Miss. Admin. Code 15-21-78:1.13
Alternatively cited as MS ADC 15 378 001

15-21-78:1.13. Transportation of Radioactive Materials

Currentness

Rule 1.13.1 **Purpose and Scope.** The regulations in this section establish requirements for packaging, preparation for shipment, and transportation of radioactive material and apply to any licensee authorized by specific or general license issued by the Agency to receive, possess, use, or transfer 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 Agency license, or transports that material on public highways. No provision of this section authorizes possession of licensed material.

Rule 1.13.2 **Definitions.** As used in this section, the following definitions apply:

1. “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.

2. “Certificate holder” means a person who has been issued a certificate of compliance or other package approval by the Nuclear Regulatory Commission.

3. “Certificate of Compliance (CoC)” means the certificate issued by the Nuclear Regulatory Commission which approves the design of a package for the transportation of radioactive material.

4. “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.

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

6. “Conveyance” means:

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

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

c. For transport by any aircraft.

7. “Criticality Safety Index (CSI)” means the dimensionless number (rounded up to the next tenth) assigned to and placed on the label of a fissile material package, to designate the degree of control of accumulation of packages containing fissile material during transportation. Determination of the criticality safety index is described in 1.13.11, 1.13.12 and 10 CFR 71.59.

8. “Deuterium” means, for the purposes of 1.13.4(4) and 1.13.11, deuterium and any deuterium compounds, including heavy water, in which the ratio of deuterium atoms to hydrogen atoms exceeds 1:5000.

9. “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.

10. “Fissile material” means plutonium-239, plutonium-241, uranium-233, uranium-235, or any combination of these radionuclides. Fissile material means the fissile nuclides themselves, not material containing fissile nuclides. Unirradiated natural uranium and depleted uranium, and natural uranium or depleted uranium that has been irradiated in thermal reactors only, are not included in this definition. [FN1] Certain exclusions from fissile material controls are provided in 1.13.4(4).

11. “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.

12. “Graphite” means, for the purposes of 1.13.4(4) and 1.13.11, graphite with a boron equivalent content less than 5 parts per million and density greater than 1.5 grams per cubic centimeter.

13. “Low specific activity (LSA) material” means radioactive material with limited specific activity which is nonfissile or is excepted under 1.13.4(4), and that satisfies the descriptions and limits set forth below. Shielding materials surrounding the LSA material may not be considered in determining the estimated average specific activity of the package contents. LSA material must be in one of three groups:

a. LSA-I

b. Uranium and thorium ores, concentrates of uranium or thorium ores and other ores containing naturally occurring radionuclides [FN2] which are not intended to be processed for the use of these radionuclides; or

c. Solid unirradiated natural uranium or depleted uranium or natural thorium or their solid or liquid compounds or mixtures; or

d. Radioactive material for which the A_2 value is unlimited; or

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

14. LSA-II

a. Water with tritium concentration up to 0.8 terabecquerel per liter (20.0 Ci/L); or

b. 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.

15. LSA-III Solids, excluding powders, that satisfy the requirements of 10 CFR 71.77, in which: [FN3]

a. 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; [FN4] and

b. 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

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

16. “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.

17. “Natural thorium” means thorium isotopes with a naturally occurring distribution, which is essentially 100 weight percent thorium-232.

18. “Normal form radioactive material” means radioactive material which has not been demonstrated to qualify as special form radioactive material.

19. “Nuclear waste” means a quantity of source, byproduct or special nuclear material [FN5] required to be in 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.

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

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

22. “Regulations of the Nuclear Regulatory Commission” means the regulations in 10 CFR 71 for purposes of Subchapter 13.

23. “Special form radioactive material” means radioactive material that satisfies the following conditions:

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

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

c. It satisfies the test requirements specified by the Nuclear Regulatory Commission. A special form encapsulation designed in accordance with the Nuclear Regulatory Commission requirements in effect on June 30, 1983, and constructed prior to July 1, 1985, may continue to be used. A special form encapsulation designed in accordance with the Nuclear Regulatory Commission requirements in effect on March 31, 1996, and constructed prior to April 1, 1998, may continue to be used. A special form encapsulation either designed or constructed after April 1, 1998, must meet requirements of this definition applicable at the time of its design or construction.

24. “Specific activity” of a radionuclide means the radioactivity 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.

25. “Spent nuclear fuel” or “Spent fuel” means fuel that has been withdrawn from a nuclear reactor following irradiation, has undergone at least 1 year's decay since being used as a source of energy in a power reactor, and has not been chemically separated into its constituent elements by reprocessing. Spent fuel includes the special nuclear material, byproduct material, source material, and other radioactive materials associated with fuel assemblies.

26. “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:

27. SCO-I: A solid object on which:

a. 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 becquerel per cm^2 (10^{-4} $\mu Ci/cm^2$) for beta and gamma and low toxicity alpha emitters, or 0.4 becquerel per cm^2 (10^{-5} $\mu Ci/cm^2$) for all other alpha emitters;

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

c. 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 $4x10^4$ becquerel per cm^2 (1 $\mu Ci/cm2$) for beta and gamma and low toxicity alpha emitters, or $4x10^3$ becquerel per cm^2 (0.1 $\mu Ci/cm^2$) for all other alpha emitters.

28. SCO-II: A solid object on which the limits for SCO-I are exceeded and on which:

a. 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 becquerel per cm^2 (10^{-2} $\mu Ci/cm^2$) for beta and gamma and low toxicity alpha emitters or 40 becquerel per cm^2 (10^{-3} $\mu Ci/cm^2$) for all other alpha emitters;

b. 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 $8x10^5$ becquerel per cm^2 (20 $\mu Ci/cm^2$) for beta and gamma and low toxicity alpha emitters, or $8x10^4$ becquerel per cm^2 (2 $\mu Ci/cm^2$) for all other alpha emitters; and

c. 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 $8x10^5$ becquerel per cm^2 (20 $\mu Ci/cm^2$) for beta and gamma and low toxicity alpha emitters, or $8x10^4$ becquerel per cm^2 (2 $\mu Ci/cm^2$) for all other alpha emitters.

29. “Transport index” means the dimensionless number, rounded up to the next tenth, placed on the label of a package to designate the degree of control to be exercised by the carrier during transportation. The transport index is the number expressing the maximum radiation level at 1 meter (3.3 feet) from the external surface of the package in millisievert (mSv) per hour multiplied by 100, which is thus equivalent to the maximum radiation level in millirem per hour at 1 meter (3.3 feet).

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

31. “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 Subchapter 13 under normal conditions of transport as demonstrated by the tests set forth in 49 CFR 173.465 or 173.466, as appropriate.

32. “Type B package” means a Type B packaging together with its radioactive contents. On approval, a Type B package design is designated by Nuclear Regulatory Commission as B(U) unless the package has a maximum normal operating pressure of more than 700 kPa (100 lbs/in ^{2}) gauge or a pressure relief device that would allow the release of radioactive material to the environment under the tests specified in 10 CFR 71.73 (hypothetical accident conditions), in which case it will receive a designation B(M). B(U) refers to the need for unilateral approval of international shipments; B(M) refers to the need for multilateral approval of international shipments. There is no distinction made in how packages with these designations may be used in domestic transportation. To determine their distinction for international transportation, see DOT regulations in 49 CFR Part 173. A Type B package approved before September 6, 1983, was designated only as Type B. Limitations on its use are specified in 1.13.8.

33. “Type B packaging” means a packaging designed to retain the integrity of containment and shielding when subjected to the normal conditions of transport and hypothetical accident test conditions set forth in 10 CFR Part 71.

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

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

36. “Uranium - natural, depleted, enriched”

a. “Natural uranium” means uranium isotopes with the naturally occurring distribution of uranium, which is approximately 0.711 weight percent uranium-235, and the remainder by weight essentially uranium-238.

b. “Depleted uranium” means uranium containing less uranium-235 than the naturally occurring distribution of uranium isotopes.

c. “Enriched uranium” means uranium containing more uranium-235 than the naturally occurring distribution of uranium isotopes.

Rule 1.13.3 **Requirements 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 1.13.4.

Rule 1.13.4 **Exemptions.**

1. Common and contract carriers, freight forwarders, and warehouse workers which are subject to the requirements of the U.S. Department of Transportation in 49 CFR 170 through 189 or the U.S. Postal Service in the U.S. Postal Service Domestic Mail Manual (DMM), Section C-023.9.0, and the U.S. Postal Service, are exempt from the requirements of this section 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 U.S. Department of Transportation or U.S. Postal Service are subject to 1.13.3 and other applicable requirements of these regulations.

2. A licensee is exempt from all the requirements of this section with respect to shipment or carriage of the following low-level materials:

a. Natural material and ores containing naturally occurring radionuclides that are not intended to be processed for use of these radionuclides, provided the activity concentration of the material does not exceed 10 times the values specified in Appendix A, Table A-2, of this section.

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

3. **Exemptions for Physicians**. Any physician licensed by a State to dispense drugs in the practice of medicine is exempt from 1.13.5 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 Subchapter 7 of these regulations or an equivalent Agreement State or Nuclear Regulatory Commission regulations.

4. **Exemption from Classification as Fissile Material.** Fissile material meeting at least one of the requirements provided in 1.13.4(4)(a) through (f) of this section are exempt from classification as fissile material and from the fissile material package standards of 10 CFR 71.55 and 71.59, but are subject to all other requirements of this section, except as noted.

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

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

c. Low concentrations of solid fissile material commingled with solid nonfissile material, provided that:

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

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

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

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

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

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

Rule 1.13.5 **Transportation of Licensed Material.**

1. 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:

a. comply with the applicable requirements, appropriate to the mode of transport, of the regulations of the U.S. Department of Transportation; particularly the regulations of the U.S. Department of Transportation in the following areas:

i. Packaging -- 49 CFR Part 173: Subparts A and B and I.

ii. Marking and labeling -- 49 CFR Part 172: Subpart D; and 172.400 through 172.407 and 172.436 through 172.441 of Subpart E.

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

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

v. Shipping papers and emergency information -- 49 CFR Part 172: Subpart C and Subpart G.

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

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

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

b. The licensee shall also comply with applicable U.S. Department of Transportation regulations pertaining to the following modes of transportation:

i. Rail -- 49 CFR Part 174: Sections 100 through 400 and K.

ii. Air -- 49 CFR Part 175.

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

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

c. Before delivery of a package to a carrier for transport, 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 1.4.34(5).

2. If for any reason, the regulations of the U.S. Department of Transportation are not applicable to a shipment of licensed material, the licensee shall conform to the standards and requirements of 49 CFR Parts 107, 171 through 180, and 390 through 397 appropriate to the mode of transport to the same extent as if the shipment was subject to the regulations.

Rule 1.13.6 **General Licenses for Carriers.**

1. A general license is hereby issued to any common or contract carrier not exempt under 1.13.4 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 U.S. Department of Transportation insofar as such requirements relate to the loading and storage of packages, placarding of the transporting vehicle, and incident reporting.

2. A general license is hereby issued to any private carrier to transport radioactive material, provided the transportation is in accordance with the applicable requirements, appropriate to the mode of transport, of the U.S. Department of Transportation insofar as such requirements relate to the loading and storage of packages, placarding of the transporting vehicle, and incident reporting. [FN6]

3. Persons who transport radioactive material pursuant to the general licenses in 1.13.6(1) or 1.13.6(2) are exempt from the requirements of Subchapters 4 and 10 of these regulations to the extent that they transport radioactive material.

