

PART T**TRANSPORTATION OF RADIOACTIVE MATERIAL**Sec. T.1 - Purpose and Scope.

- a. The regulations in this Part establish requirements for packaging, preparation for shipment, and transportation of radioactive material;
- b. The packaging and transport of radioactive material are also subject to other Parts of these regulations and to the regulations of other agencies (such as the United States Department of Transportation, the United States Postal Service and the United States Nuclear Regulatory Commission) having jurisdiction over means of transport. The requirements of this Part are in addition to, and not in substitution for, other requirements.
- c. This Part applies to any licensee authorized by specific or general license issued to receive, possess, use, or transfer licensed material, if the licensee delivers that material to a carrier for transport, transports the material outside the site of usage as specified in the license, or transports that material on public highways. No provision of this Part authorizes possession of licensed material.
- d. Exemptions from the requirement for license are specified in T.4. General licenses for which no package approval is required are issued in T.8 through T.10. The general license in T.7 requires that a United States Nuclear Regulatory Commission certificate of compliance or other package approval be issued for the package to be used under the general license. The transport of licensed material or delivery of licensed material to a carrier for transport is subject to the operating controls and procedures requirements of T.15 through T.19, to the quality assurance requirements of T.20 and to the general provisions of rules T.1 through T.5, including referenced United States Department of Transportation regulations.
- e. These rules apply to any person required to obtain a certificate of compliance or an approved compliance plan from the United States Nuclear Regulatory Commission pursuant to 10 CFR 71 if the person delivers radioactive material to a common or contract carrier for transport or transports the material outside the confines of the person's plant or other authorized place of use.

Sec. T.2 - Definitions. As used in this Part, the following definitions apply:

“A₁” means the maximum activity of special form radioactive material permitted in a Type A package. This value is either listed in Tables A-1, A-1(Supplement) and A-3 in Appendix A of this Part, or may be derived in accordance with the procedures prescribed in Appendix A of this Part.

“A₂” means the maximum activity of radioactive material, other than special form material, LSA, and SCO material, permitted in a Type A package. This value is either listed in Tables A-1, A-1 Supplement or A-3 in Appendix A of this Part, or may be derived in accordance with the procedures prescribed in Appendix A of this Part.

“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 of Compliance” (CoC) means the certificate issued by the U.S. Nuclear Regulatory Commission under subpart D of 10 CFR 71 which approves the design of a package for the transportation of radioactive material.

“Certificate Holder” means a person who has been issued a Certificate of Compliance or other package approval by the US Nuclear Regulatory Commission.

“Closed transport vehicle” means a transport vehicle equipped with a securely attached exterior enclosure that during normal transportation restricts the access of unauthorized persons to the cargo space containing the radioactive material. The enclosure may be either temporary or permanent but shall limit access from top, sides, and ends. In the case of packaged materials, it may be of the "see-through" type.

"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.

“Contamination” means the presence of a radioactive substance on a surface in quantities in excess of 0.4 Bq/cm^2 ($1 \times 10^{-5} \text{ } \mu\text{Ci/cm}^2$) for beta and gamma emitters and low toxicity alpha emitters, or 0.04 Bq/cm^2 ($1 \times 10^{-6} \text{ } \mu\text{Ci/cm}^2$) for all other alpha emitters.

- (1) *Fixed contamination* means contamination that cannot be removed from a surface during normal conditions of transport.
- (2) *Non-fixed contamination* means contamination that can be removed from a surface during normal conditions of 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
- (3) For transport by 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, overpacks or freight containers containing fissile material during transportation. Determination of the criticality safety index is described in T.9 and T.10 and 10 CFR 71.59. The criticality safety index for an overpack, freight container, consignment or conveyance containing fissile material packages is the arithmetic sum of the criticality safety indices of all the fissile material packages contained within the overpack, freight container, consignment or conveyance.

“Deuterium” means, for the purposes of T.4 and T.9, 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 U-233, U-235, Pu-239, and Pu-241, or any combination of these radionuclides. Fissile material means the fissile nuclides themselves, not material containing fissile nuclides. Unirradiated natural uranium and depleted uranium, and natural uranium or depleted uranium, that has been irradiated in thermal reactors only, are not included in this definition. Certain exclusions from fissile material controls are provided in T.4 and 10 CFR 71.15.

“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.

“Graphite” means, for the purposes of this Part, graphite with a boron equivalent content less than five parts per million and density greater than 1.5 grams per cubic centimeter.

“Highway Route Controlled Quantity (HRCQ)” means a quantity within a single package which exceeds:

- (1) 3,000 times the A_1 value of the radionuclides as specified in 49 CFR 173.435 for special form Class 7 (radioactive) material;
- (2) 3,000 times the A_2 value of the radionuclides as specified in 49 CFR 173.435 for normal form Class 7 (radioactive) material; or
- (3) 1,000 TBq (27,000 Ci), whichever is least.

“Indian Tribe” means an Indian or Alaska Native Tribe, band, nation, pueblo, village, or community that the Secretary of the Interior acknowledges to exist as an Indian Tribe pursuant to the Federally Recognized Indian Tribe List Act of 1994, 25 U.S.C. 479a.

“Low specific activity (LSA) material” means radioactive material with limited specific activity which is nonfissile or excepted under this Part and which satisfies the descriptions and limits set forth below. Shielding materials surrounding the LSA material may not be considered in determining the estimated average specific activity of the package contents. LSA material must be in one of three groups:

- (1) LSA-I

- (i) Uranium and thorium ores, concentrates of uranium and thorium ores, and other ores containing naturally occurring radionuclides which are intended to be processed for the use of these radionuclides;
 - (ii) Natural uranium, depleted uranium, natural thorium or their compounds or mixtures, provided they are unirradiated and in solid or liquid form;
 - (iii) Radioactive material, other than fissile material, for which the A_2 value is unlimited; or
 - (iv) Other radioactive material in which the radioactive material is distributed throughout and the estimated average specific activity does not exceed 30 times the value for exempt material activity concentrations determined under Appendix A.
- (2) LSA-II
- (i) Water with tritium concentration up to 0.8 TBq/L (20.0 Ci/L); or
 - (ii) Material in which the radioactive material 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.
- (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; for example, concrete, bitumen, or ceramic 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, excluding any shielding, does not exceed $2 \times 10^{-3} A_2/g$.

“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.

“Natural thorium” means thorium with the naturally occurring distribution of thorium isotopes, which is 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.”

“Nuclear waste” means a quantity of source, byproduct or special nuclear material required to be in US Nuclear Regulatory Commission-approved specification packaging while transported to, through or across a state boundary to a disposal site, or to a collection point for transport to a disposal site.

“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.
- (3) Type B package means a Type B packaging together with its radioactive contents. On approval, a Type B package design is designated by NRC as B(U) unless the package has a maximum normal operating pressure of more than 700 kPa (100 lbs/in²) gauge or a pressure relief device that would allow the release of radioactive material to the environment under the tests specified in 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 10 CFR 71.19.

“Packaging” means the assembly of components necessary to ensure compliance with the packaging requirements of 49 CFR Part 173, Subpart I and 10 CFR 71. 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.

“Regulations of the US Department of Transportation” means the regulations in 49 CFR Parts 100-189 and Parts 390-397.

“Regulations of the US Nuclear Regulatory Commission” means the regulations in 10 CFR 71 for purposes of Part T.

“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 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; 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, 1996),

and constructed before April 1, 1998; and special form material that was successfully tested before September 10, 2015 in accordance with the requirements of 10 CFR 71.75(d) of this section in effect before September 10, 2015, 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.

“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. An 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 ($10^{-4}\text{ }\mu\text{Ci/cm}^2$) for beta and gamma and low toxicity alpha emitters, or 0.4 Bq/cm^2 ($10^{-5}\text{ }\mu\text{Ci/cm}^2$) 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 $4\times 10^4\text{ Bq/cm}^2$ ($1.0\text{ }\mu\text{Ci/cm}^2$) for beta and gamma and low toxicity alpha emitters, or $4\times 10^3\text{ Bq/cm}^2$ ($0.1\text{ }\mu\text{Ci/cm}^2$) 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 $4\times 10^4\text{ Bq/cm}^2$ ($1\text{ }\mu\text{Ci/cm}^2$) for beta and gamma and low toxicity alpha emitters, or $4\times 10^3\text{ Bq/cm}^2$ ($0.1\text{ }\mu\text{Ci/cm}^2$) 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 ($10^{-2}\text{ }\mu\text{Ci/cm}^2$) for beta and gamma and low toxicity alpha emitters or 40 Bq/cm^2 ($10^{-3}\text{ }\mu\text{Ci/cm}^2$) 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 $8\times 10^5\text{ Bq/cm}^2$ ($20\text{ }\mu\text{Ci/cm}^2$) for beta and gamma and low toxicity alpha emitters, or $8\times 10^4\text{ Bq/cm}^2$ ($2\text{ }\mu\text{Ci/cm}^2$) 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 $8\times 10^5\text{ Bq/cm}^2$ ($20\text{ }\mu\text{Ci/cm}^2$) for beta and gamma and low toxicity alpha emitters, or $8\times 10^4\text{ Bq/cm}^2$ ($2\text{ }\mu\text{Ci/cm}^2$) 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 one meter (3.3 feet) from the external surface of the package by 100, which is equivalent to the maximum radiation level in millirem per hour at 1 meter (3.3 feet).

“Tribal official” means the highest ranking individual that represents Tribal leadership, such as the Chief, President, or Tribal Council leadership.

“Type A package” means a packaging that, together with its radioactive contents limited to A_1 or A_2 as appropriate, meets the requirements of 49 CFR 173.410 and 173.412 and is designed to retain the integrity of containment and shielding required by this Part T under normal conditions of transport as demonstrated by the tests set forth in 49 CFR 173.465 or 173.466, as appropriate.

“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 Appendix A or may be determined by procedures described in Appendix A.

“Type B package” means a Type B packaging, that together with its radioactive contents, is designed to retain the integrity of containment and shielding required by 49 CFR 173 when subjected to the normal conditions of transport and hypothetical accident conditions set forth in 10 CFR 71.

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

“Unirradiated uranium” means uranium containing not more than 2×10^3 Bq (54 nCi) of plutonium per gram of uranium-235, not more than 9×10^6 Bq (243 μ Ci) of fission products per gram of uranium-235, and not more than 0.005 grams of uranium-236 per gram of uranium-235.

“Uranium—natural, depleted, enriched”

- (1) Natural uranium means uranium (which may be chemically separated) 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.

General Regulatory Provisions

Sec. T.3 - Requirement for License. No person shall transport radioactive material or deliver radioactive material to a carrier for transport except as authorized in a general or specific license

issued by the Agency or as exempted in T.4.

Sec. T.4 - Exemptions.

- a. Common and contract carriers, freight forwarders, and warehouse workers who are subject to the requirements of the US Department of Transportation in 49 CFR 170 through 189 or the US Postal Service in the US Postal Service Domestic Mail Manual (DMM), Section C-023.9.0, and the US Postal Service, are exempt from the requirements of this Part to the extent that they transport or store radioactive material in the regular course of their carriage for others or storage incident thereto. Common and contract carriers who are not subject to the requirements of the US Department of Transportation or US Postal Service are subject to T.3 and other applicable requirements of these regulations.
- b. A licensee is exempt from the requirements of this Part with respect to shipment or carriage of the following low-level materials:
 - i. 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, or Table A-3 of this Part.
 - ii. Materials for which the activity concentration is not greater than the activity concentration values specified in Appendix A, Table A-2, or Table A-3 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, or Table A-3 of this Part.
 - iii. Non-radioactive solid objects with radioactive substances present on any surfaces in quantities not in excess of the levels cited in the definition of “contamination” in T.2.
- c. Fissile materials meeting one of the following requirements are exempt from classification as fissile material and from the fissile material package standards of 10 CFR 71.55 and 10 CFR 71.59, but are subject to all other requirements of 10 CFR 71, except as noted.
 - i. Individual package containing 2 grams or less of fissile material.
 - ii. 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.
 - iii. Low concentrations of solid fissile material commingled with solid nonfissile material, provided that there is at least 2000 grams of solid nonfissile material for every gram of fissile material and that there is no more than 180 grams of fissile material distributed within 360 kg of contiguous nonfissile 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 of solid nonfissile material.

- iv. 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, and that the fissile material is distributed homogeneously and does not form a lattice arrangement within the package.
- v. Liquid solutions of uranyl nitrate enriched in uranium-235 to a maximum of two percent by mass, provided that:
 - (1) The total plutonium and uranium-233 content does not exceed 0.002 percent of the total mass of uranium;
 - (2) The nitrogen to uranium atomic ratio (N/U) is greater than or equal to 2.0; and
 - (3) The material must be contained in at least a DOT Type A package.
- vi. Plutonium with a total mass not more than 1000 grams, provided that: plutonium-239, plutonium-241, or any combination of these radionuclides, constitutes not more than 20 percent by mass of the total quantity of plutonium in the package.
- d. Any physician licensed by a State to dispense drugs in the practice of medicine is exempt from 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 Part G, 10 CFR Part 35 or the equivalent Agreement State regulations.

Sec. T.5 - Transportation of Licensed Material.

