(Ci/g)
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	$5.4X10^1$	$1.5X10^6$	$4.2X10^7$
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] A_1 and/or A_2 values include contributions from daughter nuclides with half-lives less than 10 days.
[b] The values of A_1 and A_2 in Curies (Ci) are approximate and for information only; the regulatory standard units are Terabecquerels (TBq), (see Appendix A to Part 71 - Determination of A_1 and A_2, Section I.).
[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 UF_6, UO_2F_2 and $UO_2(NO_3)_2$ 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.
[h] A_1 = 0.1 TBq (2.7 Ci) and A_2 = 0.001 TBq (0.027 Ci) for Cf-252 for domestic use.
[i] A_2 = 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	_	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
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)	_	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$

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)
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	_	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$

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)
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	_	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$
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	_	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$

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)
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	_	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$

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)
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	_	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$

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)
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	_	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$
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	_	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$

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)
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	-	$1.0X10^{4}$	$2.7X10^{-7}$	$1.0X10^{7}$	$2.7X10^{-4}$

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)
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)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
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	$2.7X10^{-11}$	$1.0X10^{4}$	$2.7X10^{-7}$

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)
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	_	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$
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	_	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$

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)
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	_	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$

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)
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	_	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{6}$	$2.7X10^{-5}$
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	_	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{7}$	$2.7X10^{-4}$

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)
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)	_	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{4}$	$2.7X10^{-7}$

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)
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)	-	$1.0X10^{1}$	$2.7X10^{-10}$	$1.0X10^{5}$	$2.7X10^{-6}$
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	$2.7X10^{-11}$	$1.0X10^{3}$	$2.7X10^{-8}$

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)
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)	$1.0X10^{2}$	$2.7X10^{-9}$	$1.0X10^{6}$	$2.7X10^{-5}$

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)
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 $UO_2(NO_3)_2$ 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 A_1 AND A_2

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}

261 **TABLE A-4—ACTIVITY-MASS RELATIONSHIPS FOR URANIUM**

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

263 [1] The figures for uranium include representative values for the activity of the uranium-234 that is
264 concentrated during the enrichment process.

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