Rule 1.13.7 **General License: Nuclear Regulatory Commission-Approved Packages.**

1. 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.

2. This general license applies only to a licensee who:

a. Has a copy of the specific license, certificate of compliance, or other approval by the Nuclear Regulatory Commission of the package and has the drawings and other documents referenced in the approval relating to the use and maintenance of the packaging and to the actions to be taken prior to shipment;

b. Complies with the terms and conditions of the license, certificate, or other approval by the. Nuclear Regulatory Commission, as applicable, and the applicable requirements of 10 CFR, Part 71, Subparts A, G, and H;

c. Prior to the licensee's first use of the package, has registered with the Nuclear Regulatory Commission; and

d. Has a quality assurance program required by 1.13.20

3. The general license in 1.13.7(1) applies only when the package approval authorizes use of the package under this general license.

4. For a Type B or fissile material packages, the design of which was approved by the U.S. Nuclear Regulatory Commission before April 1, 1996, the general license is subject to the additional restrictions of 1.13.8.

Rule 1.13.8 **General License: Previously Approved Packages.**

1. A Type B(U) package, a Type B(M) package, or a fissile material package, previously approved by the Nuclear Regulatory Commission but without the designation “-85” in the identification number of the Nuclear Regulatory Commission Certificate of Compliance, may be used under the general license of 1.13.7 with the following additional conditions:

a. Fabrication of the package is satisfactorily completed by April 1, 1999, as demonstrated by application of its model number in accordance with Nuclear Regulatory Commission regulations in 10 CFR 71.85(c);

b. A package used for a shipment to a location outside the United States is subject to multilateral approval except approved under special arrangement in accordance with U.S. Department of Transportation regulations in 49 CFR 173.403; and

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

2. A Type B(U) package, a Type B(M) package, or a fissile material package previously approved by the Nuclear Regulatory Commission with the designation "-85" in the identification number of the Nuclear Regulatory Commission CoC, may be used under the general license of 1.13.7 with the following additional conditions:

a. Fabrication of the package must be satisfactorily completed by December 31, 2006, as demonstrated by application of its model number in accordance with Nuclear Regulatory Commission regulations in 10 CFR 71.85(c); and

b. After December 31, 2003, a package used for a shipment to a location outside the United States is subject to multilateral approval as defined in DOT regulations at 49 CFR 173.403

Rule 1.13.9 **Reserved**

Rule 1.13.10 **General License: Use of Foreign Approved Package.**

1. 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 U.S. Department of Transportation as meeting the applicable requirements of 49 CFR 171.12.

2. Except as otherwise provided in this section, the general license applies only to a licensee who has a quality assurance program approved by the Nuclear Regulatory Commission as satisfying the applicable provisions of 10 CFR Part 71.

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

4. This general license applies only to a licensee who:

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

b. Complies with the terms and conditions of the certificate and revalidation, and with the applicable requirements of this section. With respect to the quality assurance provisions of 10 CFR Part 71, the licensee is exempt from design, construction, and fabrication considerations.

Rule 1.13.11 **General License: Fissile Material.**

1. 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 this section; 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).

2. The general license applies only to a licensee who has a quality assurance program approved by the Nuclear Regulatory Commission as satisfying the provisions of 10 CFR Part 71.

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

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

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

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

a. Has been determined in accordance with 1.13.11(5) of this section;

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

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

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

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

a. The calculated CSI must be rounded up to the first decimal place;

b. The values of X, Y, and Z used in the CSI equation must be taken from Tables I or II, as appropriate;

c. 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

d. Table I values for X, Y, and Z must be used to determine the CSI if:

i. Uranium-233 is present in the package;

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

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

iv. Substances having a moderating effectiveness (i.e., an average hydrogen density greater than H_2O) (e.g., certain hydrocarbon oils or plastics) are present in any form, except as polyethylene used for packing or wrapping.

Table I

Mass Limits for General License Packages Containing Mixed Quantities of Fissile Material or Uranium-235 of Unknown Enrichment

Fissile material	**Fissile material mass mixed with moderating substances having an average hydrogen density less than or equal to H_2O (grams)**	**Fissile material mass mixed with moderating substances having an average hydrogen density greater than H_2O [a] (grams)**
^{235}U (X)	60	38
^{233}U (Y)	43	27
^{239}Pu or ^{241}Pu (Z)	37	24

a. When mixtures of moderating substances are present, the lower mass limits shall be used if more than 15 percent of the moderating substance has an average hydrogen density greater than H_2O.

Table II

Mass Limits for General License Packages Containing Uranium-235 of Known Enrichment

Uranium enrichment in weight percent of ^{235}U not exceeding	**Fissile material mass of ^{235}U (X) (grams)**
24	60
20	63
15	67
11	72
10	76

9.5	78
9	81
8.5	82
8	85
7.5	88
7	90
6.5	93
6	97
5.5	102
5	108
4.5	114
4	120
3.5	132
3	150
2.5	180
2	246
1.5	408
1.35	480
1	1,020

0.92	1,800

Rule 1.13.12 **General license: Plutonium-Beryllium Special Form Material**

1. A general license is issued to any licensee of the Commission 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 10 CFR Part 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).

2. The general license applies only to a licensee who has a quality assurance program approved by the U. S. Nuclear Regulatory Commission as satisfying the provisions of 10 CFR 71.

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

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

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

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

a. Has been determined in accordance with 1.13.12(5) of this section;

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

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

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

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

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

Rule 1.13.13 **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.

Rule 1.13.14 **Preliminary Determinations.** Prior to the first use of any packaging for the shipment of radioactive material:

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

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

3. The licensee shall determine that the packaging has been fabricated in accordance with the design approved by the Nuclear Regulatory Commission; and

4. The licensee shall conspicuously and durably mark the packaging with its model number, serial number, gross weight, and a package identification number as assigned by the Nuclear Regulatory Commission.

Rule 1.13.15 **Routine Determinations.** Prior to each shipment of licensed material, the licensee shall ensure that the package with its contents satisfies the applicable requirements of this section and of the license. The licensee shall determine that:

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

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

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

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

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

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

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

8. Any structural part of the package 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;

9. The level of non-fixed radioactive contamination on the external surfaces of each package offered for shipment is as low as reasonably achievable.

a. The level of non-fixed radioactive contamination may be determined by wiping an area of 300 square centimeters 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 removable contamination levels. Except as provided in 1.13.15(9)(b), the amount of radioactivity measured on any single wiping material, when averaged over the surface wiped, must not exceed the limits given in TABLE III at any time during transport. Other methods of assessment of equal or greater efficiency may be used. When other methods are used, the detection efficiency of the method used must be taken into account and in no case may the removable contamination on the external surfaces of the package exceed 10 times the limits listed in TABLE III.

b. In the case of packages transported as exclusive use shipments by rail or highway only, the non-fixed radioactive contamination at any time during transport must not exceed 10 times the levels prescribed in 1.13.15(9)(a). The levels at the beginning of transport must not exceed the levels in 1.13.15(9)(a);

TABLE III

NON-FIXED (REMOVABLE) EXTERNAL RADIOACTIVE CONTAMINATION - WIPE LIMITS

Beta and gamma emitters and low toxicity alpha emitters	Bq/cm^2 0.4	μCi/cm^2 10^{-5}	dpm/cm^2 22
All other alpha emitting radionuclides	0.04	10^{-6}	2.2

10. Except as provided in 1.13.15(11), each package of radioactive material offered for transportation must be designed and prepared for shipment so that under conditions normally incident to transportation the radiation levels will not exceed 2 millisievert 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;

11. A package that exceeds the radiation level limits specified in 1.13.15(10) must be transported by exclusive use shipment only, and the radiation levels for such shipment must not exceed the following during transportation:

a. 2 millisievert per hour (200 mrem/hr) on the accessible external surface of the package unless the following conditions are met, in which case the limit is 10 millisievert per hour (1000 mrem/hr);

i. The shipment is made in a closed transport vehicle;

ii. Provisions are made to secure the package so that its position within the vehicle remains fixed during transportation; and

iii. There are no loading or unloading operations between the beginning and end of the transportation.

b. 2 millisievert 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, with a personnel barrier, 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;

c. 0.1 millisievert 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

d. 0.02 millisievert 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 special health supervision, personnel radiation exposure monitoring devices, and training in accordance with Subchapter 10 of these regulations.

e. For shipments made under the provisions of 1.13.15(11) of this section, the shipper shall provide specific written instructions to the carrier for maintenance of the exclusive use shipment controls. The instructions must be included with the shipping paper information.

f. 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.

12. 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.

13. A package may not incorporate a feature intended to allow continuous venting during transport.

Rule 1.13.16 **Air Transport of Plutonium.** Notwithstanding the provisions of any general licenses and notwithstanding any exemptions stated directly in this section or included indirectly by citation of the U.S. Department of Transportation regulations, as may be applicable, the licensee shall assure that plutonium in any form, whether for import, export, or domestic shipment, is not transported by air, or delivered to a carrier for air transport, unless:

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

2. The plutonium is contained in a material in which the specific activity is less than or equal to the activity concentration values for plutonium specified in Appendix A, Table A-2, of this section, and in which the radioactivity is essentially uniformly distributed; or

3. The plutonium is shipped in a single package containing no more than an A_2 quantity of plutonium in any isotope or form and is shipped in accordance with 1.13.5; or

4. 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, the U.S. Department of Transportation regulations applicable to the air transport of plutonium.

5. Nothing in 1.13.16 is to be interpreted as removing or diminishing the requirements of 10 CFR 73.24.

Rule 1.13.17 **Shipment Records.** Each licensee shall maintain for a period of 3 years after shipment a record of each shipment of licensed material not exempt under 1.13.4, showing, where applicable:

1. Identification of the packaging by model number and serial number;

2. Verification that the packaging, as shipped, had no significant defect;

3. Volume and identification of coolant;

4. Type and quantity of licensed material in each package, and the total quantity of each shipment;

5. Date of the shipment;

6. Name and address of the transferee;

7. Address to which the shipment was made; and

8. Results of the determinations required by 1.13.15 and by the conditions of the package approval.

Rule 1.13.18 **Reports.** The licensee shall report to the Agency within 60 days:

1. Any instance in which there is significant reduction in the effectiveness of any packaging during use;

2. Details of any defects with safety significance in the packaging after first use, with the means employed to repair the defects and prevent their recurrence; or

3. Instances in which the conditions of approval in the Certificate of Compliance were not observed in making a shipment.

Rule 1.13.19 **Advance Notification of Transport of Irradiated Reactor Fuel and Nuclear Waste.**

1. Prior to the transport of licensed material outside of the confines of the licensee's facility or other place of use or storage, or prior to the delivery of licensed material to a carrier for transport, each licensee shall provide advance notification of such transport to the governor, or governor's designee, [FN7] of each state within or through which the waste will be transported.

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

a. The licensed material is required to be in Type B packaging for transportation;

b. 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

c. The quantity of licensed material in a single package exceeds:

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

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

iii. 1000 terabecquerel (27,000 Ci).