- a. Each licensee who transports licensed material outside the site of usage, as specified in the Agency license, or where transport is on public highways, or who delivers licensed material to a carrier for transport, shall:
 - i. Comply with the applicable requirements, appropriate to the mode of transport, of the regulations of the US Department of Transportation 49 CFR parts 107, 171 through 180, and 390 through 397; particularly the regulations of the US Department of Transportation in the following areas:
 - (1) Packaging - 49 CFR Part 173: Subparts A, B, and I.
 - (2) Marking and labeling - 49 CFR Part 172: Subpart D; §§ 172.400 through 172.407 and §§ 172.436 through 172.441 of Subpart E.
 - (3) Placarding - 49 CFR Part 172: Subpart F, especially §§ 172.500 through 172.519 and 172.556; and Appendices B and C.
 - (4) Accident reporting - 49 CFR Part 171: §§ 171.15 and 171.16.
 - (5) Shipping papers and emergency information - 49 CFR Part 172: Subpart C

and Subpart G.

- (6) Hazardous material employee training - 49 CFR Part 172: Subpart H.
 - (7) Security Plans - 49 CFR Part 172: subpart I.
 - (8) Hazardous material shipper/carrier registration - 49 CFR Part 107: Subpart G.
- ii. The licensee shall also comply with applicable US Department of Transportation regulations pertaining to the following modes of transportation:
 - (1) Rail - 49 CFR Part 174: Subparts A through D and K.
 - (2) Air - 49 CFR Part 175.
 - (3) Vessel - 49 CFR Part 176: Subparts A through F and M. (4)
Public Highway - 49 CFR Part 177 and Parts 390 through 397.
- iii. Assure that any special instructions needed to safely open the package are sent to or have been made available to the consignee in accordance with D.1906e of these regulations.
- b. If, for any reason, the regulations of the US Department of Transportation are not applicable to a shipment of licensed material, the licensee shall conform to the standards and requirements of T.5a. to the mode of transport to the same extent as if the shipment was subject to the Department of Transportation regulations. A request for modification, waiver, or exemption from these requirements, and any notification referred to in these requirements, shall be submitted in writing to the Agency.

General Licenses

Sec. T.6 - General Licenses for Carriers.

- a. A general license is hereby issued to any common or contract carrier not exempt under T.4 to receive, possess, transport, and store radioactive material in the regular course of their carriage for others or storage incident thereto, provided the transportation and storage is in accordance with the applicable requirements, appropriate to the mode of transport, of the US Department of Transportation relating to the loading and storage of packages, placarding of the transporting vehicle, and incident reporting.^{1/}
- b. A general license is hereby issued to any private carrier to transport radioactive material, provided the transportation is in accordance with the applicable requirements, appropriate to the mode of transport, of the US Department of Transportation insofar as requirements relate to the loading and storage of packages, placarding of the transporting vehicle, and incident

^{1/} Notification of an incident shall be filed with, or made to, the Agency as prescribed in 49 CFR, regardless of and in addition to notification made to the US Department of Transportation or other agencies.

reporting.^{1/}

- c. Persons who transport radioactive material pursuant to the general licenses in T.6a. or T.6b. are exempt from the requirements of Parts D and J of these regulations to the extent that they transport radioactive material.

Sec. T.7 - General License: Nuclear Regulatory Commission-Approved Package.

- a. A general license is hereby issued to any licensee (of the agency) to transport, or to deliver to a carrier for transport, licensed material in a package for which a license, certificate of compliance, or other approval has been issued by the Nuclear Regulatory Commission.
- b. This general license applies only to a licensee who has a quality assurance program approved by the agency as satisfying the provisions of this Part.
- c. Each licensee issued a general license under T.7a. shall:
 - i. Maintain a copy of the Certificate of Compliance, or other approval of the package, and 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;
 - ii. Comply with the terms and conditions of the license, certificate, or other approval by the Nuclear Regulatory Commission, as applicable, and the applicable requirements of this Part T;
 - iii. Prior to the licensee's first use of the package, submits in writing to ATTN: Document Control Desk, Director, Division of Fuel Management, Office of Nuclear Material Safety and Safeguards, using an appropriate method listed in 10 C.F.R. 71.1(a), the licensee's name and license number and the package identification number specified in the package approval.
 - iv. Has a quality assurance program that complies with Subpart H of 10 CFR 71.
- d. The general license in T.7a. 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 Nuclear Regulatory Commission before April 1, 1996, the general license is subject to the additional restrictions of 10 CFR 71.19.

Sec. T.8 - General License: Use of Foreign Approved Package.

- a. A general license is issued to any licensee 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 which has been revalidated by the US Department of Transportation as meeting the applicable requirements of 49 CFR 171.23.
- b. The general license applies only to shipments made to or from locations outside the United States.

- c. This general license applies only to a licensee who:
 - i. Except as otherwise noted, has a quality assurance program approved by the United States Nuclear Regulatory Commission (or the Agency if an Agreement State) as satisfying the applicable provisions listed in T-20 and T-21
 - ii. 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 prior to shipment; and
 - iii. Complies with the terms and conditions of the certificate and revalidation, and with the applicable requirements of this Part.

Sec. T.9 - General License: Fissile Material.

- a. A general license is hereby issued to any licensee 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 subparts E and F of 10 CFR 71; 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 NRC as satisfying the provision of subpart H of 10 CFR 71.
- c. The general license applies only when a package's contents:
 - i. Contain no more than a Type A quantity of radioactive material; and
 - ii. 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:
 - i. Has been determined in accordance with T.9e.;
 - ii. Has a value less than or equal to 10.0; and
 - iii. For a shipment of multiple packages containing fissile material, the sum of the CSIs must be less than or equal to 50.0 (for shipment on a nonexclusive use conveyance) and less than or equal to 100.0 (for shipment on an exclusive use conveyance).
- e. i. The value for the CSI must be greater than or equal to the number calculated by the following equation:

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

- ii. The calculated CSI must be rounded up to the first decimal place;
- iii. The values of X, Y, and Z used in the CSI equation must be taken from Tables I or II, as appropriate;
- iv. If Table II 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
- v. Table I values for X, Y, and Z must be used to determine the CSI if:
 - (1) Uranium-233 is present in the package;
 - (2) The mass of plutonium exceeds one percent of the mass of uranium-235;
 - (3) The uranium is of unknown uranium-235 enrichment or greater than 24 weight percent enrichment; or
- (4) Substances having a moderating effectiveness (i.e., an average hydrogen density greater than H₂O [e.g., certain hydrocarbon oils or plastics]) are present in any form, except as polyethylene used for packing or wrapping.

TABLE I — Mass Limits for General License Packages Containing Mixed Quantities of Fissile Material or Uranium-235 of Unknown Enrichment per T.9e.

Fissile Materials	Fissile material mass mixed with moderating substances having an average hydrogen density less than or equal to H ₂ O. (grams)	Fissile material mass mixed with moderating substances having an average hydrogen density greater than H ₂ O ^{a/} . (grams)
²³⁵ U (X)	60	38
²³³ U (Y)	43	27
²³⁹ Pu or ²⁴¹ Pu (Z)	37	24

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

Table II Mass Limits for General License Packages Containing Uranium-235 of Known Enrichment per T.9e.

Uranium enrichment in weight % U-235 not exceeding	Fissile material mass of U-235 (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	1020
0.92	1800

Sec. T.10 - General License: Plutonium-Beryllium Special Form Materials.

- a. A general license is issued to any licensee 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 subparts E and F of 10 CFR 71; 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 Nuclear Regulatory Commission as satisfying the provision of subpart H of 10 CFR 71.
- c. The general license applies when a package's contents:
 - i. Contain no more than a Type A quantity of material; and
 - ii. Contain less than 1000 grams of plutonium, provided that: plutonium-239, plutonium-241, or any combination of these radionuclides, constitutes less than 240 grams of the total quantity of plutonium in the package.
- d. The general license applies only to packages labeled with a CSI which:

- i. Has been determined in accordance with T.10e.
 - ii. Has a value less than or equal to 100.0; and
 - iii. For a shipment of multiple packages containing Pu-Be sealed sources, the sum of the CSIs must be less than or equal to 50.0 (for shipment on a nonexclusive use conveyance) and to less than or equal to 100.0 (for shipment on an exclusive use conveyance).
- e. i. The value for the CSI must be greater than or equal to the number calculated by the following equation:

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

- ii. The calculated CSI must be rounded up to the first decimal place.

Sec. T.11 - Reserved.

Operating Controls and Procedures

Sec. T.12 - Assumptions as to Unknown Properties of Fissile Material. When the isotopic 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.13 - Preliminary Determinations. Prior to the first use of any packaging for the shipment of radioactive material, the licensee shall ascertain that the determinations in paragraphs (a) through (c) of 10 CFR 71.85 have been made.

Sec. T.14 - Routine Determinations. Prior to each shipment of licensed material, 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 which could be used to lift or tie down the package during transport is rendered inoperable for that purpose unless it satisfies design requirements specified in 10 CFR 71.45;
- i. The level of non-fixed (removable) radioactive contamination on the external surfaces of each package offered for transport must be kept as low as reasonably achievable. The level of non-fixed radioactive contamination may not exceed the limits set forth in Table III and must be determined by either:
 - i. Wiping an area of 300 cm² of the surface concerned with an absorbent material, using moderate pressure, and measuring the activity on the wiping material. Sufficient measurements must be taken in the most appropriate locations to yield a representative assessment of the non-fixed contamination levels. The amount of radioactivity measured on any single wiping material, divided by the surface area wiped and divided by the efficiency of the wipe procedure (the fraction of removable contamination transferred from the surface to the absorbent material), may not exceed the limits set forth in Table III at any time during transport. For this purpose the actual wipe efficiency may be used, or the wipe efficiency may be assumed to be 0.10; or
 - ii. Alternatively, the level of non-fixed radioactive contamination may be determined by using other methods of equal or greater efficiency.
- j. Except as provided in T.14l. in the case of packages transported as exclusive use shipments by rail or public highway only, the removable (non-fixed) radioactive contamination on any package at any time during transport may not exceed ten times the levels prescribed in paragraph i of this section. The levels at the beginning of transport may not exceed the levels prescribed in paragraph i of this section.

TABLE III
NON-FIXED (REMOVABLE) EXTERNAL RADIOACTIVE
CONTAMINATION LIMITS for PACKAGES

Contaminant	Maximum Permissible Limits		
	Bq/cm ²	μCi/cm ²	dpm/cm ²
Beta and gamma emitters and low toxicity alpha emitters	4	10 ⁻⁴	220

All other alpha emitting radionuclides	0.4	10^{-5}	22
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- k. Except as provided in T.14l., each transport vehicle used for transporting Class 7 (radioactive) materials as an exclusive use shipment that utilizes the provisions of T.14j. must be surveyed with appropriate radiation detection instruments after each use. A vehicle may not be returned to service until the radiation dose rate at each accessible surface is 0.005 mSv per hour (0.5 mrem per hour) or less, and there is no significant removable (non-fixed) radioactive surface contamination as specified in paragraph (i) of this section.

- l. T.14j. and T.14k. do not apply to any closed transport vehicle used solely for the transportation by highway or rail of Class 7 (radioactive) material packages with contamination levels that do not exceed 10 times the levels prescribed in T.14.i. if:
 - i. A survey of the interior surfaces of the empty vehicle shows that the radiation dose rate at any point does not exceed 0.1 mSv per hour (10 mrem per hour) at the surface or 0.02 mSv per hour (2 mrem per hour) at 1 m (3.3 feet) from the surface;
 - ii. Each vehicle is stenciled with the words “For Radioactive Materials Use Only” in letters at least 76 millimeters (3 inches) high in a conspicuous place on both sides of the exterior of the vehicle; and
 - iii. Each vehicle is kept closed except for loading or unloading.
- m. Except as provided in paragraph (n) 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 external radiation levels will not exceed 2 mSv per hour (200 mrem/hr) at any point on the external surface of the package at any time during transportation. The transport index shall not exceed 10.0;
- n. A package that exceeds the radiation level limits specified in paragraph T.14m. 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:
 - i. 2 mSv per hour (200 mrem/hr) on the external surface of the package unless the following conditions are met, in which case the limit is 10 mSv per hour (1000 mrem/hr);
 - (1) The shipment is made in a closed transport vehicle;
 - (2) Provisions are made to secure the package so that its position within the vehicle remains fixed during transportation; and
 - (3) There are no loading or unloading operations between the beginning and end of the transportation.
 - ii. 2 mSv per hour (200 mrem/hr) 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;
 - iii. 0.1 mSv per hour (10 mrem/hr) at any point 2 meters from the vertical planes represented by the outer lateral surfaces of the vehicle, or, in the case of a flat-bed style vehicle, at any point 2 meters from the vertical planes projected from the outer edges of the vehicle; and

- iv. 0.02 mSv per hour (2 mrem/hr) in any normally occupied positions of the vehicle, except that this provision does not apply to private motor carriers when persons occupying these positions are provided with personnel radiation exposure monitoring devices.
- o. For shipments made under the provisions of T.14n., 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. 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.
- p. A package must be prepared for transport so that in still air at 38°Celsius (100°F) and in the shade, no accessible surface of a package would have a temperature exceeding 50°Celsius (122°F) in a nonexclusive use shipment or 85°Celsius (185°F) in an exclusive use shipment. Accessible package surface temperatures shall not exceed these limits at any time during transportation.