3. Each advance notification of shipment of irradiated reactor fuel or nuclear waste required by 1.13.19(1) shall contain the following information:

a. The name, address, and telephone number of the shipper, carrier, and receiver of the shipment;

b. A description of the of irradiated reactor fuel or nuclear waste contained in the shipment as required by 49 CFR 172.202 and 172.203(d);

c. The point of origin of the shipment and the 7-day period during which departure of the shipment is estimated to occur;

d. The 7-day period during which arrival of the shipment at state boundaries is estimated to occur;

e. The destination of the shipment, and the 7-day period during which arrival of the shipment is estimated to occur; and

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

4. The notification required by 1.13.19(1) shall be made in writing to the office of each appropriate governor, or governor's designee, and to the Agency. 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. A notification delivered by any other means must reach the office of the governor, or governor's designee, at least 4 days before the beginning of the 7-day period during which departure of the shipment is estimated to occur. A copy of the notification shall be retained by the licensee for 3 years.

5. The licensee shall notify each appropriate governor, or governor's designee, and the Agency of any changes to schedule information provided pursuant to 1.13.19(1). Such notification shall be by telephone to a responsible individual in the office of the governor, or governor's designee, of the appropriate state or states. The licensee shall maintain for 3 years a record of the name of the individual contacted.

6. Each licensee who cancels an irradiated reactor fuel or 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, or governor's designee, of each appropriate state and to the Agency. A copy of the notice shall be retained by the licensee for 3 years.

Rule 1.13.20 **Quality Assurance Requirements.** This section 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 section, “quality assurance” comprises all those planned and systematic actions necessary to provide adequate confidence that a system or component will perform satisfactorily in service. Quality assurance includes quality control, which comprises those quality assurance actions related to control of the physical characteristics and quality of the material or component to predetermined requirements. The licensee, certificate holder, and applicant for a CoC are responsible for the quality assurance requirements as they apply to design, fabrication, testing, and modification of packaging. Each licensee is responsible for the quality assurance provision which applies to its use of a packaging for the shipment of licensed material subject to this section.

1. **Establishment of Program.** Each licensee, certificate holder, and applicant for a CoC shall establish, maintain, and execute a quality assurance program satisfying each of the applicable criteria of 10 CFR 71.101 through 71.137 and satisfying any specific provisions that are applicable to the licensee's activities including procurement of packaging.

The licensee, certificate holder, and applicant for a CoC shall execute the applicable criteria in a graded approach to an extent that is commensurate with the quality assurance requirement's importance to safety.

2. **Approval of Program.** Before the use of any package for the shipment of licensed material subject to this section, each licensee shall obtain Agency approval of its quality assurance program and file a description of its quality assurance program, including a discussion of which requirements of this section are applicable and how they will be satisfied.

3. **Radiography Containers.** A program for transport container inspection and maintenance limited to radiographic exposure devices, source changers, or packages transporting these devices and meeting the requirements of 1.5.12(4) and (5) of these regulations or equivalent Nuclear Regulatory Commission, or Agreement State requirements, is deemed to satisfy the requirements of 1.13.7 and 1.13.20(1).

Rule 1.13.21 **Quality Assurance Organization**

1. The licensee, [FN8] certificate holder, and applicant for a CoC shall be responsible for the establishment and execution of the quality assurance program. The licensee, certificate holder, and applicant for a CoC 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. These activities include performing the functions associated with attaining quality objectives and the quality assurance functions.

2. The quality assurance functions are:

a. Assuring that an appropriate quality assurance program is established and effectively executed; and

b. Verifying, by procedures such as checking, auditing, and inspection, that activities affecting the functions that are important to safety have been correctly performed.

c. 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.

Rule 1.13.22 **Quality Assurance Program.**

1. The licensee, certificate holder, and applicant for a CoC shall establish, at the earliest practicable time consistent with the schedule for accomplishing the activities, a quality assurance program that complies with the requirements of

10 CFR 71.101 through 71.137. The licensee, certificate holder, and applicant for a CoC shall document the quality assurance program by written procedures or instructions and shall carry out the program in accordance with those procedures throughout the period during which the packaging is used. The licensee, certificate holder, and applicant for a CoC shall identify the material and components to be covered by the quality assurance program, the major organizations participating in the program, and the designated functions of these organizations.

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

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

a. The impact of malfunction or failure of the item to safety;

b. The design and fabrication complexity or uniqueness of the item;

c. The need for special controls and surveillance over processes and equipment;

d. The degree to which functional compliance can be demonstrated by inspection or test; and

e. The quality history and degree of standardization of the item.

4. The licensee, certificate holder, and applicant for a CoC shall provide for indoctrination and training of personnel performing activities affecting quality, as necessary to assure that suitable proficiency is achieved and maintained. The licensee, certificate holder, and applicant for a CoC 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.

Rule 1.13.23 **Handling, Storage, and Shipping Control.** The licensee, certificate holder, and applicant for a CoC shall establish measures to control, in accordance with instructions, the handling, storage, shipping, cleaning, and preservation of materials and equipment to be used in packaging to prevent damage or deterioration. When necessary for particular products, special protective environments, such as inert gas atmosphere, and specific moisture content and temperature levels must be specified and provided.

Rule 1.13.24 **Inspection, Test, and Operating Status.**

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

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

Rule 1.13.25 **Nonconforming Materials, Parts, or Components.** The licensee, certificate holder, and applicant for a CoC shall establish measures to control materials, parts, or components that do not conform to the licensee's requirements to prevent their inadvertent use or installation. These measures must include, as appropriate, procedures for identification, documentation, segregation, disposition, and notification to affected organizations. Nonconforming items must be reviewed and accepted, rejected, repaired, or reworked in accordance with documented procedures.

Rule 1.13.26 **Corrective Action.** The licensee, certificate holder, and applicant for a CoC shall establish measures to assure that conditions adverse to quality, such as deficiencies, deviations, defective material and equipment, and nonconformances, are promptly identified and corrected. In the case of a significant condition adverse to quality, the measures must assure that the cause of the condition is determined and corrective action taken to preclude repetition. The identification of the significant condition adverse to quality, the cause of the condition, and the corrective action taken must be documented and reported to appropriate levels of management.

Rule 1.13.27 **Quality Assurance Records.** The licensee, certificate holder, and applicant for a CoC shall maintain sufficient written records to describe the activities affecting quality. The records must include the instructions, procedures, and drawings required by 10 CFR 71.111 to prescribe quality assurance activities and must include closely related specifications such as required qualifications of personnel, procedures, and equipment. The records must include the instructions or procedures which establish a records retention program that is consistent with applicable regulations and designates factors such as duration, location, and assigned responsibility. The licensee, certificate holder, and applicant for a CoC shall retain these records for 3 years beyond the date when the licensee, certificate holder, and applicant for a CoC last engage in the activity for which the quality assurance program was developed. If any portion of the written procedures or instructions is superseded, the licensee, certificate holder, and applicant for a CoC shall retain the superseded material for 3 years after it is superseded.

Rule 1.13.28 **Audits.** The licensee, certificate holder, and applicant for a CoC shall carry out a comprehensive system of planned and periodic audits to verify compliance with all aspects of the quality assurance program and to determine the effectiveness of the program. The audits must be performed in accordance with written procedures or checklists by appropriately trained personnel not having direct responsibilities in the areas being audited. Audited results must be documented and reviewed by management having responsibility in the area audited. Followup action, including reaudit of deficient areas, must be taken where indicated.

APPENDIX A

Determination Of A_1 And A_2

1. Values of A_1 and A_2 for individual radionuclides, which are the bases for many activity limits elsewhere in these regulations, are given in TABLE A-1. The curie (Ci) values specified are obtained by converting from the Terabecquerel (TBq) figure. The curie values are expressed to three significant figures to assure that the difference in the TBq and Ci quantities is one tenth of one percent or less. Where values of A_1 or A_2 are unlimited, it is for radiation control purposes only. For nuclear criticality safety, some materials are subject to controls placed on fissile material.

2. For individual radionuclides whose identities are known, but which are not listed in Table A-1, the values of A_1 and A_2 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.

3. 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.

4. The licensee shall submit requests for prior approval, described in the paragraphs above to the Agency, in accordance with 1.1.14 of these regulations.

5. 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.

6. For mixtures of radionuclides whose identities and respective activities are known, the following conditions apply:

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

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

8. For normal form radioactive material, the maximum quantity transported in a Type A package:

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

where B(i) is the activity of radionuclide i and $A_1(i)$ and $A_2(i)$ are the A_1 and A_2 values for radionuclide i, respectively.

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

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

where f(i) is the fraction of activity of nuclide i in the mixture and $A_1(i)$ is the appropriate A_1 value for nuclide i.

10. An A_2 value for mixtures of normal form material may be determined as follows:

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

where f(i) is the fraction of activity of nuclide i in the mixture and $A_2(i)$ is the appropriate A_2 value for nuclide i.

11. The exempt activity concentration for mixtures of nuclides may be determined as follows:

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

where f(i) is the fraction of activity concentration of radionuclide I in the mixture, and [A] is the activity concentration for exempt material containing radionuclide I.

12. 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.

13. When the identity of each radionuclide is known, but the individual activities of some of the radionuclides are not known, the radionuclides may be grouped and the lowest A_1 or A_2 value, as appropriate, for the radionuclides in each group may be used in applying the formulas in paragraph IV. Groups may be based on the total alpha activity and the total beta/gamma activity when these are known, using the lowest A_1 or A_2 values for the alpha emitters and beta/gamma emitters.

Table A-1--A_1 and A_2 VALUES FOR RADIONUCLIDES

Symbol of radionuclide	Element and atomic number	A_1 (TBq)	A_1(Ci) [b]	A_2 (TBq)	A_2(Ci) [b]	Specific activity	
						(TBq/g)	(Ci/g)
Ac-225 [a]	Actinium (89)	8.0×10^{-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)	$1.0x10^{-1}$	2.7	$1.0x10^{-1}$	2.7	$7.0x10^{-4}$	$1.9x10^{-2}$
Am-241	Americium (95)	$1.0x10^{1}$	$2.7x10^{2}$	$1.0x10^{-3}$	$2.7x10^{-2}$	$1.3x10^{-1}$	3.4
Am-242m [a]		$1.0x10^{1}$	$2.7x10^{2}$	$1.0x10^{-3}$	$2.7x10^{-2}$	$3.6x10^{-1}$	$1.0x10^{1}$
Am-243 [a]		5.0	$1.4x10^{2}$	$1.0x10^{-3}$	$2.7x10^{-2}$	$7.4x10^{-3}$	$2.0x10^{-1}$
Ar-37	Argon (18)	$4.0x10^{1}$	$1.1x10^{3}$	$4.0x10^{1}$	$1.1x10^{3}$	$3.7x10^{3}$	$9.9x10^{4}$
Ar-39		$4.0x10^{1}$	$1.1x10^{3}$	$2.0x10^{1}$	$5.4x10^{2}$	1.3	$3.4x10^{1}$
Ar-41		$3.0x10^{-1}$	8.1	$3.0x10^{-1}$	8.1	$1.5x10^{6}$	$4.2x10^{7}$
As-72	Arsenic (33)	$3.0x10^{-1}$	8.1	$3.0x10^{-1}$	8.1	$6.2x10^{4}$	$1.7x10^{6}$
As-73		$4.0x10^{1}$	$1.1x10^{3}$	$4.0x10^{1}$	$1.1x10^{3}$	$8.2x10^{2}$	$2.2x10^{4}$
As-74		1.0	$2.7x10^{1}$	$9.0x10^{-1}$	$2.4x10^{1}$	$3.7x10^{3}$	$9.9x10^{4}$
As-76		$3.0x10^{-1}$	8.1	$3.0x10^{-1}$	8.1	$5.8x10^{4}$	$1.6x10^{6}$
As-77		$2.0x10^{1}$	$5.4x10^{2}$	$7.0x10^{-1}$	$1.9x10^{1}$	$3.9x10^{4}$	$1.0x10^{6}$
At-211 [a]	Astatine (85)	$2.0x10^{1}$	$5.4x10^{2}$	$5.0x10^{-1}$	$1.4x10^{1}$	$7.6x10^{4}$	$2.1x10^{6}$
Au-193	Gold (79)	7.0	$1.9x10^{2}$	2.0	$5.4x10^{1}$	$3.4x10^{4}$	$9.2x10^{5}$
Au-194		1.0	$2.7x10^{1}$	1.0	$2.7x10^{1}$	$1.5x10^{4}$	$4.1x10^{5}$
Au-195		$1.0x10^{1}$	$2.7x10^{2}$	6.0	$1.6x10^{2}$	$1.4x10^{2}$	$3.7x10^{3}$
Au-198		1.0	$2.7x10^{1}$	$6.0x10^{-1}$	$1.6x10^{1}$	$9.0x10^{3}$	$2.4x10^{5}$
Au-199		$1.0x10^{1}$	$2.7x10^{2}$	$6.0x10^{-1}$	$1.6x10^{1}$	$7.7x10^{3}$	$2.1x10^{5}$