Sec. T.15 - Air Transport of Plutonium. Notwithstanding the provisions of any general licenses and notwithstanding any exemptions stated directly in this Part or included indirectly by citation of the US Department of Transportation regulations, as may be applicable, the licensee shall assure that plutonium in any form is not transported by air, or delivered to a carrier for air transport, unless:

- a. The plutonium is contained in a medical device designed for individual human application; or,
- b. The plutonium is contained in a material in which the specific activity is less than or equal to the activity concentration values for plutonium specified in Table A-2 of this chapter and in which the radioactivity is essentially uniformly distributed; or,
- c. The plutonium is shipped in a single package containing no more than an A₂ quantity of plutonium in any isotope or form and is shipped in accordance with T.5; or
- d. The plutonium is shipped in a package specifically authorized, in the certificate of compliance issued by the Nuclear Regulatory Commission for the shipment of plutonium by air, and the licensee requires, through special arrangement with the carrier, compliance with 49 CFR 175.704.

Sec. T.16 - 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 D.1906e., or equivalent state regulation.

Sec. T.17 - Shipment 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 T.4, showing, where applicable:

- i. Identification of the packaging by model number and serial number;
 - ii. Verification that the packaging, as shipped, had no significant defect;
 - iii. Volume and identification of coolant;
 - iv. Type and quantity of licensed material in each package, and the total quantity of each shipment;
 - v. For each item of irradiated fissile material:
 - (1) Identification by model number and serial number;
 - (2) Irradiation and decay history to the extent appropriate to demonstrate that its nuclear and thermal characteristics comply with license conditions; and
 - (3) Any abnormal or unusual condition relevant to radiation safety.
 - vi. Date of the shipment;
 - vii. For fissile packages and for Type B packages, any special controls exercised;
 - viii. Name and address of the transferee;
 - ix. Address to which the shipment was made; and
 - x. Results of the determinations required by T.14 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 10 CFR 71.85; 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. These records must be retained for 3 years after the life of the packaging to which they apply.

Sec. T.18 - Reports. The licensee shall report to the Agency within 30 days:

- a. Any instance in which there is significant reduction in the effectiveness of any packaging during use;
- b. Details of any defects with safety significance in the packaging after first use, 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.19 - Advance Notification of Shipment of Irradiated Reactor Fuel and Nuclear Waste.

- a.
 - i. As specified in T.19b., T.19c., and T.19d., each licensee shall provide advance notification to the governor of a State, or the governor's designee, of the shipment of licensed material, within or across the boundary of the State, before the transport, or delivery to a carrier, for transport, of licensed material outside the confines of the licensee's plant or other place of use or storage.
 - ii. As specified in T.19b., T.19c., and T.19d., each licensee shall provide advance notification to the Tribal official of participating Tribes referenced in T.19c.iii.(2), or the official's designee, of the shipment of licensed material, within or across the boundary of the Tribe's reservation, before the transport, or delivery to a carrier, for transport, of licensed material outside the confines of the licensee's plant or other place of use or storage.
- b. Advance notification is also required for the shipment of licensed material, other than for irradiated fuel, when:
 - i. The licensed material is required to be in Type B packaging for transportation;
 - ii. The licensed material is being transported into, within, or through a state enroute to a disposal facility or to a collection point for transport to a disposal facility; and
 - iii. The quantity of licensed material in a single package exceeds the least of the following:
 - (1) 3000 times the A_1 value of the radionuclides as specified in Appendix A, Table A-1 for special form radioactive material;
 - (2) 3000 times the A_2 value of the radionuclides as specified in Appendix A, Table A-1 for normal form radioactive material; or
 - (3) 1000 TBq (27,000 Ci).
- c. Procedures for submitting advance notification.
 - i. The notification must be made in writing to:
 - (1) The office of each appropriate governor or governor's designee;
 - (2) The office of each appropriate Tribal official or Tribal official's designee;

- (3) The Director, Office of Nuclear Security and Incident Response, U.S Nuclear Regulatory Commission; and
 - (4) [The appropriate state radiation control Agency].
 - ii. 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.
 - iii. A notification delivered by any other means than mail must reach the office of the governor or of the governor's designee or the Tribal official or Tribal official's designee at least 4 days before the beginning of the 7-day period during which departure of the shipment is estimated to occur.
 - (1) Contact information for each State, including telephone and mailing addresses of governors and governors' designees, and participating Tribes, including telephone and mailing addresses of Tribal officials and Tribal official's designees, is available on the NRC Web site at:
<https://scp.nrc.gov/special/designee.pdf>.
 - (2) A list of the names and mailing addresses of the governors' designees and Tribal officials' designees of participating Tribes is available on request from the Director, Division of Materials Safety, Security, State, and Tribal Programs, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001.
- d. Each advance notification of irradiated reactor fuel or nuclear waste must contain the following information:
 - i. The name, address, and telephone number of the shipper, carrier, and receiver of the irradiated reactor fuel or nuclear waste shipment;
 - ii. A description of the irradiated reactor fuel or nuclear waste contained in the shipment as required by 49 CFR 172.202 and 172.203(d);
 - iii. The point of origin of the shipment and the 7-day period during which departure of the shipment is estimated to occur;
 - iv. The 7-day period during which arrival of the shipment at state boundaries or Tribal reservation boundaries is estimated to occur;
 - v. The destination of the shipment, and the 7-day period during which arrival of the shipment is estimated to occur; and
 - vi. A point of contact with a telephone number for current shipment information.
- e. Revisions: The licensee shall notify each appropriate governor or governor's designee or a

Tribal official or Tribal official's designee, and the Agency of any changes to schedule information provided pursuant to T.19. Such notification shall be by telephone to a responsible individual in the office of the governor of the State(s) or governor's designee, or the Tribal official or the Tribal official's designee providing the official with the pertinent information about the delay. The licensee shall maintain for 3 years a record of the name of the individual contacted.

- f. Cancellations: Each licensee who cancels a nuclear waste shipment, for which advance notification has been sent, shall send a cancellation notice, identifying the advance notification that is being canceled, to the governor of each State, or governor's designee previously notified, each Tribal official or to the Tribal official's designee previously notified, to the Agency, and to the Director, Office of Nuclear Security and Incident Response. A copy of the notice shall be retained by the licensee for 3 years.

Quality Assurance

Sec. T.20 - Quality Assurance Requirements.

- a. *Purpose.* This Part 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 Part, "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. 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 this Part.
- b. *Establishment of program.* Each licensee shall establish, maintain, and execute a quality assurance program satisfying each of the applicable criteria of 10 C.F.R. 71.101 through 71.137 and satisfying any specific provisions that are applicable to the licensee's activities including procurement of packaging. The licensee shall execute the applicable criteria in a graded approach to an extent that is commensurate with the quality assurance requirement's importance to safety.
- c. *Approval of program.* Before the use of any package for the shipment of licensed material subject to this Part, each licensee shall obtain Agency 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 are applicable and how they will be satisfied by submitting the description to the Agency.
- d. 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 Part E.12 of these regulations, NRC or equivalent Agreement State requirements is deemed to satisfy the requirements of T.7b. and T.20b.
- e. The licensee 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. 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 before the time a package approval is issued.

- f. The quality assurance functions are:
 - i. Assuring that an appropriate quality assurance program is established and effectively executed; and
 - ii. Verifying, by procedures such as checking, auditing, and inspection, that activities affecting the safety-related functions have been performed correctly.
- g. The persons and organizations performing quality assurance functions must have sufficient authority and organizational freedom to:
 - i. Identify quality problems;
 - ii. Initiate, recommend, or provide solutions; and
 - iii. Verify implementation of solutions.
- h. 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 this Part. 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.
- i. 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.

- j. 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.
- k. 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 they are executing.
- l. **Changes.** Each quality assurance program approval holder shall submit to the NRC, in accordance with 10 CFR 71.1(a) or the department, a description of a proposed change to its NRC or Agreement State-approved quality assurance program that will reduce commitments in the program description as approved by the NRC or Agreement State. The quality assurance program approval holder shall not implement the change before receiving NRC or Agreement State approval.
- (1) The description of a proposed change to the NRC or Agreement State-approved quality assurance program must identify the change, the reason for the change, and the basis for concluding that the revised program incorporating the change continues to satisfy **the applicable requirements of T.20 and T.21.**
- m. Each quality assurance program approval holder may change a previously approved quality assurance program without prior Agency approval, if the change does not reduce the commitments in the quality assurance program previously approved by the Agency. Changes to the quality assurance program that do not reduce the commitments shall be submitted to the Agency every 24 months, in accordance with A.12. In addition to quality assurance program changes involving administrative improvements and clarifications, spelling corrections, and non-substantive changes to punctuation or editorial items, the following changes are not considered reductions in commitment:
- (1) The use of a quality assurance standard approved by the Agency that is more recent than the quality assurance standard in the certificate holder's or applicant's current quality assurance program at the time of the change;

- (2) The use of generic organizational position titles that clearly denote the position function, supplemented as necessary by descriptive text, rather than specific titles, provided that there is no substantive change to either the functions of the position or reporting responsibilities;
- (3) The use of generic organizational charts to indicate functional relationships, authorities, and responsibilities, or alternatively, the use of descriptive text, provided that there is no substantive change to the functional relationships, authorities, or responsibilities;
- (4) The elimination of quality assurance program information that duplicates language in quality assurance regulatory guides and quality assurance standards to which the quality assurance program approval holder has committed to on record; and
- (5) Organizational revisions that ensure that persons and organizations performing quality assurance functions continue to have the requisite authority and organizational freedom, including sufficient independence from cost and schedule when opposed to safety considerations.

Sec. T.21 - Quality Assurance Records. The licensee shall maintain sufficient written records to describe the activities affecting quality. These records must include changes to the quality assurance program as required by T.20, the instructions, procedures, and drawings required by 10 CFR 71.111 to prescribe quality assurance activities, and closely related specifications such as required qualifications of personnel, procedures, and equipment. The records must include the instructions or procedures that 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 engage in the activity for which the quality assurance program was developed. If any portion of the quality assurance program, written procedures or instructions is superseded, the licensee shall retain the superseded material for 3 years after it is superseded.

PART T

APPENDIX A

DETERMINATION OF A₁ AND A₂

- I. Values of A₁ and A₂ for individual radionuclides, which are the bases for many activity limits elsewhere in these regulations, are given in TABLE A-1. The Terabecquerel values are the

regulatory standard. The curie values are for information only and are not intended to be the regulatory standard. Where values of 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 A_1 and A_2 values contained in Table A-3 may be used. Otherwise, the licensee shall obtain prior Agency approval of the A_1 and A_2 values for radionuclides not listed in Table A-1, before shipping the material.
 - (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 Agency 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 Agency, in accordance with Part A.12 of these regulations.
- 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 nuclide has a half-life either longer than 10 days, or longer than that of the parent nuclide, 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 nuclide of that chain. In the case of radioactive decay chains in which any daughter nuclide has a half-life either longer than 10 days, or greater than that of the parent nuclide, the parent and those daughter nuclides shall be considered as mixtures of different nuclides.
- 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: (equation below changed)

$$\sum_i \frac{B(i)}{A_1(i)} \leq 1$$

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:

$$\sum_i \frac{B(i)}{A_2(i)} \leq 1$$

where B(i) is the activity of radionuclide i and A₂(i) is the A₂ values for radionuclide i.

- (c) If the package contains both special and normal form radioactive material, the activity that may be transported in a Type A package is as follows:

$$\sum_i \frac{B(i)}{A_1(i)} + \sum_j \frac{C(j)}{A_2(j)} \leq 1$$

where B(i) is the activity of radionuclide i as special form radioactive material, A₁(i) is the A₁ value for radionuclide i, C(j) is the activity of radionuclide j as normal form radioactive material, and A₂(j) is the A₂ value for radionuclide j.

- (d) Alternatively, an A₁ value for mixtures of special form material may be determined as follows:

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

where f(i) is the fraction of activity of nuclide i in the mixture and A₁(i) is the appropriate A₁ value for nuclide i.

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

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

where f(i) is the fraction of activity of nuclide i in the mixture and A₂(i) is the appropriate A₂ value for nuclide i.

- (f) 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 $[A](i)$ is the activity concentration for exempt material containing radionuclide i .

- (g) 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. (a) 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.
- (b) When the identity of each nuclide is known but the individual activities of some of the nuclides are not known, the nuclides may be grouped and the lowest activity $[A]$ (activity concentration for exempt material) or A (activity limit for exempt consignment) value, as appropriate, for the nuclides in each group may be used in applying the formulas in paragraph IV of the appendix. Groups may be based on the total alpha activity and the total beta/gamma activity when these are known, using the lowest $[A]$ or A values for the alpha emitters and beta/gamma emitters, respectively.