Ba-131 [a]	Barium (56)	2.0	$5.4x10^{1}$	2.0	$5.4x10^{1}$	$3.1x10^{3}$	$8.4x10^{4}$
Ba-133		3.0	$8.1x10^{1}$	3.0	$8.1x10^{1}$	9.4	$2.6x10^{2}$
Ba-133m		$2.0x10^{1}$	$5.4x10^{2}$	$6.0x10^{-1}$	$1.6x10^{1}$	$2.2x10^{4}$	$6.1x10^{5}$
Ba-140 [a]		$5.0x10^{-1}$	$1.4x10^{1}$	$3.0x10^{-1}$	8.1	$2.7x10^{3}$	$7.3x10^{4}$
Be-7	Beryllium (4)	$2.0x10^{1}$	$5.4x10^{2}$	$2.0x10^{1}$	$5.4x10^{2}$	$1.3x10^{4}$	$3.5x10^{5}$
Be-10		$4.0x10^{1}$	$1.1x10^{3}$	$6.0x10^{-1}$	$1.6x10^{1}$	$8.3x10^{-4}$	$2.2x10^{-2}$
Bi-205	Bismuth (83)	$7.0x10^{-1}$	$1.9x10^{1}$	$7.0x10^{-1}$	$1.9x10^{1}$	$1.5x10^{3}$	$4.2x10^{4}$
Bi-206		$3.0x10^{-1}$	8.1	$3.0x10^{-1}$	8.1	$3.8x10^{3}$	$1.0x10^{5}$
Bi-207		$7.0x10^{-1}$	$1.9x10^{1}$	$7.0x10^{-1}$	$1.9x10^{1}$	1.9	$5.2x10^{1}$
Bi-210		1.0	$2.7x10^{1}$	$6.0x10^{-1}$	$1.6x10^{1}$	$4.6x10^{3}$	$1.2x10^{5}$
Bi-210m [a]		$6.0x10^{-1}$	$1.6x10^{1}$	$2.0x10^{-2}$	$5.4x10^{-1}$	$2.1x10^{-5}$	$5.7x10^{-4}$
Bi-212 [a]		$7.0x10^{-1}$	$1.9x10^{1}$	$6.0x10^{-1}$	$1.6x10^{1}$	$5.4x10^{5}$	$1.5x10^{7}$
Bk-247	Berkelium (97)	8.0	$2.2x10^{2}$	$8.0x10^{-4}$	$2.2x10^{-2}$	$3.8x10^{-2}$	1.0
Bk-249 [a]		$4.0x10^{1}$	$1.1x10^{3}$	$3.0x10^{-1}$	8.1	$6.1x10^{1}$	$1.6x10^{3}$
Br-76	Bromine (35)	$4.0x10^{-1}$	$1.1x10^{1}$	$4.0x10^{-1}$	$1.1x10^{1}$	$9.4x10^{4}$	$2.5x10^{6}$
Br-77		3.0	$8.1x10^{1}$	3.0	$8.1x10^{1}$	$2.6x10^{4}$	$7.1x10^{5}$
Br-82		$4.0x10^{-1}$	$1.1x10^{1}$	$4.0x10^{-1}$	$1.1x10^{1}$	$4.0x10^{4}$	$1.1x10^{6}$
C-11	Carbon (6)	1.0	$2.7x10^{1}$	$6.0x10^{-1}$	$1.6x10^{1}$	$3.1x10^{7}$	$8.4x10^{8}$

C-14		$4.0x10^{1}$	$1.1x10^{3}$	3.0	$8.1x10^{1}$	$1.6x10^{-1}$	4.5
Ca-41	Calcium (20)	Unlimited	Unlimited	Unlimited	Unlimited	$3.1x10^{-3}$	$8.5x10^{-2}$
Ca-45		$4.0x10^{1}$	$1.1x10^{3}$	1.0	$2.7x10^{1}$	$6.6x10^{2}$	$1.8x10^{4}$
Ca-47 [a]		3.0	$8.1x10^{1}$	$3.0x10^{-1}$	8.1	$2.3x10^{4}$	$6.1x10^{5}$
Cd-109	Cadmium (48)	$3.0x10^{1}$	$8.1x10^{2}$	2.0	$5.4x10^{1}$	$9.6x10^{1}$	$2.6x10^{3}$
Cd-113m		$4.0x10^{1}$	$1.1x10^{3}$	$5.0x10^{-1}$	$1.4x10^{1}$	8.3	$2.2x10^{2}$
Cd-115 [a]		3.0	$8.1x10^{1}$	$4.0x10^{-1}$	$1.1x10^{1}$	$1.9x10^{4}$	$5.1x10^{5}$
Cd-115m		$5.0x10^{-1}$	$1.4x10^{1}$	$5.0x10^{-1}$	$1.4x10^{1}$	$9.4x10^{2}$	$2.5x10^{4}$
Ce-139	Cerium (58)	7.0	$1.9x10^{2}$	2.0	$5.4x10^{1}$	$2.5x10^{2}$	$6.8x10^{3}$
Ce-141		$2.0x10^{1}$	$5.4x10^{2}$	$6.0x10^{-1}$	$1.6x10^{1}$	$1.1x10^{3}$	$2.8x10^{4}$
Ce-143		$9.0x10^{-1}$	$2.4x10^{1}$	$6.0x10^{-1}$	$1.6x10^{1}$	$2.5x10^{4}$	$6.6x10^{5}$
Ce-144 [a]		$2.0x10^{-1}$	5.4	$2.0x10^{-1}$	5.4	$1.2x10^{2}$	$3.2x10^{3}$
Cf-248	Californium (98)	$4.0x10^{1}$	$1.1x10^{3}$	$6.0x10^{-3}$	$1.6x10^{-1}$	$5.8x10^{1}$	$1.6x10^{3}$
Cf-249		3.0	$8.1x10^{1}$	$8.0x10^{-4}$	$2.2x10^{-2}$	$1.5x10^{-1}$	4.1
Cf-250		$2.0x10^{1}$	$5.4x10^{2}$	$2.0x10^{-3}$	$5.4x10^{-2}$	4.0	$1.1x10^{2}$
Cf-251		7.0	$1.9x10^{2}$	$7.0x10^{-4}$	$1.9x10^{-2}$	$5.9x10^{-2}$	1.6
Cf-252 [h]		$5.0x10^{-2}$	1.4	$3.0x10^{-3}$	$8.1x10^{-2}$	$2.0x10^{1}$	$5.4x10^{2}$
Cf-253 [a]		$4.0x10^{1}$	$1.1x10^{3}$	$4.0x10^{-2}$	1.1	$1.1x10^{3}$	$2.9x10^{4}$

Cf-254		$1.0x10^{-3}$	$2.7x10^{-2}$	$1.0x10^{-3}$	$2.7x10^{-2}$	$3.1x10^{2}$	$8.5x10^{3}$
Cl-36	Chlorine (17)	$1.0x10^{1}$	$2.7x10^{2}$	$6.0x10^{-1}$	$1.6x10^{1}$	$1.2x10^{-3}$	$3.3x10^{-2}$
Cl-38		$2.0x10^{-1}$	5.4	$2.0x10^{-1}$	5.4	$4.9x10^{6}$	$1.3x10^{8}$
Cm-240	Curium (96)	$4.0x10^{1}$	$1.1x10^{3}$	$2.0x10^{-2}$	$5.4x10^{-1}$	$7.5x10^{2}$	$2.0x10^{4}$
Cm-241		2.0	$5.4x10^{1}$	1.0	$2.7x10^{1}$	$6.1x10^{2}$	$1.7x10^{4}$
Cm-242		$4.0x10^{1}$	$1.1x10^{3}$	$1.0x10^{-2}$	$2.7x10^{-1}$	$1.2x10^{2}$	$3.3x10^{3}$
Cm-243		9.0	$2.4x10^{2}$	$1.0x10^{-3}$	$2.7x10^{-2}$	$1.9x10^{-3}$	$5.2x10^{1}$
Cm-244		$2.0x10^{1}$	$5.4x10^{2}$	$2.0x10^{-3}$	$5.4x10^{-2}$	3.0	$8.1x10^{1}$
Cm-245		9.0	$2.4x10^{2}$	$9.0x10^{-4}$	$2.4x10^{-2}$	$6.4x10^{-3}$	$1.7x10^{-1}$
Cm-246		9.0	$2.4x10^{2}$	$9.0x10^{-4}$	$2.4x10^{-2}$	$1.1x10^{-2}$	$3.1x10^{-1}$
Cm-247 [a]		3.0	$8.1x10^{1}$	$1.0x10^{-3}$	$2.7x10^{-2}$	$3.4x10^{-6}$	$9.3x10^{-5}$
Cm-248		$2.0x10^{-2}$	$5.4x10^{-1}$	$3.0x10^{-4}$	$8.1x10^{-3}$	$1.6x10^{-4}$	$4.2x10^{-3}$
Co-55	Cobalt (27)	$5.0x10^{-1}$	$1.4x10^{1}$	$5.0x10^{-1}$	$1.4x10^{1}$	$1.1x10^{5}$	$3.1x10^{6}$
Co-56		$3.0x10^{-1}$	8.1	$3.0x10^{-1}$	8.1	$1.1x10^{3}$	$3.0x10^{4}$
Co-57		$1.0x10^{1}$	$2.7x10^{2}$	$1.0x10^{1}$	$2.7x10^{2}$	$3.1x10^{2}$	$8.4x10^{3}$
Co-58		1.0	$2.7x10^{1}$	1.0	$2.7x10^{1}$	$1.2x10^{3}$	$3.2x10^{4}$
Co-58m		$4.0x10^{1}$	$1.1x10^{3}$	$4.0x10^{1}$	$1.1x10^{3}$	$2.2x10^{5}$	$5.9x10^{6}$
Co-60		$4.0x10^{-1}$	$1.1x10^{1}$	$4.0x10^{-1}$	$1.1x10^{1}$	$4.2x10^{1}$	$1.1x10^{3}$