TABLE A - 1: A₁ AND A₂ 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)	Specific activity (Ci/g)
Ac-225 (a)	Actinium (89)	8.0×10^{-1}	2.2×10^1	6.0×10^{-3}	1.6×10^{-1}	2.1×10^3	5.8×10^4
Ac-227 (a)		9.0×10^{-1}	2.4×10^1	9.0×10^{-5}	2.4×10^{-3}	2.7	7.2×10^1
Ac-228		6.0×10^{-1}	1.6×10^1	5.0×10^{-1}	1.4×10^1	8.4×10^4	2.2×10^6
Ag-105	Silver (47)	2.0	5.4×10^1	2.0	5.4×10^1	1.1×10^3	3.0×10^4
Ag-108m (a)		7.0×10^{-1}	1.9×10^1	7.0×10^{-1}	1.9×10^1	9.7×10^{-1}	2.6×10^1
Ag-110m (a)		4.0×10^{-1}	1.1×10^1	4.0×10^{-1}	1.1×10^1	1.8×10^2	4.7×10^3
Ag-111		2.0	5.4×10^1	6.0×10^{-1}	1.6×10^1	5.8×10^3	1.6×10^5
Al-26	Aluminum (13)	1.0×10^{-1}	2.7	1.0×10^{-1}	2.7	7.0×10^{-4}	1.9×10^{-2}
Am-241	Americium (95)	1.0×10^1	2.7×10^2	1.0×10^{-3}	2.7×10^{-2}	1.3×10^{-1}	3.4
Am-242m (a)		1.0×10^1	2.7×10^2	1.0×10^{-3}	2.7×10^{-2}	3.6×10^{-1}	1.0×10^1
Am-243 (a)		5.0	1.4×10^2	1.0×10^{-3}	2.7×10^{-2}	7.4×10^{-3}	2.0×10^{-1}
Ar-37	Argon (18)	4.0×10^1	1.1×10^3	4.0×10^1	1.1×10^3	3.7×10^3	9.9×10^4
Ar-39		4.0×10^1	1.1×10^3	2.0×10^1	5.4×10^2	1.3	3.4×10^1
Ar-41		3.0×10^{-1}	8.1	3.0×10^{-1}	8.1	1.5×10^6	4.2×10^7
As-72	Arsenic (33)	3.0×10^{-1}	8.1	3.0×10^{-1}	8.1	6.2×10^4	1.7×10^6
As-73		4.0×10^1	1.1×10^3	4.0×10^1	1.1×10^3	8.2×10^2	2.2×10^4
As-74		1.0	2.7×10^1	9.0×10^{-1}	2.4×10^1	3.7×10^3	9.9×10^4
As-76		3.0×10^{-1}	8.1	3.0×10^{-1}	8.1	5.8×10^4	1.6×10^6
As-77		2.0×10^1	5.4×10^2	7.0×10^{-1}	1.9×10^1	3.9×10^4	1.0×10^6
At-211 (a)	Astatine (85)	2.0×10^1	5.4×10^2	5.0×10^{-1}	1.4×10^1	7.6×10^4	2.1×10^6
Au-193	Gold (79)	7.0	1.9×10^2	2.0	5.4×10^1	3.4×10^4	9.2×10^5
Au-194		1.0	2.7×10^1	1.0	2.7×10^1	1.5×10^4	4.1×10^5
Au-195		1.0×10^1	2.7×10^2	6.0	1.6×10^2	1.4×10^2	3.7×10^3
Au-198		1.0	2.7×10^1	6.0×10^{-1}	1.6×10^1	9.0×10^3	2.4×10^5

TABLE A - 1: A₁ AND A₂ 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)	Specific activity (Ci/g)
Au-199		1.0X10 ¹	2.7X10 ²	6.0X10 ⁻¹	1.6X10 ¹	7.7X10 ³	2.1X10 ⁵
Ba-131 (a)	Barium (56)	2.0	5.4X10 ¹	2.0	5.4X10 ¹	3.1X10 ³	8.4X10 ⁴
Ba-133		3.0	8.1X10 ¹	3.0	8.1X10 ¹	9.4	2.6X10 ²
Ba-133m		2.0X10 ¹	5.4X10 ²	6.0X10 ⁻¹	1.6X10 ¹	2.2X10 ⁴	6.1X10 ⁵
Ba-140 (a)		5.0X10 ⁻¹	1.4X10 ¹	3.0X10 ⁻¹	8.1	2.7X10 ³	7.3X10 ⁴
Be-7	Beryllium (4)	2.0X10 ¹	5.4X10 ²	2.0X10 ¹	5.4X10 ²	1.3X10 ⁴	3.5X10 ⁵
Be-10		4.0X10 ¹	1.1X10 ³	6.0X10 ⁻¹	1.6X10 ¹	8.3X10 ⁻⁴	2.2X10 ⁻²
Bi-205	Bismuth (83)	7.0X10 ⁻¹	1.9X10 ¹	7.0X10 ⁻¹	1.9X10 ¹	1.5X10 ³	4.2X10 ⁴
Bi-206		3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	3.8X10 ³	1.0X10 ⁵
Bi-207		7.0X10 ⁻¹	1.9X10 ¹	7.0X10 ⁻¹	1.9X10 ¹	1.9	5.2X10 ¹
Bi-210		1.0	2.7X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	4.6X10 ³	1.2X10 ⁵
Bi-210m (a)		6.0X10 ⁻¹	1.6X10 ¹	2.0X10 ⁻²	5.4X10 ⁻¹	2.1X10 ⁻⁵	5.7X10 ⁻⁴
Bi-212 (a)		7.0X10 ⁻¹	1.9X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	5.4X10 ⁵	1.5X10 ⁷
Bk-247	Berkelium (97)	8.0	2.2X10 ²	8.0X10 ⁻⁴	2.2X10 ⁻²	3.8X10 ⁻²	1.0
Bk-249 (a)		4.0X10 ¹	1.1X10 ³	3.0X10 ⁻¹	8.1	6.1X10 ¹	1.6X10 ³
Br-76	Bromine (35)	4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	9.4X10 ⁴	2.5X10 ⁶
Br-77		3.0	8.1X10 ¹	3.0	8.1X10 ¹	2.6X10 ⁴	7.1X10 ⁵
Br-82		4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁴	1.1X10 ⁶
C-11	Carbon (6)	1.0	2.7X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	3.1X10 ⁷	8.4X10 ⁸
C-14		4.0X10 ¹	1.1X10 ³	3.0	8.1X10 ¹	1.6X10 ⁻¹	4.5
Ca-41	Calcium (20)	Unlimited	Unlimited	Unlimited	Unlimited	3.1X10 ⁻³	8.5X10 ⁻²
Ca-45		4.0X10 ¹	1.1X10 ³	1.0	2.7X10 ¹	6.6X10 ²	1.8X10 ⁴
Ca-47 (a)		3.0	8.1X10 ¹	3.0X10 ⁻¹	8.1	2.3X10 ⁴	6.1X10 ⁵
Cd-109	Cadmium (48)	3.0X10 ¹	8.1X10 ²	2.0	5.4X10 ¹	9.6X10 ¹	2.6X10 ³

TABLE A - 1: A₁ AND A₂ 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)	Specific activity (Ci/g)
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		1.0X10 ⁻¹	2.7	3.0X10 ⁻³	8.1X10 ⁻²	2.0X10 ¹	5.4X10 ²
Cf-253 (a)		4.0X10 ¹	1.1X10 ³	4.0X10 ⁻²	1.1	1.1X10 ³	2.9X10 ⁴
Cf-254		1.0X10 ⁻³	2.7X10 ⁻²	1.0X10 ⁻³	2.7X10 ⁻²	3.1X10 ²	8.5X10 ³
Cl-36	Chlorine (17)	1.0X10 ¹	2.7X10 ²	6.0X10 ⁻¹	1.6X10 ¹	1.2X10 ⁻³	3.3X10 ⁻²
Cl-38		2.0X10 ⁻¹	5.4	2.0X10 ⁻¹	5.4	4.9X10 ⁶	1.3X10 ⁸
Cm-240	Curium (96)	4.0X10 ¹	1.1X10 ³	2.0X10 ⁻²	5.4X10 ⁻¹	7.5X10 ²	2.0X10 ⁴
Cm-241		2.0	5.4X10 ¹	1.0	2.7X10 ¹	6.1X10 ²	1.7X10 ⁴
Cm-242		4.0X10 ¹	1.1X10 ³	1.0X10 ⁻²	2.7X10 ⁻¹	1.2X10 ²	3.3X10 ³
Cm-243		9.0	2.4X10 ²	1.0X10 ⁻³	2.7X10 ⁻²	1.9X10 ⁻³	5.2X10 ¹
Cm-244		2.0X10 ¹	5.4X10 ²	2.0X10 ⁻³	5.4X10 ⁻²	3.0	8.1X10 ¹
Cm-245		9.0	2.4X10 ²	9.0X10 ⁻⁴	2.4X10 ⁻²	6.4X10 ⁻³	1.7X10 ⁻¹
Cm-246		9.0	2.4X10 ²	9.0X10 ⁻⁴	2.4X10 ⁻²	1.1X10 ⁻²	3.1X10 ⁻¹
Cm-247 (a)		3.0	8.1X10 ¹	1.0X10 ⁻³	2.7X10 ⁻²	3.4X10 ⁻⁶	9.3X10 ⁻⁵

TABLE A - 1: A₁ AND A₂ 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)	Specific activity (Ci/g)
Cm-248		2.0X10 ⁻²	5.4X10 ⁻¹	3.0X10 ⁻⁴	8.1X10 ⁻³	1.6X10 ⁻⁴	4.2X10 ⁻³
Co-55	Cobalt (27)	5.0X10 ⁻¹	1.4X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	1.1X10 ⁵	3.1X10 ⁶
Co-56		3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	1.1X10 ³	3.0X10 ⁴
Co-57		1.0X10 ¹	2.7X10 ²	1.0X10 ¹	2.7X10 ²	3.1X10 ²	8.4X10 ³
Co-58		1.0	2.7X10 ¹	1.0	2.7X10 ¹	1.2X10 ³	3.2X10 ⁴
Co-58m		4.0X10 ¹	1.1X10 ³	4.0X10 ¹	1.1X10 ³	2.2X10 ⁵	5.9X10 ⁶
Co-60		4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	4.2X10 ¹	1.1X10 ³
Cr-51	Chromium (24)	3.0X10 ¹	8.1X10 ²	3.0X10 ¹	8.1X10 ²	3.4X10 ³	9.2X10 ⁴
Cs-129	Cesium (55)	4.0	1.1X10 ²	4.0	1.1X10 ²	2.8X10 ⁴	7.6X10 ⁵
Cs-131		3.0X10 ¹	8.1X10 ²	3.0X10 ¹	8.1X10 ²	3.8X10 ³	1.0X10 ⁵
Cs-132		1.0	2.7X10 ¹	1.0	2.7X10 ¹	5.7X10 ³	1.5X10 ⁵
Cs-134		7.0X10 ⁻¹	1.9X10 ¹	7.0X10 ⁻¹	1.9X10 ¹	4.8X10 ¹	1.3X10 ³
Cs-134m		4.0X10 ¹	1.1X10 ³	6.0X10 ⁻¹	1.6X10 ¹	3.0X10 ⁵	8.0X10 ⁶
Cs-135		4.0X10 ¹	1.1X10 ³	1.0	2.7X10 ¹	4.3X10 ⁻⁵	1.2X10 ⁻³
Cs-136		5.0X10 ⁻¹	1.4X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	2.7X10 ³	7.3X10 ⁴
Cs-137 (a)		2.0	5.4X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	3.2	8.7X10 ¹
Cu-64	Copper (29)	6.0	1.6X10 ²	1.0	2.7X10 ¹	1.4X10 ⁵	3.9X10 ⁶
Cu-67		1.0X10 ¹	2.7X10 ²	7.0X10 ⁻¹	1.9X10 ¹	2.8X10 ⁴	7.6X10 ⁵
Dy-159	Dysprosium (66)	2.0X10 ¹	5.4X10 ²	2.0X10 ¹	5.4X10 ²	2.1X10 ²	5.7X10 ³
Dy-165		9.0X10 ⁻¹	2.4X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	3.0X10 ⁵	8.2X10 ⁶
Dy-166 (a)		9.0X10 ⁻¹	2.4X10 ¹	3.0X10 ⁻¹	8.1	8.6X10 ³	2.3X10 ⁵
Er-169	Erbium (68)	4.0X10 ¹	1.1X10 ³	1.0	2.7X10 ¹	3.1X10 ³	8.3X10 ⁴
Er-171		8.0X10 ⁻¹	2.2X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	9.0X10 ⁴	2.4X10 ⁶
Eu-147		2.0	5.4X10 ¹	2.0	5.4X10 ¹	1.4X10 ³	3.7X10 ⁴

TABLE A - 1: A₁ AND A₂ 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)	Specific activity (Ci/g)
Eu-148	Europium (63)	5.0×10^{-1}	1.4×10^1	5.0×10^{-1}	1.4×10^1	6.0×10^2	1.6×10^4
Eu-149		2.0×10^1	5.4×10^2	2.0×10^1	5.4×10^2	3.5×10^2	9.4×10^3
Eu-150 (short lived)		2.0	5.4×10^1	7.0×10^{-1}	1.9×10^1	6.1×10^4	1.6×10^6
Eu-150 (long lived)		7.0×10^{-1}	1.9×10^1	7.0×10^{-1}	1.9×10^1	6.1×10^4	1.6×10^6
Eu-152		1.0	2.7×10^1	1.0	2.7×10^1	6.5	1.8×10^2
Eu-152m		8.0×10^{-1}	2.2×10^1	8.0×10^{-1}	2.2×10^1	8.2×10^4	2.2×10^6
Eu-154		9.0×10^{-1}	2.4×10^1	6.0×10^{-1}	1.6×10^1	9.8	2.6×10^2
Eu-155		2.0×10^1	5.4×10^2	3.0	8.1×10^1	1.8×10^1	4.9×10^2
Eu-156		7.0×10^{-1}	1.9×10^1	7.0×10^{-1}	1.9×10^1	2.0×10^3	5.5×10^4
F-18	Fluorine (9)	1.0	2.7×10^1	6.0×10^{-1}	1.6×10^1	3.5×10^6	9.5×10^7
Fe-52 (a)	Iron (26)	3.0×10^{-1}	8.1	3.0×10^{-1}	8.1	2.7×10^5	7.3×10^6
Fe-55		4.0×10^1	1.1×10^3	4.0×10^1	1.1×10^3	8.8×10^1	2.4×10^3
Fe-59		9.0×10^{-1}	2.4×10^1	9.0×10^{-1}	2.4×10^1	1.8×10^3	5.0×10^4
Fe-60 (a)		4.0×10^1	1.1×10^3	2.0×10^{-1}	5.4	7.4×10^{-4}	2.0×10^{-2}
Ga-67	Gallium (31)	7.0	1.9×10^2	3.0	8.1×10^1	2.2×10^4	6.0×10^5
Ga-68		5.0×10^{-1}	1.4×10^1	5.0×10^{-1}	1.4×10^1	1.5×10^6	4.1×10^7
Ga-72		4.0×10^{-1}	1.1×10^1	4.0×10^{-1}	1.1×10^1	1.1×10^5	3.1×10^6
Gd-146 (a)	Gadolinium (64)	5.0×10^{-1}	1.4×10^1	5.0×10^{-1}	1.4×10^1	6.9×10^2	1.9×10^4
Gd-148		2.0×10^1	5.4×10^2	2.0×10^{-3}	5.4×10^{-2}	1.2	3.2×10^1
Gd-153		1.0×10^1	2.7×10^2	9.0	2.4×10^2	1.3×10^2	3.5×10^3
Gd-159		3.0	8.1×10^1	6.0×10^{-1}	1.6×10^1	3.9×10^4	1.1×10^6
Ge-68 (a)	Germanium (32)	5.0×10^{-1}	1.4×10^1	5.0×10^{-1}	1.4×10^1	2.6×10^2	7.1×10^3
Ge-71		4.0×10^1	1.1×10^3	4.0×10^1	1.1×10^3	5.8×10^3	1.6×10^5

TABLE A - 1: A₁ AND A₂ 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)	Specific activity (Ci/g)
Ge-77		3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	1.3X10 ⁵	3.6X10 ⁶
Hf-172 (a)	Hafnium (72)	6.0X10 ⁻¹	1.6X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	4.1X10 ¹	1.1X10 ³
Hf-175		3.0	8.1X10 ¹	3.0	8.1X10 ¹	3.9X10 ²	1.1X10 ⁴
Hf-181		2.0	5.4X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	6.3X10 ²	1.7X10 ⁴
Hf-182		Unlimited	Unlimited	Unlimited	Unlimited	8.1X10 ⁻⁶	2.2X10 ⁻⁴
Hg-194 (a)	Mercury (80)	1.0	2.7X10 ¹	1.0	2.7X10 ¹	1.3X10 ⁻¹	3.5
Hg-195m (a)		3.0	8.1X10 ¹	7.0X10 ⁻¹	1.9X10 ¹	1.5X10 ⁴	4.0X10 ⁵
Hg-197		2.0X10 ¹	5.4X10 ²	1.0X10 ¹	2.7X10 ²	9.2X10 ³	2.5X10 ⁵
Hg-197m		1.0X10 ¹	2.7X10 ²	4.0X10 ⁻¹	1.1X10 ¹	2.5X10 ⁴	6.7X10 ⁵
Hg-203		5.0	1.4X10 ²	1.0	2.7X10 ¹	5.1X10 ²	1.4X10 ⁴
Ho-166	Holmium (67)	4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	2.6X10 ⁴	7.0X10 ⁵
Ho-166m		6.0X10 ⁻¹	1.6X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	6.6X10 ⁻²	1.8
I-123	Iodine (53)	6.0	1.6X10 ²	3.0	8.1X10 ¹	7.1X10 ⁴	1.9X10 ⁶
I-124		1.0	2.7X10 ¹	1.0	2.7X10 ¹	9.3X10 ³	2.5X10 ⁵
I-125		2.0X10 ¹	5.4X10 ²	3.0	8.1X10 ¹	6.4X10 ²	1.7X10 ⁴
I-126		2.0	5.4X10 ¹	1.0	2.7X10 ¹	2.9X10 ³	8.0X10 ⁴
I-129		Unlimited	Unlimited	Unlimited	Unlimited	6.5X10 ⁻⁶	1.8X10 ⁻⁴
I-131		3.0	8.1X10 ¹	7.0X10 ⁻¹	1.9X10 ¹	4.6X10 ³	1.2X10 ⁵
I-132		4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	3.8X10 ⁵	1.0X10 ⁷
I-133		7.0X10 ⁻¹	1.9X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	4.2X10 ⁴	1.1X10 ⁶
I-134		3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	9.9X10 ⁵	2.7X10 ⁷
I-135 (a)		6.0X10 ⁻¹	1.6X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	1.3X10 ⁵	3.5X10 ⁶
In-111	Indium (49)	3.0	8.1X10 ¹	3.0	8.1X10 ¹	1.5X10 ⁴	4.2X10 ⁵
In-113m		4.0	1.1X10 ²	2.0	5.4X10 ¹	6.2X10 ⁵	1.7X10 ⁷

TABLE A - 1: A₁ AND A₂ 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)	Specific activity (Ci/g)
In-114m (a)	Iridium (77)	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)		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
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-79	Krypton (36)	4.0	1.1X10 ²	2.0	5.4X10 ¹	4.2X10 ⁴	1.1X10 ⁶
Kr-81		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

TABLE A - 1: A₁ AND A₂ 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)	Specific activity (Ci/g)
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) (h)		1.0	2.7X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	1.8X10 ⁴	4.8X10 ⁵
N-13	Nitrogen (7)	9.0X10 ⁻¹	2.4X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	5.4X10 ⁷	1.5X10 ⁹
Na-22	Sodium (11)	5.0X10 ⁻¹	1.4X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	2.3X10 ²	6.3X10 ³
Na-24		2.0X10 ⁻¹	5.4	2.0X10 ⁻¹	5.4	3.2X10 ⁵	8.7X10 ⁶
Nb-93m	Niobium (41)	4.0X10 ¹	1.1X10 ³	3.0X10 ¹	8.1X10 ²	8.8	2.4X10 ²
Nb-94		7.0X10 ⁻¹	1.9X10 ¹	7.0X10 ⁻¹	1.9X10 ¹	6.9X10 ⁻³	1.9X10 ⁻¹
Nb-95		1.0	2.7X10 ¹	1.0	2.7X10 ¹	1.5X10 ³	3.9X10 ⁴
Nb-97		9.0X10 ⁻¹	2.4X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	9.9X10 ⁵	2.7X10 ⁷
Nd-147	Neodymium (60)	6.0	1.6X10 ²	6.0X10 ⁻¹	1.6X10 ¹	3.0X10 ³	8.1X10 ⁴
Nd-149		6.0X10 ⁻¹	1.6X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	4.5X10 ⁵	1.2X10 ⁷
Ni-59	Nickel (28)	Unlimited	Unlimited	Unlimited	Unlimited	3.0X10 ⁻³	8.0X10 ⁻²
Ni-63		4.0X10 ¹	1.1X10 ³	3.0X10 ¹	8.1X10 ²	2.1	5.7X10 ¹
Ni-65		4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	7.1X10 ⁵	1.9X10 ⁷
Np-235	Neptunium (93)	4.0X10 ¹	1.1X10 ³	4.0X10 ¹	1.1X10 ³	5.2X10 ¹	1.4X10 ³
Np-236 (short-lived)		2.0X10 ¹	5.4X10 ²	2.0	5.4X10 ¹	4.7X10 ⁻⁴	1.3X10 ⁻²
Np-236 (long-lived)		9.0X10 ⁰	2.4X10 ²	2.0X10 ⁻²	5.4X10 ⁻¹	4.7X10 ⁻⁴	1.3X10 ⁻²
Np-237		2.0X10 ¹	5.4X10 ²	2.0X10 ⁻³	5.4X10 ⁻²	2.6X10 ⁻⁵	7.1X10 ⁻⁴
Np-239		7.0	1.9X10 ²	4.0X10 ⁻¹	1.1X10 ¹	8.6X10 ³	2.3X10 ⁵
Os-185	Osmium	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

TABLE A - 1: A₁ AND A₂ 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)	Specific activity (Ci/g)
Os-193	(76)	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
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

TABLE A - 1: A₁ AND A₂ 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)	Specific activity (Ci/g)
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		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

TABLE A - 1: A₁ AND A₂ 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)	Specific activity (Ci/g)
Rb-84	Rubidium (37)	1.0	2.7X10 ¹	1.0	2.7X10 ¹	1.8X10 ³	4.7X10 ⁴
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

TABLE A - 1: A₁ AND A₂ 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)	Specific activity (Ci/g)
Sb-124		6.0X10 ⁻¹	1.6X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	6.5X10 ²	1.7X10 ⁴
Sb-125		2.0	5.4X10 ¹	1.0	2.7X10 ¹	3.9X10 ¹	1.0X10 ³
Sb-126		4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	3.1X10 ³	8.4X10 ⁴
Sc-44	Scandium (21)	5.0X10 ⁻¹	1.4X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	6.7X10 ⁵	1.8X10 ⁷
Sc-46		5.0X10 ⁻¹	1.4X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	1.3X10 ³	3.4X10 ⁴
Sc-47		1.0X10 ¹	2.7X10 ²	7.0X10 ⁻¹	1.9X10 ¹	3.1X10 ⁴	8.3X10 ⁵
Sc-48		3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	5.5X10 ⁴	1.5X10 ⁶
Se-75	Selenium (34)	3.0	8.1X10 ¹	3.0	8.1X10 ¹	5.4X10 ²	1.5X10 ⁴
Se-79		4.0X10 ¹	1.1X10 ³	2.0	5.4X10 ¹	2.6X10 ⁻³	7.0X10 ⁻²
Si-31	Silicon (14)	6.0X10 ⁻¹	1.6X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	1.4X10 ⁶	3.9X10 ⁷
Si-32		4.0X10 ¹	1.1X10 ³	5.0X10 ⁻¹	1.4X10 ¹	3.9	1.1X10 ²
Sm-145	Samarium (62)	1.0X10 ¹	2.7X10 ²	1.0X10 ¹	2.7X10 ²	9.8X10 ¹	2.6X10 ³
Sm-147		Unlimited	Unlimited	Unlimited	Unlimited	8.5X10 ⁻¹⁰	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

TABLE A - 1: A₁ AND A₂ 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)	Specific activity (Ci/g)
Sr-85m		5.0	1.4X10 ²	5.0	1.4X10 ²	1.2X10 ⁶	3.3X10 ⁷
Sr-87m		3.0	8.1X10 ¹	3.0	8.1X10 ¹	4.8X10 ⁵	1.3X10 ⁷
Sr-89		6.0X10 ⁻¹	1.6X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	1.1X10 ³	2.9X10 ⁴
Sr-90 (a)		3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	5.1	1.4X10 ²
Sr-91 (a)		3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	1.3X10 ⁵	3.6X10 ⁶
Sr-92 (a)		1.0	2.7X10 ¹	3.0X10 ⁻¹	8.1	4.7X10 ⁵	1.3X10 ⁷
T(H-3)	Tritium (1)	4.0X10 ¹	1.1X10 ³	4.0X10 ¹	1.1X10 ³	3.6X10 ²	9.7X10 ³
Ta-178 (long-lived)	Tantalum (73)	1.0	2.7X10 ¹	8.0X10 ⁻¹	2.2X10 ¹	4.2X10 ⁶	1.1X10 ⁸
Ta-179		3.0X10 ¹	8.1X10 ²	3.0X10 ¹	8.1X10 ²	4.1X10 ¹	1.1X10 ³
Ta-182		9.0X10 ⁻¹	2.4X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	2.3X10 ²	6.2X10 ³
Tb-157	Terbium (65)	4.0X10 ¹	1.1X10 ³	4.0X10 ¹	1.1X10 ³	5.6X10 ⁻¹	1.5X10 ¹
Tb-158		1.0	2.7X10 ¹	1.0	2.7X10 ¹	5.6X10 ⁻¹	1.5X10 ¹
Tb-160		1.0	2.7X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	4.2X10 ²	1.1X10 ⁴
Tc-95m (a)	Technetium (43)	2.0	5.4X10 ¹	2.0	5.4X10 ¹	8.3X10 ²	2.2X10 ⁴
Tc-96		4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	1.2X10 ⁴	3.2X10 ⁵
Tc-96m (a)		4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	1.4X10 ⁶	3.8X10 ⁷
Tc-97		Unlimited	Unlimited	Unlimited	Unlimited	5.2X10 ⁻⁵	1.4X10 ⁻³
Tc-97m		4.0X10 ¹	1.1X10 ³	1.0	2.7X10 ¹	5.6X10 ²	1.5X10 ⁴
Tc-98		8.0X10 ⁻¹	2.2X10 ¹	7.0X10 ⁻¹	1.9X10 ¹	3.2X10 ⁻⁵	8.7X10 ⁻⁴
Tc-99		4.0X10 ¹	1.1X10 ³	9.0X10 ⁻¹	2.4X10 ¹	6.3X10 ⁻⁴	1.7X10 ⁻²
Tc-99m		1.0X10 ¹	2.7X10 ²	4.0	1.1X10 ²	1.9X10 ⁵	5.3X10 ⁶
Te-121	Tellurium (52)	2.0	5.4X10 ¹	2.0	5.4X10 ¹	2.4X10 ³	6.4X10 ⁴
Te-121m		5.0	1.4X10 ²	3.0	8.1X10 ¹	2.6X10 ²	7.0X10 ³
Te-123m		8.0	2.2X10 ²	1.0	2.7X10 ¹	3.3X10 ²	8.9X10 ³