Cr-51	Chromium (24)	$3.0x10^{1}$	$8.1x10^{2}$	$3.0x10^{1}$	$8.1x10^{2}$	$3.4x10^{3}$	$9.2x10^{4}$
Cs-129	Cesium (55)	4.0	$1.1x10^{2}$	4.0	$1.1x10^{2}$	$2.8x10^{4}$	$7.6x10^{5}$
Cs-131		$3.0x10^{1}$	$8.1x10^{2}$	$3.0x10^{1}$	$8.1x10^{2}$	$3.8x10^{3}$	$1.0x10^{5}$
Cs-132		1.0	$2.7x10^{1}$	1.0	$2.7x10^{1}$	$5.7x10^{3}$	$1.5x10^{5}$
Cs-134		$7.0x10^{-1}$	$1.9x10^{1}$	$7.0x10^{-1}$	$1.9x10^{1}$	$4.8x10^{1}$	$1.3x10^{3}$
Cs-134m		$4.0x10^{1}$	$1.1x10^{3}$	$6.0x10^{-1}$	$1.6x10^{1}$	$3.0x10^{5}$	$8.0x10^{6}$
Cs-135		$4.0x10^{1}$	$1.1x10^{3}$	1.0	$2.7x10^{1}$	$4.3x10^{-5}$	$1.2x10^{-3}$
Cs-136		$5.0x10^{-1}$	$1.4x10^{1}$	$5.0x10^{-1}$	$1.4x10^{1}$	$2.7x10^{3}$	$7.3x10^{4}$
Cs-137 [a]		2.0	$5.4x10^{1}$	$6.0x10^{-1}$	$1.6x10^{1}$	3.2	$8.7x10^{1}$
Cu-64	Copper (29)	6.0	$1.6x10^{2}$	1.0	$2.7x10^{1}$	$1.4x10^{5}$	$3.9x10^{6}$
Cu-67		$1.0x10^{1}$	$2.7x10^{2}$	$7.0x10^{-1}$	$1.9x10^{1}$	$2.8x10^{4}$	$7.6x10^{5}$
Dy-159	Dysprosium (66)	$2.0x10^{1}$	$5.4x10^{2}$	$2.0x10^{1}$	$5.4x10^{2}$	$2.1x10^{2}$	$5.7x10^{3}$
Dy-165		$9.0x10^{-1}$	$2.4x10^{1}$	$6.0x10^{-1}$	$1.6x10^{1}$	$3.0x10^{5}$	$8.2x10^{6}$
Dy-166 [a]		$9.0x10^{-1}$	$2.4x10^{1}$	$3.0x10^{-1}$	8.1	$8.6x10^{3}$	$2.3x10^{5}$
Er-169	Erbium (68)	$4.0x10^{1}$	$1.1x10^{3}$	1.0	$2.7x10^{1}$	$3.1x10^{3}$	$8.3x10^{4}$
Er-171		$8.0x10^{-1}$	$2.2x10^{1}$	$5.0x10^{-1}$	$1.4x10^{1}$	$9.0x10^{4}$	$2.4x10^{6}$
Eu-147	Europium (63)	2.0	$5.4x10^{1}$	2.0	$5.4x10^{1}$	$1.4x10^{3}$	$3.7x10^{4}$
Eu-148		$5.0x10^{-1}$	$1.4x10^{1}$	$5.0x10^{-1}$	$1.4x10^{1}$	$6.0x10^{2}$	$1.6x10^{4}$

Eu-149		$2.0x10^{1}$	$5.4x10^{2}$	$2.0x10^{1}$	$5.4x10^{2}$	$3.5x10^{2}$	$9.4x10^{3}$
Eu-150 (short lived)		2.0	$5.4x10^{1}$	$7.0x10^{-1}$	$1.9x10^{1}$	$6.1x10^{4}$	$1.6x10^{6}$
Eu-150 (long lived)		$7.0x10^{-1}$	$1.9x10^{1}$	$7.0x10^{-1}$	$1.9x10^{1}$	$6.1x10^{4}$	$1.6x10^{6}$
Eu-152		1.0	$2.7x10^{1}$	1.0	$2.7x10^{1}$	6.5	$1.8x10^{2}$
Eu-152m		$8.0x10^{-1}$	$2.2x10^{1}$	$8.0x10^{-1}$	$2.2x10^{1}$	$8.2x10^{4}$	$2.2x10^{6}$
Eu-154		$9.0x10^{-1}$	$2.4x10^{1}$	$6.0x10^{-1}$	$1.6x10^{1}$	9.8	$2.6x10^{2}$
Eu-155		$2.0x10^{1}$	$5.4x10^{2}$	3.0	$8.1x10^{1}$	$1.8x10^{1}$	$4.9x10^{2}$
Eu-156		$7.0x10^{-1}$	$1.9x10^{1}$	$7.0x10^{-1}$	$1.9x10^{1}$	$2.0x10^{3}$	$5.5x10^{4}$
F-18	Fluorine (9)	1.0	$2.7x10^{1}$	$6.0x10^{-1}$	$1.6x10^{1}$	$3.5x10^{6}$	$9.5x10^{7}$
Fe-52 [a]	Iron (26)	$3.0x10^{-1}$	8.1	$3.0x10^{-1}$	8.1	$2.7x10^{5}$	$7.3x10^{6}$
Fe-55		$4.0x10^{1}$	$1.1x10^{3}$	$4.0x10^{1}$	$1.1x10^{3}$	$8.8x10^{1}$	$2.4x10^{3}$
Fe-59		$9.0x10^{-1}$	$2.4x10^{1}$	$9.0x10^{-1}$	$2.4x10^{1}$	$1.8x10^{3}$	$5.0x10^{4}$
Fe-60 [a]		$4.0x10^{1}$	$1.1x10^{3}$	$2.0x10^{-1}$	5.4	$7.4x10^{-4}$	$2.0x10^{-2}$
Ga-67	Gallium (31)	7.0	$1.9x10^{2}$	3.0	$8.1x10^{1}$	$2.2x10^{4}$	$6.0x10^{5}$
Ga-68		$5.0x10^{-1}$	$1.4x10^{1}$	$5.0x10^{-1}$	$1.4x10^{1}$	$1.5x10^{6}$	$4.1x10^{7}$
Ga-72		$4.0x10^{-1}$	$1.1x10^{1}$	$4.0x10^{-1}$	$1.1x10^{1}$	$1.1x10^{5}$	$3.1x10^{6}$
Gd-146 [a]	Gadolinium (64)	$5.0x10^{-1}$	$1.4x10^{1}$	$5.0x10^{-1}$	$1.4x10^{1}$	$6.9x10^{2}$	$1.9x10^{4}$
Gd-148		$2.0x10^{1}$	$5.4x10^{2}$	$2.0x10^{-3}$	$5.4x10^{-2}$	1.2	$3.2x10^{1}$

Gd-153		$1.0x10^{1}$	$2.7x10^{2}$	9.0	$2.4x10^{2}$	$1.3x10^{2}$	$3.5x10^{3}$
Gd-159		3.0	$8.1x10^{1}$	$6.0x10^{-1}$	$1.6x10^{1}$	$3.9x10^{4}$	$1.1x10^{6}$
Ge-68 [a]	Germanium (32)	$5.0x10^{-1}$	$1.4x10^{1}$	$5.0x10^{-1}$	$1.4x10^{1}$	$2.6x10^{2}$	$7.1x10^{3}$
Ge-71		$4.0x10^{1}$	$1.1x10^{3}$	$4.0x10^{1}$	$1.1x10^{3}$	$5.8x10^{3}$	$1.6x10^{5}$
Ge-77		$3.0x10^{-1}$	8.1	$3.0x10^{-1}$	8.1	$1.3x10^{5}$	$3.6x10^{6}$
Hf-172 [a]	Hafnium (72)	$6.0x10^{-1}$	$1.6x10^{1}$	$6.0x10^{-1}$	$1.6x10^{1}$	$4.1x10^{1}$	$1.1x10^{3}$
Hf-175		3.0	$8.1x10^{1}$	3.0	$8.1x10^{1}$	$3.9x10^{2}$	$1.1x10^{4}$
Hf-181		2.0	$5.4x10^{1}$	$5.0x10^{-1}$	$1.4x10^{1}$	$6.3x10^{2}$	$1.7x10^{4}$
Hf-182		Unlimited	Unlimited	Unlimited	Unlimited	$8.1x10^{-6}$	$2.2x10^{-4}$
Hg-194 [a]	Mercury (80)	1.0	$2.7x10^{1}$	1.0	$2.7x10^{1}$	$1.3x10^{-1}$	3.5
Hg-195m [a]		3.0	$8.1x10^{1}$	$7.0x10^{-1}$	$1.9x10^{1}$	$1.5x10^{4}$	$4.0x10^{5}$
Hg-197		$2.0x10^{1}$	$5.4x10^{2}$	$1.0x10^{1}$	$2.7x10^{2}$	$9.2x10^{3}$	$2.5x10^{5}$
Hg-197m		$1.0x10^{1}$	$2.7x10^{2}$	$4.0x10^{-1}$	$1.1x10^{1}$	$2.5x10^{4}$	$6.7x10^{5}$
Hg-203		5.0	$1.4x10^{2}$	1.0	$2.7x10^{1}$	$5.1x10^{2}$	$1.4x10^{4}$
Ho-166	Holmium (67)	$4.0x10^{-1}$	$1.1x10^{1}$	$4.0x10^{-1}$	$1.1x10^{1}$	$2.6x10^{4}$	$7.0x10^{5}$
Ho-166m		$6.0x10^{-1}$	$1.6x10^{1}$	$5.0x10^{-1}$	$1.4x10^{1}$	$6.6x10^{-2}$	1.8
I-123	Iodine (53)	6.0	$1.6x10^{2}$	3.0	$8.1x10^{1}$	$7.1x10^{4}$	$1.9x10^{6}$
I-124		1.0	$2.7x10^{1}$	1.0	$2.7x10^{1}$	$9.3x10^{3}$	$2.5x10^{5}$

I-125		$2.0x10^{1}$	$5.4x10^{2}$	3.0	$8.1x10^{1}$	$6.4x10^{2}$	$1.7x10^{4}$
I-126		2.0	$5.4x10^{1}$	1.0	$2.7x10^{1}$	$2.9x10^{3}$	$8.0x10^{4}$
I-129		Unlimited	Unlimited	Unlimited	Unlimited	$6.5x10^{-6}$	$1.8x10^{-4}$
I-131		3.0	$8.1x10^{1}$	$7.0x10^{-1}$	$1.9x10^{1}$	$4.6x10^{3}$	$1.2x10^{5}$
I-132		$4.0x10^{-1}$	$1.1x10^{1}$	$4.0x10^{-1}$	$1.1x10^{1}$	$3.8x10^{5}$	$1.0x10^{7}$
I-133		$7.0x10^{-1}$	$1.9x10^{1}$	$6.0x10^{-1}$	$1.6x10^{1}$	$4.2x10^{4}$	$1.1x10^{6}$
I-134		$3.0x10^{-1}$	8.1	$3.0x10^{-1}$	8.1	$9.9x10^{5}$	$2.7x10^{7}$
I-135 [a]		$6.0x10^{-1}$	$1.6x10^{1}$	$6.0x10^{-1}$	$1.6x10^{1}$	$1.3x10^{5}$	$3.5x10^{6}$
In-111	Indium (49)	3.0	$8.1x10^{1}$	3.0	$8.1x10^{1}$	$1.5x10^{4}$	$4.2x10^{5}$
In-113m		4.0	$1.1x10^{2}$	2.0	$5.4x10^{1}$	$6.2x10^{5}$	$1.7x10^{7}$
In-114m [a]		$1.0x10^{1}$	$2.7x10^{2}$	$5.0x10^{-1}$	$1.4x10^{1}$	$8.6x10^{2}$	$2.3x10^{4}$
In-115m		7.0	$1.9x10^{2}$	1.0	$2.7x10^{1}$	$2.2x10^{5}$	$6.1x10^{6}$
Ir-189 [a]	Iridium (77)	$1.0x10^{1}$	$2.7x10^{2}$	$1.0x10^{1}$	$2.7x10^{2}$	$1.9x10^{3}$	$5.2x10^{4}$
Ir-190		$7.0x10^{-1}$	$1.9x10^{1}$	$7.0x10^{-1}$	$1.9x10^{1}$	$2.3x10^{3}$	$6.2x10^{4}$
Ir-192 [c]		1.0	$2.7x10^{1}$	$6.0x10^{-1}$	$1.6x10^{1}$	$3.4x10^{2}$	$9.2x10^{3}$
Ir-194		$3.0x10^{-1}$	8.1	$3.0x10^{-1}$	8.1	$3.1x10^{4}$	$8.4x10^{5}$
K-40	Potassium (19)	$9.0x10^{-1}$	$2.4x10^{1}$	$9.0x10^{-1}$	$2.4x10^{1}$	$2.4x10^{-7}$	$6.4x10^{-6}$
K-42		$2.0x10^{-1}$	5.4	$2.0x10^{-1}$	5.4	$2.2x10^{5}$	$6.0x10^{6}$

K-43		$7.0x10^{-1}$	$1.9x10^{1}$	$6.0x10^{-1}$	$1.6x10^{1}$	$1.2x10^{5}$	$3.3x10^{6}$
Kr-81	Krypton (36)	$4.0x10^{1}$	$1.1x10^{3}$	$4.0x10^{1}$	$1.1x10^{3}$	$7.8x10^{-4}$	$2.1x10^{-2}$
Kr-85		$1.0x10^{1}$	$2.7x10^{2}$	$1.0x10^{1}$	$2.7x10^{2}$	$1.5x10^{1}$	$3.9x10^{2}$
Kr-85m		8.0	$2.2x10^{2}$	3.0	$8.1x10^{1}$	$3.0x10^{5}$	$8.2x10^{6}$
Kr-87		$2.0x10^{-1}$	5.4	$2.0x10^{-1}$	5.4	$1.0x10^{6}$	$2.8x10^{7}$
La-137	Lanthanum (57)	$3.0x10^{1}$	$8.1x10^{2}$	6.0	$1.6x10^{2}$	$1.6x10^{-3}$	$4.4x10^{-2}$
La-140		$4.0x10^{-1}$	$1.1x10^{1}$	$4.0x10^{-1}$	$1.1x10^{1}$	$2.1x10^{4}$	$5.6x10^{5}$
Lu-172	Lutetium (71)	$6.0x10^{-1}$	$1.6x10^{1}$	$6.0x10^{-1}$	$1.6x10^{1}$	$4.2x10^{3}$	$1.1x10^{5}$
Lu-173		8.0	$2.2x10^{2}$	8.0	$2.2x10^{2}$	$5.6x10^{1}$	$1.5x10^{3}$
Lu-174		9.0	$2.4x10^{2}$	9.0	$2.4x10^{2}$	$2.3x10^{1}$	$6.2x10^{2}$
Lu-174m		$2.0x10^{1}$	$5.4x10^{2}$	$1.0x10^{1}$	$2.7x10^{2}$	$2.0x10^{2}$	$5.3x10^{3}$
Lu-177		$3.0x10^{1}$	$8.1x10^{2}$	$7.0x10^{-1}$	$1.9x10^{1}$	$4.1x10^{3}$	$1.1x10^{5}$
Mg-28 [a]	Magnesium (12)	$3.0x10^{-1}$	8.1	$3.0x10^{-1}$	8.1	$2.0x10^{5}$	$5.4x10^{6}$
Mn-52	Manganese (25)	$3.0x10^{-1}$	8.1	$3.0x10^{-1}$	8.1	$1.6x10^{4}$	$4.4x10^{5}$
Mn-53		Unlimited	Unlimited	Unlimited	Unlimited	$6.8x10^{-5}$	$1.8x10^{-3}$
Mn-54		1.0	$2.7x10^{1}$	1.0	$2.7x10^{1}$	$2.9x10^{2}$	$7.7x10^{3}$
Mn-56		$3.0x10^{-1}$	8.1	$3.0x10^{-1}$	8.1	$8.0x10^{5}$	$2.2x10^{7}$
Mo-93	Molybdenum (42)	$4.0x10^{1}$	$1.1x10^{3}$	$2.0x10^{1}$	$5.4x10^{2}$	$4.1x10^{-2}$	1.1

Mo-99[a i]		1.0	$2.7x10^{1}$	$6.0x10^{-1}$	$1.6x10^{1}$	$1.8x10^{4}$	$4.8x10^{5}$
N-13	Nitrogen (7)	$9.0x10^{-1}$	$2.4x10^{1}$	$6.0x10^{-1}$	$1.6x10^{1}$	$5.4x10^{7}$	$1.5x10^{9}$
Na-22	Sodium (11)	$5.0x10^{-1}$	$1.4x10^{1}$	$5.0x10^{-1}$	$1.4x10^{1}$	$2.3x10^{2}$	$6.3x10^{3}$
Na-24		$2.0x10^{-1}$	5.4	$2.0x10^{-1}$	5.4	$3.2x10^{5}$	$8.7x10^{6}$
Nb-93m	Niobium (41)	$4.0x10^{1}$	$1.1x10^{3}$	$3.0x10^{1}$	$8.1x10^{2}$	8.8	$2.4x10^{2}$
Nb-94		$7.0x10^{-1}$	$1.9x10^{1}$	$7.0x10^{-1}$	$1.9x10^{1}$	$6.9x10^{-3}$	$1.9x10^{-1}$
Nb-95		1.0	$2.7x10^{1}$	1.0	$2.7x10^{1}$	$1.5x10^{3}$	$3.9x10^{4}$
Nb-97		$9.0x10^{-1}$	$2.4x10^{1}$	$6.0x10^{-1}$	$1.6x10^{1}$	$9.9x10^{5}$	$2.7x10^{7}$
Nd-147	Neodymium (60)	6.0	$1.6x10^{2}$	$6.0x10^{-1}$	$1.6x10^{1}$	$3.0x10^{3}$	$8.1x10^{4}$
Nd-149		$6.0x10^{-1}$	$1.6x10^{1}$	$5.0x10^{-1}$	$1.4x10^{1}$	$4.5x10^{5}$	$1.2x10^{7}$
Ni-59	Nickel (28)	Unlimited	Unlimited	Unlimited	Unlimited	$3.0x10^{-3}$	$8.0x10^{-2}$
Ni-63		$4.0x10^{1}$	$1.1x10^{3}$	$3.0x10^{1}$	$8.1x10^{2}$	2.1	$5.7x10^{1}$
Ni-65		$4.0x10^{-1}$	$1.1x10^{1}$	$4.0x10^{-1}$	$1.1x10^{1}$	$7.1x10^{5}$	$1.9x10^{7}$
Np-235	Neptunium (93)	$4.0x10^{1}$	$1.1x10^{3}$	$4.0x10^{1}$	$1.1x10^{3}$	$5.2x10^{1}$	$1.4x10^{3}$
Np-236 (short-lived)		$2.0x10^{1}$	$5.4x10^{2}$	2.0	$5.4x10^{1}$	$4.7x10^{-4}$	$1.3x10^{-2}$
Np-236 (long-lived)		$9.0x10^{0}$	$2.4x10^{2}$	$2.0x10^{-2}$	$5.4x10^{-1}$	$4.7x10^{-4}$	$1.3x10^{-2}$
Np-237		$2.0x10^{1}$	$5.4x10^{2}$	$2.0x10^{-3}$	$5.4x10^{-2}$	$2.6x10^{-5}$	$7.1x10^{-4}$
Np-239		7.0	$1.9x10^{2}$	$4.0x10^{-1}$	$1.1x10^{1}$	$8.6x10^{3}$	$2.3x10^{5}$

Os-185	Osmium (76)	1.0	$2.7x10^{1}$	1.0	$2.7x10^{1}$	$2.8x10^{2}$	$7.5x10^{3}$
Os-191		$1.0x10^{1}$	$2.7x10^{2}$	2.0	$5.4x10^{1}$	$1.6x10^{3}$	$4.4x10^{4}$
Os-191m		$4.0x10^{1}$	$1.1x10^{3}$	$3.0x10^{1}$	$8.1x10^{2}$	$4.6x10^{4}$	$1.3x10^{6}$
Os-193		2.0	$5.4x10^{1}$	$6.0x10^{-1}$	$1.6x10^{1}$	$2.0x10^{4}$	$5.3x10^{5}$
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)	$4.0x10^{1}$	$1.1x10^{3}$	$2.0x10^{-2}$	$5.4x10^{-1}$	$1.7x10^{2}$	$4.5x10^{3}$
Pr-142	Praseodymium (59)	$4.0x10^{-1}$	$1.1x10^{1}$	$4.0x10^{-1}$	$1.1x10^{1}$	$4.3x10^{4}$	$1.2x10^{6}$
Pr-143		3.0	$8.1x10^{1}$	$6.0x10^{-1}$	$1.6x10^{1}$	$2.5x10^{3}$	$6.7x10^{4}$
Pt-188 [a]	Platinum (78)	1.0	$2.7x10^{1}$	$8.0x10^{-1}$	$2.2x10^{1}$	$2.5x10^{3}$	$6.8x10^{4}$
Pt-191		4.0	$1.1x10^{2}$	3.0	$8.1x10^{1}$	$8.7x10^{3}$	$2.4x10^{5}$
Pt-193		$4.0x10^{1}$	$1.1x10^{3}$	$4.0x10^{1}$	$1.1x10^{3}$	1.4	$3.7x10^{1}$
Pt-193m		$4.0x10^{1}$	$1.1x10^{3}$	$5.0x10^{-1}$	$1.4x10^{1}$	$5.8x10^{3}$	$1.6x10^{5}$
Pt-195m		$1.0x10^{1}$	$2.7x10^{2}$	$5.0x10^{-1}$	$1.4x10^{1}$	$6.2x10^{3}$	$1.7x10^{5}$
Pt-197		$2.0x10^{1}$	$5.4x10^{2}$	$6.0x10^{-1}$	$1.6x10^{1}$	$3.2x10^{4}$	$8.7x10^{5}$
Pt-197m		$1.0x10^{1}$	$2.7x10^{2}$	$6.0x10^{-1}$	$1.6x10^{1}$	$3.7x10^{5}$	$1.0x10^{7}$