TABLE A - 1: A₁ AND A₂ 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)	Specific activity (Ci/g)
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	1.1X10 ⁴	3.0X10 ⁵
Th-227	Thorium (90)	1.0X10 ¹	2.7X10 ²	5.0X10 ⁻³	1.4X10 ⁻¹	1.1X10 ³	3.1X10 ⁴
Th-228 (a)		5.0X10 ⁻¹	1.4X10 ¹	1.0X10 ⁻³	2.7X10 ⁻²	3.0X10 ¹	8.2X10 ²
Th-229		5.0	1.4X10 ²	5.0X10 ⁻⁴	1.4X10 ⁻²	7.9X10 ⁻³	2.1X10 ⁻¹
Th-230		1.0X10 ¹	2.7X10 ²	1.0X10 ⁻³	2.7X10 ⁻²	7.6X10 ⁻⁴	2.1X10 ⁻²
Th-231		4.0X10 ¹	1.1X10 ³	2.0X10 ⁻²	5.4X10 ⁻¹	2.0X10 ⁴	5.3X10 ⁵
Th-232		Unlimited	Unlimited	Unlimited	Unlimited	4.0X10 ⁻⁹	1.1X10 ⁻⁷
Th-234 (a)		3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	8.6X10 ²	2.3X10 ⁴
Th(nat)		Unlimited	Unlimited	Unlimited	Unlimited	8.1X10 ⁻⁹	2.2X10 ⁻⁷
Ti-44 (a)	Titanium (22)	5.0X10 ⁻¹	1.4X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	6.4	1.7X10 ²
Tl-200	Thallium (81)	9.0X10 ⁻¹	2.4X10 ¹	9.0X10 ⁻¹	2.4X10 ¹	2.2X10 ⁴	6.0X10 ⁵
Tl-201		1.0X10 ¹	2.7X10 ²	4.0	1.1X10 ²	7.9X10 ³	2.1X10 ⁵
Tl-202		2.0	5.4X10 ¹	2.0	5.4X10 ¹	2.0X10 ³	5.3X10 ⁴
Tl-204		1.0X10 ¹	2.7X10 ²	7.0X10 ⁻¹	1.9X10 ¹	1.7X10 ¹	4.6X10 ²
Tm-167	Thulium (69)	7.0	1.9X10 ²	8.0X10 ⁻¹	2.2X10 ¹	3.1X10 ³	8.5X10 ⁴
Tm-170		3.0	8.1X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	2.2X10 ²	6.0X10 ³
Tm-171		4.0X10 ¹	1.1X10 ³	4.0X10 ¹	1.1X10 ³	4.0X10 ¹	1.1X10 ³

TABLE A - 1: A₁ AND A₂ 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)	Specific activity (Ci/g)
U-230 (fast lung absorption) (a)(d)	Uranium (92)	4.0X10 ¹	1.1X10 ³	1.0X10 ⁻¹	2.7	1.0X10 ³	2.7X10 ⁴
U-230 (medium lung absorption) (a)(e)		4.0X10 ¹	1.1X10 ³	4.0X10 ⁻³	1.1X10 ⁻¹	1.0X10 ³	2.7X10 ⁴
U-230 (slow lung absorption) (a)(f)		3.0X10 ¹	8.1X10 ²	3.0X10 ⁻³	8.1X10 ⁻²	1.0X10 ³	2.7X10 ⁴
U-232 (fast lung absorption) (d)		4.0X10 ¹	1.1X10 ³	1.0X10 ⁻²	2.7X10 ⁻¹	8.3X10 ⁻¹	2.2X10 ¹
U-232 (medium lung absorption) (e)		4.0X10 ¹	1.1X10 ³	7.0X10 ⁻³	1.9X10 ⁻¹	8.3X10 ⁻¹	2.2X10 ¹
U-232 (slow lung absorption)(f)		1.0X10 ¹	2.7X10 ²	1.0X10 ⁻³	2.7X10 ⁻²	8.3X10 ⁻¹	2.2X10 ⁻¹
U-233 (fast lung absorption) (d)		4.0X10 ¹	1.1X10 ³	9.0X10 ⁻²	2.4	3.6X10 ⁻⁴	9.7X10 ⁻³
U-233 (medium lung absorption) (e)		4.0X10 ¹	1.1X10 ³	2.0X10 ⁻²	5.4X10 ⁻¹	3.6X10 ⁻⁴	9.7X10 ⁻³
U-233 (slow lung absorption) (f)		4.0X10 ¹	1.1X10 ³	6.0X10 ⁻³	1.6X10 ⁻¹	3.6X10 ⁻⁴	9.7X10 ⁻³
U-234 (fast lung absorption) (d)		4.0X10 ¹	1.1X10 ³	9.0X10 ⁻²	2.4	2.3X10 ⁻⁴	6.2X10 ⁻³
U-234 (medium lung absorption) (e)		4.0X10 ¹	1.1X10 ³	2.0X10 ⁻²	5.4X10 ⁻¹	2.3X10 ⁻⁴	6.2X10 ⁻³
U-234 (slow lung absorption) (f)		4.0X10 ¹	1.1X10 ³	6.0X10 ⁻³	1.6X10 ⁻¹	2.3X10 ⁻⁴	6.2X10 ⁻³
U-235 (all lung absorption types) (a),(d),(e),(f)		Unlimited	Unlimited	Unlimited	Unlimited	8.0X10 ⁻⁸	2.2X10 ⁻⁶
U-236 (fast lung absorption) (d)		Unlimited	Unlimited	Unlimited	Unlimited	2.4X10 ⁻⁶	6.5X10 ⁻⁵
U-236 (medium lung absorption) (e)		4.0X10 ¹	1.1X10 ³	2.0X10 ⁻²	5.4X10 ⁻¹	2.4X10 ⁻⁶	6.5X10 ⁻⁵
U-236 (slow lung absorption) (f)		4.0X10 ¹	1.1X10 ³	6.0X10 ⁻³	1.6X10 ⁻¹	2.4X10 ⁻⁶	6.5X10 ⁻⁵

TABLE A - 1: A₁ AND A₂ 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)	Specific activity (Ci/g)
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-4)
V-48	Vanadium (23)	4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	6.3X10 ³	1.7X10 ⁵
V-49		4.0X10 ¹	1.1X10 ³	4.0X10 ¹	1.1X10 ³	3.0X10 ²	8.1X10 ³
W-178 (a)	Tungsten (74)	9.0	2.4X10 ²	5.0	1.4X10 ²	1.3X10 ³	3.4X10 ⁴
W-181		3.0X10 ¹	8.1X10 ²	3.0X10 ¹	8.1X10 ²	2.2X10 ²	6.0X10 ³
W-185		4.0X10 ¹	1.1X10 ³	8.0X10 ⁻¹	2.2X10 ¹	3.5X10 ²	9.4X10 ³
W-187		2.0	5.4X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	2.6X10 ⁴	7.0X10 ⁵
W-188 (a)		4.0X10 ⁻¹	1.1X10 ¹	3.0X10 ⁻¹	8.1	3.7X10 ²	1.0X10 ⁴
Xe-122 (a)	Xenon (54)	4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	4.8X10 ⁴	1.3X10 ⁶
Xe-123		2.0	5.4X10 ¹	7.0X10 ⁻¹	1.9X10 ¹	4.4X10 ⁵	1.2X10 ⁷
Xe-127		4.0	1.1X10 ²	2.0	5.4X10 ¹	1.0X10 ³	2.8X10 ⁴
Xe-131m		4.0X10 ¹	1.1X10 ³	4.0X10 ¹	1.1X10 ³	3.1X10 ³	8.4X10 ⁴
Xe-133		2.0X10 ¹	5.4X10 ²	1.0X10 ¹	2.7X10 ²	6.9X10 ³	1.9X10 ⁵
Xe-135		3.0	8.1X10 ¹	2.0	5.4X10 ¹	9.5X10 ⁴	2.6X10 ⁶
Y-87 (a)	Yttrium (39)	1.0	2.7X10 ¹	1.0	2.7X10 ¹	1.7X10 ⁴	4.5X10 ⁵
Y-88		4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	5.2X10 ²	1.4X10 ⁴
Y-90		3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	2.0X10 ⁴	5.4X10 ⁵
Y-91		6.0X10 ⁻¹	1.6X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	9.1X10 ²	2.5X10 ⁴

TABLE A - 1: A₁ AND A₂ 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)	Specific activity (Ci/g)
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

NOTES

- (a) A₁ and/or A₂ values include contributions from daughter nuclides with half-lives less than 10 days, as listed in the following:

Mg-28	Al-28
Ca-47	Sc-47
Ti-44	Sc-44
Fe-52	Mn-52m
Fe-60	Co-60m
Zn-69m	Zn-69
Ge-68	Ga-68
Rb-83	Kr-83m
Sr-82	Rb-82
Sr-90	Y-90
Sr-91	Y-91m
Sr-92	Y-92
Y-87	Sr-87m
Z-95	Nb-95m
Zr-97	Nb-97m, Nb-97
Mo-99	Tc-99m
Tc-95m	Tc-95

Tc-96m	Tc-96
Ru-103	Rh-103m
Ru-106	Rh-106
Pd-103	Rh-103m
Ag-108m	Ag-108
Ag-110m	Ag-110
Cd-115	In-115m
In-114m	In-114
Sn-113	In-113m
Sn-121m	Sn-121
Sn-126	Sb-126m
Te-127m	Te-127
Te-129m	Tc-129
Te-131m	Te-131
Te-132	I-132
I-135	Xe-135m
Xe-132	I-122
Cs-137	Ba-137m
Ba-131	Cs-131
Ba-140	La-140
Ce-144	Pr-144m, Pr-144
Pm-148m	Pm-148
Gd-146	Eu-146
Dy-166	Ho-166
Hf-172	Lu-172
W-178	Ta-178
W-188	Re-188
Re-189	Os-189m
Os-194	Ir-194
Ir-189	Os-189m
Pt-188	Ir-188
Hg-194	Au-194
Hg-195m	Hg-195
Pb-210	Bi-210
Pb-212	Bi-212, Tl-208, Po-212
Bi-210m	Tl-206
Bi-212	Tl-208, Po-212
At-211	Po-211
Rn-222	Po-218, Pb-214, At-218, Bi-214, Po-214
Ra-223	Rn-219, Po-215, Pb-211, Bi-211, Po-211, Tl-207
Ra-224	Rn-220, Po-216, Pb-212, Bi-212, Tl-208, Po-212
Ra-225	Ac-225, Fr-221, At-217, Bi-213, Tl-209, Po-213, Pb-209
Ra-226	Rn-222, Po-218, Pb-214, At-218, Bi-214, Po-214
Ra-228	Ac-228
Ac-225	Fr-221, At-217, Bi-213, Tl-209, Po-213, Pb-209
Ac-227	Fr-223
Th-228	Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208, Po-212
Th-234	Pa-234m, Pa-234
Pa-230	Ac-226, Th-226, Fr-222, Ra-222, Rn-218, Po-214
U-230	Th-226, Ra-222, Rn-218, Po-214
U-235	Th-231
Pu-241	U-237
Pu-244	U-240, Np-240m
Am-242m	Am-242, Np-238
Am-243	Np-239
Cm-247	Pu-243
Bk-249	Am-245
Cf-253	Cm-249

- (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 Parts I-IV, Determination of A_1 and A_2).
- (c) The activity of Ir-192 in special form 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 (d) and (e), above.
- (g) These values apply to unirradiated uranium only.
- (h)

$A_2 = 0.74$ TBq (20 Ci) for Mo-99 for domestic use.

TABLE A - 1 (SUPPLEMENT)
A₁ AND A₂ VALUES FOR RADIONUCLIDES
FOR INTERNATIONAL SHIPMENTS

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)
Cf-252	Californium (98)	5.0X10 ⁻²	1.4	3.0X10 ⁻³	8.1X10 ⁻²	2.0X10 ¹	5.4X10 ²
Mo-99 (a)	Molybdenum (42)	1.0	2.7X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	1.8X10 ⁴	4.8X10 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)
Ac-225	Actinium (89)	1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-7}
Ac-227		1.0×10^{-1}	2.7×10^{-12}	1.0×10^3	2.7×10^{-8}
Ac-228		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Ag-105	Silver (47)	1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Ag-108m (b)		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Ag-110m		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Ag-111		1.0×10^3	2.7×10^{-8}	1.0×10^6	2.7×10^{-5}
Al-26	Aluminum (13)	1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
Am-241	Americium (95)	1.0	2.7×10^{-11}	1.0×10^4	2.7×10^{-7}
Am-242m (b)		1.0	2.7×10^{-11}	1.0×10^4	2.7×10^{-7}
Am-243 (b)		1.0	2.7×10^{-11}	1.0×10^3	2.7×10^{-8}
Ar-37	Argon (18)	1.0×10^6	2.7×10^{-5}	1.0×10^8	2.7×10^{-3}
Ar-39		1.0×10^7	2.7×10^{-4}	1.0×10^4	2.7×10^{-7}
Ar-41		1.0×10^2	2.7×10^{-9}	1.0×10^9	2.7×10^{-2}
As-72	Arsenic (33)	1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
As-73		1.0×10^3	2.7×10^{-8}	1.0×10^7	2.7×10^{-4}
As-74		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
As-76		1.0×10^2	2.7×10^{-9}	1.0×10^5	2.7×10^{-6}
As-77		1.0×10^3	2.7×10^{-8}	1.0×10^6	2.7×10^{-5}
At-211	Astatine (85)	1.0×10^3	2.7×10^{-8}	1.0×10^7	2.7×10^{-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)
Au-193	Gold (79)	1.0×10^2	2.7×10^{-9}	1.0×10^7	2.7×10^{-4}
Au-194		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Au-195		1.0×10^2	2.7×10^{-9}	1.0×10^7	2.7×10^{-4}
Au-198		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Au-199		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Ba-131	Barium (56)	1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Ba-133		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Ba-133m		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Ba-140 (b)		1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
Be-7	Beryllium (4)	1.0×10^3	2.7×10^{-8}	1.0×10^7	2.7×10^{-4}
Be-10		1.0×10^4	2.7×10^{-7}	1.0×10^6	2.7×10^{-5}
Bi-205	Bismuth (83)	1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Bi-206		1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
Bi-207		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Bi-210		1.0×10^3	2.7×10^{-8}	1.0×10^6	2.7×10^{-5}
Bi-210m		1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
Bi-212 (b)		1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
Bk-247	Berkelium (97)	1.0	2.7×10^{-11}	1.0×10^4	2.7×10^{-7}
Bk-249		1.0×10^3	2.7×10^{-8}	1.0×10^6	2.7×10^{-5}
Br-76	Bromine (35)	1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
Br-77		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-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)
Br-82		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
C-11	Carbon (6)	1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
C-14		1.0×10^4	2.7×10^{-7}	1.0×10^7	2.7×10^{-4}
Ca-41	Calcium (20)	1.0×10^5	2.7×10^{-6}	1.0×10^7	2.7×10^{-4}
Ca-45		1.0×10^4	2.7×10^{-7}	1.0×10^7	2.7×10^{-4}
Ca-47		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Cd-109	Cadmium (48)	1.0×10^4	2.7×10^{-7}	1.0×10^6	2.7×10^{-5}
Cd-113m		1.0×10^3	2.7×10^{-8}	1.0×10^6	2.7×10^{-5}
Cd-115		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Cd-115m		1.0×10^3	2.7×10^{-8}	1.0×10^6	2.7×10^{-5}
Ce-139	Cerium (58)	1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Ce-141		1.0×10^2	2.7×10^{-9}	1.0×10^7	2.7×10^{-4}
Ce-143		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Ce-144 (b)		1.0×10^2	2.7×10^{-9}	1.0×10^5	2.7×10^{-6}
Cf-248	Californium (98)	1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-7}
Cf-249		1.0	2.7×10^{-11}	1.0×10^3	2.7×10^{-8}
Cf-250		1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-7}
Cf-251		1.0	2.7×10^{-11}	1.0×10^3	2.7×10^{-8}
Cf-252		1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-7}
Cf-253		1.0×10^2	2.7×10^{-9}	1.0×10^5	2.7×10^{-6}
Cf-254		1.0	2.7×10^{-11}	1.0×10^3	2.7×10^{-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)
Cl-36	Chlorine (17)	1.0×10^4	2.7×10^{-7}	1.0×10^6	2.7×10^{-5}
Cl-38		1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
Cm-240	Curium (96)	1.0×10^2	2.7×10^{-9}	1.0×10^5	2.7×10^{-6}
Cm-241		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Cm-242		1.0×10^2	2.7×10^{-9}	1.0×10^5	2.7×10^{-6}
Cm-243		1.0	2.7×10^{-11}	1.0×10^4	2.7×10^{-7}
Cm-244		1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-7}
Cm-245		1.0	2.7×10^{-11}	1.0×10^3	2.7×10^{-8}
Cm-246		1.0	2.7×10^{-11}	1.0×10^3	2.7×10^{-8}
Cm-247		1.0	2.7×10^{-11}	1.0×10^4	2.7×10^{-7}
Cm-248		1.0	2.7×10^{-11}	1.0×10^3	2.7×10^{-8}
Co-55	Cobalt (27)	1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Co-56		1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
Co-57		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Co-58		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Co-58m		1.0×10^4	2.7×10^{-7}	1.0×10^7	2.7×10^{-4}
Co-60		1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
Cr-51	Chromium (24)	1.0×10^3	2.7×10^{-8}	1.0×10^7	2.7×10^{-4}
Cs-129		1.0×10^2	2.7×10^{-9}	1.0×10^5	2.7×10^{-6}
Cs-131		1.0×10^3	2.7×10^{-8}	1.0×10^6	2.7×10^{-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)
Cs-132	Cesium (55)	1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
Cs-134		1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-7}
Cs-134m		1.0×10^3	2.7×10^{-8}	1.0×10^5	2.7×10^{-6}
Cs-135		1.0×10^4	2.7×10^{-7}	1.0×10^7	2.7×10^{-4}
Cs-136		1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
Cs-137 (b)		1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-7}
Cu-64	Copper (29)	1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Cu-67		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Dy-159	Dysprosium (66)	1.0×10^3	2.7×10^{-8}	1.0×10^7	2.7×10^{-4}
Dy-165		1.0×10^3	2.7×10^{-8}	1.0×10^6	2.7×10^{-5}
Dy-166		1.0×10^3	2.7×10^{-8}	1.0×10^6	2.7×10^{-5}
Er-169	Erbium (68)	1.0×10^4	2.7×10^{-7}	1.0×10^7	2.7×10^{-4}
Er-171		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Eu-147	Europium (63)	1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Eu-148		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Eu-149		1.0×10^2	2.7×10^{-9}	1.0×10^7	2.7×10^{-4}
Eu-150 (short lived)		1.0×10^3	2.7×10^{-8}	1.0×10^6	2.7×10^{-5}
Eu-150 (long lived)		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Eu-152		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Eu-152 m		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-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)
Eu-154		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Eu-155		1.0×10^2	2.7×10^{-9}	1.0×10^7	2.7×10^{-4}
Eu-156		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
F-18	Fluorine (9)	1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Fe-52	Iron (26)	1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Fe-55		1.0×10^4	2.7×10^{-7}	1.0×10^6	2.7×10^{-5}
Fe-59		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Fe-60		1.0×10^2	2.7×10^{-9}	1.0×10^5	2.7×10^{-6}
Ga-67	Gallium (31)	1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Ga-68		1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
Ga-72		1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
Gd-146	Gadolinium (64)	1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Gd-148		1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-7}
Gd-153		1.0×10^2	2.7×10^{-9}	1.0×10^7	2.7×10^{-4}
Gd-159		1.0×10^3	2.7×10^{-8}	1.0×10^6	2.7×10^{-5}
Ge-68	Germanium (32)	1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
Ge-71		1.0×10^4	2.7×10^{-7}	1.0×10^8	2.7×10^{-3}
Ge-77		1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
Hf-172	Hafnium (72)	1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Hf-175		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Hf-181		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-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)
Hf-182		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Hg-194	Mercury (80)	1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Hg-195m		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Hg-197		1.0×10^2	2.7×10^{-9}	1.0×10^7	2.7×10^{-4}
Hg-197m		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Hg-203		1.0×10^2	2.7×10^{-9}	1.0×10^5	2.7×10^{-6}
Ho-166	Holmium (67)	1.0×10^3	2.7×10^{-8}	1.0×10^5	2.7×10^{-6}
Ho-166m		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
I-123	Iodine (53)	1.0×10^2	2.7×10^{-9}	1.0×10^7	2.7×10^{-4}
I-124		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
I-125		1.0×10^3	2.7×10^{-8}	1.0×10^6	2.7×10^{-5}
I-126		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
I-129		1.0×10^2	2.7×10^{-9}	1.0×10^5	2.7×10^{-6}
I-131		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
I-132		1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
I-133		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
I-134		1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
I-135		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
In-111	Indium (49)	1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
In-113m		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
In-114m		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-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-79	Krypton (36)	1.0X10 ³	2.7X10 ⁻⁸	1.0X10 ⁵	2.7X10 ⁻⁶
Kr-81		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

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)
Mn-52	Manganese (25)	1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
Mn-53		1.0×10^4	2.7×10^{-7}	1.0×10^9	2.7×10^{-2}
Mn-54		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Mn-56		1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
Mo-93	Molybdenum (42)	1.0×10^3	2.7×10^{-8}	1.0×10^8	2.7×10^{-3}
Mo-99		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
N-13	Nitrogen (7)	1.0×10^2	2.7×10^{-9}	1.0×10^9	2.7×10^{-2}
Na-22	Sodium (11)	1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Na-24		1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
Nb-93m	Niobium (41)	1.0×10^4	2.7×10^{-7}	1.0×10^7	2.7×10^{-4}
Nb-94		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Nb-95		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Nb-97		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Nd-147	Neodymium (60)	1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Nd-149		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Ni-59	Nickel (28)	1.0×10^4	2.7×10^{-7}	1.0×10^8	2.7×10^{-3}
Ni-63		1.0×10^5	2.7×10^{-6}	1.0×10^8	2.7×10^{-3}
Ni-65		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Np-235	Neptunium (93)	1.0×10^3	2.7×10^{-8}	1.0×10^7	2.7×10^{-4}
Np-236 (short-lived)		1.0×10^3	2.7×10^{-8}	1.0×10^7	2.7×10^{-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)
Np-236 (long-lived)		1.0×10^2	2.7×10^{-9}	1.0×10^5	2.7×10^{-6}
Np-237(b)		1.0	2.7×10^{-11}	1.0×10^3	2.7×10^{-8}
Np-239		1.0×10^2	2.7×10^{-9}	1.0×10^7	2.7×10^{-4}
Os-185	Osmium (76)	1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Os-191		1.0×10^2	2.7×10^{-9}	1.0×10^7	2.7×10^{-4}
Os-191m		1.0×10^3	2.7×10^{-8}	1.0×10^7	2.7×10^{-4}
Os-193		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Os-194		1.0×10^2	2.7×10^{-9}	1.0×10^5	2.7×10^{-6}
P-32	Phosphorus (15)	1.0×10^3	2.7×10^{-8}	1.0×10^5	2.7×10^{-6}
P-33		1.0×10^5	2.7×10^{-6}	1.0×10^8	2.7×10^{-3}
Pa-230	Protactinium (91)	1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Pa-231		1.0	2.7×10^{-11}	1.0×10^3	2.7×10^{-8}
Pa-233		1.0×10^2	2.7×10^{-9}	1.0×10^7	2.7×10^{-4}
Pb-201	Lead (82)	1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Pb-202		1.0×10^3	2.7×10^{-8}	1.0×10^6	2.7×10^{-5}
Pb-203		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Pb-205		1.0×10^4	2.7×10^{-7}	1.0×10^7	2.7×10^{-4}
Pb-210 (b)		1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-7}
Pb-212 (b)		1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
Pd-103	Palladium (46)	1.0×10^3	2.7×10^{-8}	1.0×10^8	2.7×10^{-3}
Pd-107		1.0×10^5	2.7×10^{-6}	1.0×10^8	2.7×10^{-3}