Pu-236	Plutonium (94)	$3.0x10^{1}$	$8.1x10^{2}$	$3.0x10^{-3}$	$8.1x10^{-2}$	$2.0x10^{1}$	$5.3x10^{2}$
Pu-237		$2.0x10^{1}$	$5.4x10^{2}$	$2.0x10^{1}$	$5.4x10^{2}$	$4.5x10^{2}$	$1.2x10^{4}$
Pu-238		$1.0x10^{1}$	$2.7x10^{2}$	$1.0x10^{-3}$	$2.7x10^{-2}$	$6.3x10^{-1}$	$1.7x10^{1}$
Pu-239		$1.0x10^{1}$	$2.7x10^{2}$	$1.0x10^{-3}$	$2.7x10^{-2}$	$2.3x10^{-3}$	$6.2x10^{-2}$
Pu-240		$1.0x10^{1}$	$2.7x10^{2}$	$1.0x10^{-3}$	$2.7x10^{-2}$	$8.4x10^{-3}$	$2.3x10^{-1}$
Pu-241 [a]		$4.0x10^{1}$	$1.1x10^{3}$	$6.0x10^{-2}$	1.6	3.8	$1.0x10^{2}$
Pu-242		$1.0x10^{1}$	$2.7x10^{2}$	$1.0x10^{-3}$	$2.7x10^{-2}$	$1.5x10^{-4}$	$3.9x10^{-3}$
Pu-244 [a]		$4.0x10^{-1}$	$1.1x10^{1}$	$1.0x10^{-3}$	$2.7x10^{-2}$	$6.7x10^{-7}$	$1.8x10^{-5}$
Ra-223 [a]	Radium (88)	$4.0x10^{-1}$	$1.1x10^{1}$	$7.0x10^{-3}$	$1.9x10^{-1}$	$1.9x10^{3}$	$5.1x10^{4}$
Ra-224 [a]		$4.0x10^{-1}$	$1.1x10^{1}$	$2.0x10^{-2}$	$5.4x10^{-1}$	$5.9x10^{3}$	$1.6x10^{5}$
Ra-225 [a]		$2.0x10^{-1}$	5.4	$4.0x10^{-3}$	$1.1x10^{-1}$	$1.5x10^{3}$	$3.9x10^{4}$
Ra-226 [a]		$2.0x10^{-1}$	5.4	$3.0x10^{-3}$	$8.1x10^{-2}$	$3.7x10^{-2}$	1.0
Ra-228 [a]		$6.0x10^{-1}$	$1.6x10^{1}$	$2.0x10^{-2}$	$5.4x10^{-1}$	$1.0x10^{1}$	$2.7x10^{2}$
Rb-81	Rubidium (37)	2.0	$5.4x10^{1}$	$8.0x10^{-1}$	$2.2x10^{1}$	$3.1x10^{5}$	$8.4x10^{6}$
Rb-83 [a]		2.0	$5.4x10^{1}$	2.0	$5.4x10^{1}$	$6.8x10^{2}$	$1.8x10^{4}$
Rb-84		1.0	$2.7x10^{1}$	1.0	$2.7x10^{1}$	$1.8x10^{3}$	$4.7x10^{4}$
Rb-86		$5.0x10^{-1}$	$1.4x10^{1}$	$5.0x10^{-1}$	$1.4x10^{1}$	$3.0x10^{3}$	$8.1x10^{4}$
Rb-87		Unlimited	Unlimited	Unlimited	Unlimited	$3.2x10^{-9}$	$8.6x10^{-8}$

Rb(nat)		Unlimited	Unlimited	Unlimited	Unlimited	$6.7x10^{6}$	$1.8x10^{8}$
Re-184	Rhenium (75)	1.0	$2.7x10^{1}$	1.0	$2.7x10^{1}$	$6.9x10^{2}$	$1.9x10^{4}$
Re-184m		3.0	$8.1x10^{1}$	1.0	$2.7x10^{1}$	$1.6x10^{2}$	$4.3x10^{3}$
Re-186		2.0	$5.4x10^{1}$	$6.0x10^{-1}$	$1.6x10^{1}$	$6.9x10^{3}$	$1.9x10^{5}$
Re-187		Unlimited	Unlimited	Unlimited	Unlimited	$1.4x10^{-9}$	$3.8x10^{-8}$
Re-188		$4.0x10^{-1}$	$1.1x10^{1}$	$4.0x10^{-1}$	$1.1x10^{1}$	$3.6x10^{4}$	$9.8x10^{5}$
Re-189 [a]		3.0	$8.1x10^{1}$	$6.0x10^{-1}$	$1.6x10^{1}$	$2.5x10^{4}$	$6.8x10^{5}$
Re(nat)		Unlimited	Unlimited	Unlimited	Unlimited	0.0	$2.4x10^{-8}$
Rh-99	Rhodium (45)	2.0	$5.4x10^{1}$	2.0	$5.4x10^{1}$	$3.0x10^{3}$	$8.2x10^{4}$
Rh-101		4.0	$1.1x10^{2}$	3.0	$8.1x10^{1}$	$4.1x10^{1}$	$1.1x10^{3}$
Rh-102		$5.0x10^{-1}$	$1.4x10^{1}$	$5.0x10^{-1}$	$1.4x10^{1}$	$4.5x10^{1}$	$1.2x10^{3}$
Rh-102m		2.0	$5.4x10^{1}$	2.0	$5.4x10^{1}$	$2.3x10^{2}$	$6.2x10^{3}$
Rh-103m		$4.0x10^{1}$	$1.1x10^{3}$	$4.0x10^{1}$	$1.1x10^{3}$	$1.2x10^{6}$	$3.3x10^{7}$
Rh-105		$1.0x10^{1}$	$2.7x10^{2}$	$8.0x10^{-1}$	$2.2x10^{1}$	$3.1x10^{4}$	$8.4x10^{5}$
Rn-222 [a]	Radon (86)	$3.0x10^{-1}$	8.1	$4.0x10^{-3}$	$1.1x10^{-1}$	$5.7x10^{3}$	$1.5x10^{5}$
Ru-97	Ruthenium (44)	5.0	$1.4x10^{2}$	5.0	$1.4x10^{2}$	$1.7x10^{4}$	$4.6x10^{5}$
Ru-103 [a]		2.0	$5.4x10^{1}$	2.0	$5.4x10^{1}$	$1.2x10^{3}$	$3.2x10^{4}$
Ru-105		1.0	$2.7x10^{1}$	$6.0x10^{-1}$	$1.6x10^{1}$	$2.5x10^{5}$	$6.7x10^{6}$

Ru-106 [a]		$2.0x10^{-1}$	5.4	$2.0x10^{-1}$	5.4	$1.2x10^{2}$	$3.3x10^{3}$
S-35	Sulphur (16)	$4.0x10^{1}$	$1.1x10^{3}$	3.0	$8.1x10^{1}$	$1.6x10^{3}$	$4.3x10^{4}$
Sb-122	Antimony (51)	$4.0x10^{-1}$	$1.1x10^{1}$	$4.0x10^{-1}$	$1.1x10^{1}$	$1.5x10^{4}$	$4.0x10^{5}$
Sb-124		$6.0x10^{-1}$	$1.6x10^{1}$	$6.0x10^{-1}$	$1.6x10^{1}$	$6.5x10^{2}$	$1.7x10^{4}$
Sb-125		2.0	$5.4x10^{1}$	1.0	$2.7x10^{1}$	$3.9x10^{1}$	$1.0x10^{3}$
Sb-126		$4.0x10^{-1}$	$1.1x10^{1}$	$4.0x10^{-1}$	$1.1x10^{1}$	$3.1x10^{3}$	$8.4x10^{4}$
Sc-44	Scandium (21)	$5.0x10^{-1}$	$1.4x10^{1}$	$5.0x10^{-1}$	$1.4x10^{1}$	$6.7x10^{5}$	$1.8x10^{7}$
Sc-46		$5.0x10^{-1}$	$1.4x10^{1}$	$5.0x10^{-1}$	$1.4x10^{1}$	$1.3x10^{3}$	$3.4x10^{4}$
Sc-47		$1.0x10^{1}$	$2.7x10^{2}$	$7.0x10^{-1}$	$1.9x10^{1}$	$3.1x10^{4}$	$8.3x10^{5}$
Sc-48		$3.0x10^{-1}$	8.1	$3.0x10^{-1}$	8.1	$5.5x10^{4}$	$1.5x10^{6}$
Se-75	Selenium (34)	3.0	$8.1x10^{1}$	3.0	$8.1x10^{1}$	$5.4x10^{2}$	$1.5x10^{4}$
Se-79		$4.0x10^{1}$	$1.1x10^{3}$	2.0	$5.4x10^{1}$	$2.6x10^{-3}$	$7.0x10^{-2}$
Si-31	Silicon (14)	$6.0x10^{-1}$	$1.6x10^{1}$	$6.0x10^{-1}$	$1.6x10^{1}$	$1.4x10^{6}$	$3.9x10^{7}$
Si-32		$4.0x10^{1}$	$1.1x10^{3}$	$5.0x10^{-1}$	$1.4x10^{1}$	3.9	$1.1x10^{2}$
Sm-145	Samarium (62)	$1.0x10^{1}$	$2.7x10^{2}$	$1.0x10^{1}$	$2.7x10^{2}$	$9.8x10^{1}$	$2.6x10^{3}$
Sm-147		Unlimited	Unlimited	Unlimited	Unlimited	$8.5x10^{-1}$	$2.3x10^{-8}$
Sm-151		$4.0x10^{1}$	$1.1x10^{3}$	$1.0x10^{1}$	$2.7x10^{2}$	$9.7x10^{-1}$	$2.6x10^{1}$
Sm-153		9.0	$2.4x10^{2}$	$6.0x10^{-1}$	$1.6x10^{1}$	$1.6x10^{4}$	$4.4x10^{5}$