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)
Pd-109		1.0×10^3	2.7×10^{-8}	1.0×10^6	2.7×10^{-5}
Pm-143	Promethium (61)	1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Pm-144		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Pm-145		1.0×10^3	2.7×10^{-8}	1.0×10^7	2.7×10^{-4}
Pm-147		1.0×10^4	2.7×10^{-7}	1.0×10^7	2.7×10^{-4}
Pm-148m		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Pm-149		1.0×10^3	2.7×10^{-8}	1.0×10^6	2.7×10^{-5}
Pm-151		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Po-210	Polonium (84)	1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-7}
Pr-142	Praseodymium (59)	1.0×10^2	2.7×10^{-9}	1.0×10^5	2.7×10^{-6}
Pr-143		1.0×10^4	2.7×10^{-7}	1.0×10^6	2.7×10^{-5}
Pt-188	Platinum (78)	1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Pt-191		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Pt-193		1.0×10^4	2.7×10^{-7}	1.0×10^7	2.7×10^{-4}
Pt-193m		1.0×10^3	2.7×10^{-8}	1.0×10^7	2.7×10^{-4}
Pt-195m		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Pt-197		1.0×10^3	2.7×10^{-8}	1.0×10^6	2.7×10^{-5}
Pt-197m		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Pu-236	Plutonium (94)	1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-7}
Pu-237		1.0×10^3	2.7×10^{-8}	1.0×10^7	2.7×10^{-4}
Pu-238		1.0	2.7×10^{-11}	1.0×10^4	2.7×10^{-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-239		1.0	2.7×10^{-11}	1.0×10^4	2.7×10^{-7}
Pu-240		1.0	2.7×10^{-11}	1.0×10^3	2.7×10^{-8}
Pu-241		1.0×10^2	2.7×10^{-9}	1.0×10^5	2.7×10^{-6}
Pu-242		1.0	2.7×10^{-11}	1.0×10^4	2.7×10^{-7}
Pu-244		1.0	2.7×10^{-11}	1.0×10^4	2.7×10^{-7}
Ra-223 (b)	Radium (88)	1.0×10^2	2.7×10^{-9}	1.0×10^5	2.7×10^{-6}
Ra-224 (b)		1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
Ra-225		1.0×10^2	2.7×10^{-9}	1.0×10^5	2.7×10^{-6}
Ra-226 (b)		1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-7}
Ra-228 (b)		1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
Rb-81	Rubidium (37)	1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Rb-83		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Rb-84		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Rb-86		1.0×10^2	2.7×10^{-9}	1.0×10^5	2.7×10^{-6}
Rb-87		1.0×10^4	2.7×10^{-7}	1.0×10^7	2.7×10^{-4}
Rb(nat)		1.0×10^4	2.7×10^{-7}	1.0×10^7	2.7×10^{-4}
Re-184	Rhenium (75)	1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Re-184m		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Re-186		1.0×10^3	2.7×10^{-8}	1.0×10^6	2.7×10^{-5}
Re-187		1.0×10^6	2.7×10^{-5}	1.0×10^9	2.7×10^{-2}
Re-188		1.0×10^2	2.7×10^{-9}	1.0×10^5	2.7×10^{-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)
Re-189		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Re(nat)		1.0×10^6	2.7×10^{-5}	1.0×10^9	2.7×10^{-2}
Rh-99	Rhodium (45)	1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Rh-101		1.0×10^2	2.7×10^{-9}	1.0×10^7	2.7×10^{-4}
Rh-102		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Rh-102m		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Rh-103m		1.0×10^4	2.7×10^{-7}	1.0×10^8	2.7×10^{-3}
Rh-105		1.0×10^2	2.7×10^{-9}	1.0×10^7	2.7×10^{-4}
Rn-222 (b)	Radon (86)	1.0×10^1	2.7×10^{-10}	1.0×10^8	2.7×10^{-3}
Ru-97	Ruthenium (44)	1.0×10^2	2.7×10^{-9}	1.0×10^7	2.7×10^{-4}
Ru-103		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Ru-105		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Ru-106 (b)		1.0×10^2	2.7×10^{-9}	1.0×10^5	2.7×10^{-6}
S-35	Sulphur (16)	1.0×10^5	2.7×10^{-6}	1.0×10^8	2.7×10^{-3}
Sb-122	Antimony (51)	1.0×10^2	2.7×10^{-9}	1.0×10^4	2.7×10^{-7}
Sb-124		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Sb-125		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Sb-126		1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
Sc-44	Scandium (21)	1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
Sc-46		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Sc-47		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-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)
Sc-48		1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
Se-75	Selenium (34)	1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Se-79		1.0×10^4	2.7×10^{-7}	1.0×10^7	2.7×10^{-4}
Si-31	Silicon (14)	1.0×10^3	2.7×10^{-8}	1.0×10^6	2.7×10^{-5}
Si-32		1.0×10^3	2.7×10^{-8}	1.0×10^6	2.7×10^{-5}
Sm-145	Samarium (62)	1.0×10^2	2.7×10^{-9}	1.0×10^7	2.7×10^{-4}
Sm-147		1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-7}
Sm-151		1.0×10^4	2.7×10^{-7}	1.0×10^8	2.7×10^{-3}
Sm-153		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Sn-113	Tin (50)	1.0×10^3	2.7×10^{-8}	1.0×10^7	2.7×10^{-4}
Sn-117m		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Sn-119m		1.0×10^3	2.7×10^{-8}	1.0×10^7	2.7×10^{-4}
Sn-121m		1.0×10^3	2.7×10^{-8}	1.0×10^7	2.7×10^{-4}
Sn-123		1.0×10^3	2.7×10^{-8}	1.0×10^6	2.7×10^{-5}
Sn-125		1.0×10^2	2.7×10^{-9}	1.0×10^5	2.7×10^{-6}
Sn-126		1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
Sr-82	Strontium (38)	1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
Sr-85		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Sr-85m		1.0×10^2	2.7×10^{-9}	1.0×10^7	2.7×10^{-4}
Sr-87m		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Sr-89		1.0×10^3	2.7×10^{-8}	1.0×10^6	2.7×10^{-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-90 (b)		1.0×10^2	2.7×10^{-9}	1.0×10^4	2.7×10^{-7}
Sr-91		1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
Sr-92		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
T(H-3)	Tritium (1)	1.0×10^6	2.7×10^{-5}	1.0×10^9	2.7×10^{-2}
Ta-178 (long-lived)	Tantalum (73)	1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Ta-179		1.0×10^3	2.7×10^{-8}	1.0×10^7	2.7×10^{-4}
Ta-182		1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-7}
Tb-157	Terbium (65)	1.0×10^4	2.7×10^{-7}	1.0×10^7	2.7×10^{-4}
Tb-158		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Tb-160		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Tc-95m	Technetium (43)	1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Tc-96		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Tc-96m		1.0×10^3	2.7×10^{-8}	1.0×10^7	2.7×10^{-4}
Tc-97		1.0×10^3	2.7×10^{-8}	1.0×10^8	2.7×10^{-3}
Tc-97m		1.0×10^3	2.7×10^{-8}	1.0×10^7	2.7×10^{-4}
Tc-98		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Tc-99		1.0×10^4	2.7×10^{-7}	1.0×10^7	2.7×10^{-4}
Tc-99m		1.0×10^2	2.7×10^{-9}	1.0×10^7	2.7×10^{-4}
Te-121	Tellurium (52)	1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Te-121m		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Te-123m		1.0×10^2	2.7×10^{-9}	1.0×10^7	2.7×10^{-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)
Te-125m		1.0×10^3	2.7×10^{-8}	1.0×10^7	2.7×10^{-4}
Te-127		1.0×10^3	2.7×10^{-8}	1.0×10^6	2.7×10^{-5}
Te-127m		1.0×10^3	2.7×10^{-8}	1.0×10^7	2.7×10^{-4}
Te-129		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Te-129m		1.0×10^3	2.7×10^{-8}	1.0×10^6	2.7×10^{-5}
Te-131m		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Te-132		1.0×10^2	2.7×10^{-9}	1.0×10^7	2.7×10^{-4}
Th-227	Thorium (90)	1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-7}
Th-228 (b)		1.0	2.7×10^{-11}	1.0×10^4	2.7×10^{-7}
Th-229 (b)		1.0	2.7×10^{-11}	1.0×10^3	2.7×10^{-8}
Th-230		1.0	2.7×10^{-11}	1.0×10^4	2.7×10^{-7}
Th-231		1.0×10^3	2.7×10^{-8}	1.0×10^7	2.7×10^{-4}
Th-232		1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-7}
Th-234 (b)		1.0×10^3	2.7×10^{-8}	1.0×10^5	2.7×10^{-6}
Th (nat) (b)		1.0	2.7×10^{-11}	1.0×10^3	2.7×10^{-8}
Ti-44	Titanium (22)	1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
Tl-200	Thallium (81)	1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Tl-201		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Tl-202		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Tl-204		1.0×10^4	2.7×10^{-7}	1.0×10^4	2.7×10^{-7}
Tm-167	Thulium (69)	1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-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)
Tm-170		1.0×10^3	2.7×10^{-8}	1.0×10^6	2.7×10^{-5}
Tm-171		1.0×10^4	2.7×10^{-7}	1.0×10^8	2.7×10^{-3}
U-230 (fast lung absorption)(b) (c)	Uranium (92)	1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
U-230 (medium lung absorption)(d)		1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-7}
U-230 (slow lung absorption)(e)		1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-7}
U-232 (fast lung absorption) (b)(c)	Uranium (92)	1.0	2.7×10^{-11}	1.0×10^3	2.7×10^{-8}
U-232 (medium lung absorption) (d)		1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-7}
U-232 (slow lung absorption) (e)		1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-7}
U-233 (fast lung absorption) (c)		1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-7}
U-233 (medium lung absorption) (d)		1.0×10^2	2.7×10^{-9}	1.0×10^5	2.7×10^{-6}
U-233 (slow lung absorption) (e)		1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
U-234 (fast lung absorption) (c)		1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-7}
U-234 (medium lung absorption) (d)		1.0×10^2	2.7×10^{-9}	1.0×10^5	2.7×10^{-6}
U-234 (slow lung absorption) (e)		1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
U-235 (all lung absorption types) (b),(c),(d),(e)		1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-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-236 (fast lung absorption) (c)	Uranium (92)	1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-7}
U-236 (medium lung absorption) (d)		1.0×10^2	2.7×10^{-9}	1.0×10^5	2.7×10^{-6}
U-236 (slow lung absorption) (e)		1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-7}
U-238 (all lung absorption types) (b) (c),(d),(e)		1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-7}
U (nat)(b)		1.0	2.7×10^{-11}	1.0×10^3	2.7×10^{-8}
U (enriched to 20% or less)(f)		1.0	2.7×10^{-11}	1.0×10^3	2.7×10^{-8}
U (dep)		1.0	2.7×10^{-11}	1.0×10^3	2.7×10^{-8}
V-48	Vanadium (23)	1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
V-49		1.0×10^4	2.7×10^{-7}	1.0×10^7	2.7×10^{-4}
W-178	Tungsten (74)	1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
W-181		1.0×10^3	2.7×10^{-8}	1.0×10^7	2.7×10^{-4}
W-185		1.0×10^4	2.7×10^{-7}	1.0×10^7	2.7×10^{-4}
W-187		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
W-188		1.0×10^2	2.7×10^{-9}	1.0×10^5	2.7×10^{-6}
Xe-122	Xenon (54)	1.0×10^2	2.7×10^{-9}	1.0×10^9	2.7×10^{-2}
Xe-123		1.0×10^2	2.7×10^{-9}	1.0×10^9	2.7×10^{-2}
Xe-127		1.0×10^3	2.7×10^{-8}	1.0×10^5	2.7×10^{-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)
Xe-131m		1.0×10^4	2.7×10^{-7}	1.0×10^4	2.7×10^{-7}
Xe-133		1.0×10^3	2.7×10^{-8}	1.0×10^4	2.7×10^{-7}
Xe-135		1.0×10^3	2.7×10^{-8}	1.0×10^{10}	2.7×10^{-1}
Y-87	Yttrium (39)	1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Y-88		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Y-90		1.0×10^3	2.7×10^{-8}	1.0×10^5	2.7×10^{-6}
Y-91		1.0×10^3	2.7×10^{-8}	1.0×10^6	2.7×10^{-5}
Y-91m		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Y-92		1.0×10^2	2.7×10^{-9}	1.0×10^5	2.7×10^{-6}
Y-93		1.0×10^2	2.7×10^{-9}	1.0×10^5	2.7×10^{-6}
Yb-169	Ytterbium (70)	1.0×10^2	2.7×10^{-9}	1.0×10^7	2.7×10^{-4}
Yb-175		1.0×10^3	2.7×10^{-8}	1.0×10^7	2.7×10^{-4}
Zn-65	Zinc (30)	1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Zn-69		1.0×10^4	2.7×10^{-7}	1.0×10^6	2.7×10^{-5}
Zn-69m		1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Zr-88	Zirconium (40)	1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Zr-93(b)		1.0×10^3	2.7×10^{-8}	1.0×10^7	2.7×10^{-4}
Zr-95		1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Zr-97(b)		1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}

NOTES

- (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 |
| Ag-108m | Ag-108 |
| Cs-137 | Ba-137m |
| 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-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-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 |
| | Np-237 Pa-233 |
| Am-242m | Am-242 |
| Am-243 | Np-239 |
- (c) These values apply only to compounds of uranium that take the chemical form of UF₆, UO₂F₂, and UO₂(NO₃)₂ in both normal and accident conditions of transport.
- (d) These values apply only to compounds of uranium that take the chemical form of UO₃, UF₄, UCl₄, and hexavalent compounds in both normal and accident conditions of transport.
- (e) These values apply to all compounds of uranium other than those specified in (c) and (d), above.
- (f) These values apply to unirradiated uranium only.

TABLE A-3: GENERAL VALUES FOR A₁ AND A₂

Contents	A ₁		A ₂		Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limits for exempt consignments (Bq)	Activity limits for exempt consignments (Ci)
	(TBq)	(Ci)	(TBq)	(Ci)				
Only beta or gamma emitting radionuclides are known to be present	1 x 10 ⁻¹	2.7 x 10 ⁰	2 x 10 ⁻²	5.4 x 10 ⁻¹	1 x 10 ¹	2.7 x 10 ⁻¹⁰	1 x 10 ⁴	2.7 x 10 ⁻⁷
Alpha emitting nuclides, but no neutron emitters, are known to be present ^(a)	2 x 10 ⁻¹	5.4 x 10 ⁰	9 x 10 ⁻⁵	2.4 x 10 ⁻³	1 x 10 ⁻¹	2.7 x 10 ⁻¹²	1 x 10 ³	2.7 x 10 ⁻⁸
Neutron emitting nuclides are known to be present or no relevant data are available	1 x 10 ⁻³	2.7 x 10 ⁻²	9 x 10 ⁻⁵	2.4 x 10 ⁻³	1 x 10 ⁻¹	2.7 x 10 ⁻¹²	1 x 10 ³	2.7 x 10 ⁻⁸

(a) If beta or gamma nuclides are known to be present, the A₁ value of 0.1 TBq (2.7 Ci) should be used.

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 x 10 ⁻⁸	5.0 x 10 ⁻⁷
0.72	2.6 x 10 ⁻⁸	7.1 x 10 ⁻⁷
1	2.8 x 10 ⁻⁸	7.6 x 10 ⁻⁷
1.5	3.7 x 10 ⁻⁸	1.0 x 10 ⁻⁶
5	1.0 x 10 ⁻⁷	2.7 x 10 ⁻⁶
10	1.8 x 10 ⁻⁷	4.8 x 10 ⁻⁶
20	3.7 x 10 ⁻⁷	1.0 x 10 ⁻⁵
35	7.4 x 10 ⁻⁷	2.0 x 10 ⁻⁵
50	9.3 x 10 ⁻⁷	2.5 x 10 ⁻⁵
90	2.2 x 10 ⁻⁶	5.8 x 10 ⁻⁵
93	2.6 x 10 ⁻⁶	7.0 x 10 ⁻⁵
95	3.4 x 10 ⁻⁶	9.1 x 10 ⁻⁵

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