Sn-113 [a]	Tin (50)	4.0	$1.1x10^{2}$	2.0	$5.4x10^{1}$	$3.7x10^{2}$	$1.0x10^{4}$
Sn-117m		7.0	$1.9x10^{2}$	$4.0x10^{-1}$	$1.1x10^{1}$	$3.0x10^{3}$	$8.2x10^{4}$
Sn-119m		$4.0x10^{1}$	$1.1x10^{3}$	$3.0x10^{1}$	$8.1x10^{2}$	$1.4x10^{2}$	$3.7x10^{3}$
Sn-121m [a]		$4.0x10^{1}$	$1.1x10^{3}$	$9.0x10^{-1}$	$2.4x10^{1}$	2.0	$5.4x10^{1}$
Sn-123		$8.0x10^{-1}$	$2.2x10^{1}$	$6.0x10^{-1}$	$1.6x10^{1}$	$3.0x10^{2}$	$8.2x10^{3}$
Sn-125		$4.0x10^{-1}$	$1.1x10^{1}$	$4.0x10^{-1}$	$1.1x10^{1}$	$4.0x10^{3}$	$1.1x10^{5}$
Sn-126 [a]		$6.0x10^{-1}$	$1.6x10^{1}$	$4.0x10^{-1}$	$1.1x10^{1}$	$1.0x10^{-3}$	$2.8x10^{-2}$
Sr-82 [a]	Strontium (38)	$2.0x10^{-1}$	5.4	$2.0x10^{-1}$	5.4	$2.3x10^{3}$	$6.2x10^{4}$
Sr-85		2.0	$5.4x10^{1}$	2.0	$5.4x10^{1}$	$8.8x10^{2}$	$2.4x10^{4}$
Sr-85m		5.0	$1.4x10^{2}$	5.0	$1.4x10^{2}$	$1.2x10^{6}$	$3.3x10^{7}$
Sr-87m		3.0	$8.1x10^{1}$	3.0	$8.1x10^{1}$	$4.8x10^{5}$	$1.3x10^{7}$
Sr-89		$6.0x10^{-1}$	$1.6x10^{1}$	$6.0x10^{-1}$	$1.6x10^{1}$	$1.1x10^{3}$	$2.9x10^{4}$
Sr-90 [a]		$3.0x10^{-1}$	8.1	$3.0x10^{-1}$	8.1	5.1	$1.4x10^{2}$
Sr-91 [a]		$3.0x10^{-1}$	8.1	$3.0x10^{-1}$	8.1	$1.3x10^{5}$	$3.6x10^{6}$
Sr-92 [a]		1.0	$2.7x10^{1}$	$3.0x10^{-1}$	8.1	$4.7x10^{5}$	$1.3x10^{7}$
T(H-3)	Tritium (1)	$4.0x10^{1}$	$1.1x10^{3}$	$4.0x10^{1}$	$1.1x10^{3}$	$3.6x10^{2}$	$9.7x10^{3}$
Ta-178 (long-lived)	Tantalum (73)	1.0	$2.7x10^{1}$	$8.0x10^{-1}$	$2.2x10^{1}$	$4.2x10^{6}$	$1.1x10^{8}$
Ta-179		$3.0x10^{1}$	$8.1x10^{2}$	$3.0x10^{1}$	$8.1x10^{2}$	$4.1x10^{1}$	$1.1x10^{3}$

Ta-182		$9.0x10^{-1}$	$2.4x10^{1}$	$5.0x10^{-1}$	$1.4x10^{1}$	$2.3x10^{2}$	$6.2x10^{3}$
Tb-157	Terbium (65)	$4.0x10^{1}$	$1.1x10^{3}$	$4.0x10^{1}$	$1.1x10^{3}$	$5.6x10^{-1}$	$1.5x10^{1}$
Tb-158		1.0	$2.7x10^{1}$	1.0	$2.7x10^{1}$	$5.6x10^{-1}$	$1.5x10^{1}$
Tb-160		1.0	$2.7x10^{1}$	$6.0x10^{-1}$	$1.6x10^{1}$	$4.2x10^{2}$	$1.1x10^{4}$
Tc-95m [a]	Technetium (43)	2.0	$5.4x10^{1}$	2.0	$5.4x10^{1}$	$8.3x10^{2}$	$2.2x10^{4}$
Tc-96		$4.0x10^{-1}$	$1.1x10^{1}$	$4.0x10^{-1}$	$1.1x10^{1}$	$1.2x10^{4}$	$3.2x10^{5}$
Tc-96m [a]		$4.0x10^{-1}$	$1.1x10^{1}$	$4.0x10^{-1}$	$1.1x10^{1}$	$1.4x10^{6}$	$3.8x10^{7}$
Tc-97		Unlimited	Unlimited	Unlimited	Unlimited	$5.2x10^{-5}$	$1.4x10^{-3}$
Tc-97m		$4.0x10^{1}$	$1.1x10^{3}$	1.0	$2.7x10^{1}$	$5.6x10^{2}$	$1.5x10^{4}$
Tc-98		$8.0x10^{-1}$	$2.2x10^{1}$	$7.0x10^{-1}$	$1.9x10^{1}$	$3.2x10^{-5}$	$8.7x10^{-4}$
Tc-99		$4.0x10^{1}$	$1.1x10^{3}$	$9.0x10^{-1}$	$2.4x10^{1}$	$6.3x10^{-4}$	$1.7x10^{-2}$
Tc-99m		$1.0x10^{1}$	$2.7x10^{2}$	4.0	$1.1x10^{2}$	$1.9x10^{5}$	$5.3x10^{6}$
Te-121	Tellurium (52)	2.0	$5.4x10^{1}$	2.0	$5.4x10^{1}$	$2.4x10^{3}$	$6.4x10^{4}$
Te-121m		5.0	$1.4x10^{2}$	3.0	$8.1x10^{1}$	$2.6x10^{2}$	$7.0x10^{3}$
Te-123m		8.0	$2.2x10^{2}$	1.0	$2.7x10^{1}$	$3.3x10^{2}$	$8.9x10^{3}$
Te-125m		$2.0x10^{1}$	$5.4x10^{2}$	$9.0x10^{-1}$	$2.4x10^{1}$	$6.7x10^{2}$	$1.8x10^{4}$
Te-127		$2.0x10^{1}$	$5.4x10^{2}$	$7.0x10^{-1}$	$1.9x10^{1}$	$9.8x10^{4}$	$2.6x10^{6}$
Te-127m [a]		$2.0x10^{1}$	$5.4x10^{2}$	$5.0x10^{-1}$	$1.4x10^{1}$	$3.5x10^{2}$	$9.4x10^{3}$

Te-129		$7.0x10^{-1}$	$1.9x10^{1}$	$6.0x10^{-1}$	$1.6x10^{1}$	$7.7x10^{5}$	$2.1x10^{7}$
Te-129m [a]		$8.0x10^{-1}$	$2.2x10^{1}$	$4.0x10^{-1}$	$1.1x10^{1}$	$1.1x10^{3}$	$3.0x10^{4}$
Te-131m [a]		$7.0x10^{-1}$	$1.9x10^{1}$	$5.0x10^{-1}$	$1.4x10^{1}$	$3.0x10^{4}$	$8.0x10^{5}$
Te-132 [a]		$5.0x10^{-1}$	$1.4x10^{1}$	$4.0x10^{-1}$	$1.1x10^{1}$	$3.1x10^{4}$	$3.0x10^{5}$
Th-227	Thorium (90)	$1.0x10^{1}$	$2.7x10^{2}$	$5.0x10^{-3}$	$1.4x10^{-1}$	$1.1x10^{3}$	$3.1x10^{4}$
Th-228 [a]		$5.0x10^{-1}$	$1.4x10^{1}$	$1.0x10^{-3}$	$2.7x10^{-2}$	$3.0x10^{1}$	$8.2x10^{2}$
Th-229		5.0	$1.4x10^{2}$	$5.0x10^{-4}$	$1.4x10^{-2}$	$7.9x10^{-3}$	$2.1x10^{-1}$
Th-230		$1.0x10^{1}$	$2.7x10^{2}$	$1.0x10^{-3}$	$2.7x10^{-2}$	$7.6x10^{-4}$	$2.1x10^{-2}$
Th-231		$4.0x10^{1}$	$1.1x10^{3}$	$2.0x10^{-2}$	$5.4x10^{-1}$	$2.0x10^{4}$	$5.3x10^{5}$
Th-232		Unlimited	Unlimited	Unlimited	Unlimited	$4.0x10^{-9}$	$1.1x10^{-7}$
Th-234 [a]		$3.0x10^{-1}$	8.1	$3.0x10^{-1}$	8.1	$8.6x10^{2}$	$2.3x10^{4}$
Th(nat)		Unlimited	Unlimited	Unlimited	Unlimited	$8.1x10^{-9}$	$2.2x10^{-7}$
Ti-44 [a]	Titanium (22)	$5.0x10^{-1}$	$1.4x10^{1}$	$4.0x10^{-1}$	$1.1x10^{1}$	6.4	$1.7x10^{2}$
Tl-200	Thallium (81)	$9.0x10^{-1}$	$2.4x10^{1}$	$9.0x10^{-1}$	$2.4x10^{1}$	$2.2x10^{4}$	$6.0x10^{5}$
Tl-201		$1.0x10^{1}$	$2.7x10^{2}$	4.0	$1.1x10^{2}$	$7.9x10^{3}$	$2.1x10^{5}$
Tl-202		2.0	$5.4x10^{1}$	2.0	$5.4x10^{1}$	$2.0x10^{3}$	$5.3x10^{4}$
Tl-204		$1.0x10^{1}$	$2.7x10^{2}$	$7.0x10^{-1}$	$1.9x10^{1}$	$1.7x10^{1}$	$4.6x10^{2}$
Tm-167	Thulium (69)	7.0	$1.9x10^{2}$	$8.0x10^{-1}$	$2.2x10^{1}$	$3.1x10^{3}$	$8.5x10^{4}$

Tm-170		3.0	$8.1x10^{1}$	$6.0x10^{-1}$	$1.6x10^{1}$	$2.2x10^{2}$	$6.0x10^{3}$
Tm-171		$4.0x10^{1}$	$1.1x10^{3}$	$4.0x10^{1}$	$1.1x10^{3}$	$4.0x10^{1}$	$1.1x10^{3}$
U-230 (fast lung absorption) [a] [d]	Uranium (92)	$4.0x10^{1}$	$1.1x10^{3}$	$1.0x10^{-1}$	2.7	$1.0x10^{3}$	$2.7x10^{4}$
U-230 (medium lung absorption) [a] [e]		$4.0x10^{1}$	$1.1x10^{3}$	$4.0x10^{-3}$	$1.1x10^{-1}$	$1.0x10^{3}$	$2.7x10^{4}$
U-230 (slow lung absorption) [a] [f]		$3.0x10^{1}$	$8.1x10^{2}$	$3.0x10^{-3}$	$8.1x10^{-2}$	$1.0x10^{3}$	$2.7x10^{4}$
U-232 (fast lung absorption) [d]		$4.0x10^{1}$	$1.1x10^{3}$	$1.0x10^{-2}$	$2.7x10^{-1}$	$8.3x10^{-1}$	$2.2x10^{1}$
U-232 (medium lung absorption) [e]		$4.0x10^{1}$	$1.1x10^{3}$	$7.0x10^{-3}$	$1.9x10^{-1}$	$8.3x10^{-1}$	$2.2x10^{1}$
U-232 (slow lung absorption) [f]		$1.0x10^{1}$	$2.7x10^{2}$	$1.0x10^{-3}$	$2.7x10^{-2}$	$8.3x10^{-1}$	$2.2x10^{1}$
U-233 (fast lung absorption) [d]		$4.0x10^{1}$	$1.1x10^{3}$	$9.0x10^{-2}$	2.4	$3.6x10^{-4}$	$9.7x10^{-3}$
U-233 (medium lung absorption) [e]		$4.0x10^{1}$	$1.1x10^{3}$	$2.0x10^{-2}$	$5.4x10^{-1}$	$3.6x10^{-4}$	$9.7x10^{-3}$
U-233 (slow lung absorption) [f]		$4.0x10^{1}$	$1.1x10^{3}$	$6.0x10^{-3}$	$1.6x10^{-1}$	$3.6x10^{-4}$	$9.7x10^{-3}$
U-234 (fast lung absorption) [d]		$4.0x10^{1}$	$1.1x10^{3}$	$9.0x10^{-2}$	2.4	$2.3x10^{-4}$	$6.2x10^{-3}$
U-234 (medium lung absorption) [e]		$4.0x10^{1}$	$1.1x10^{3}$	$2.0x10^{-2}$	$5.4x10^{-1}$	$2.3x10^{-4}$	$6.2x10^{-3}$
U-234 (slow lung absorption) [f]		$4.0x10^{1}$	$1.1x10^{3}$	$6.0x10^{-3}$	$1.6x10^{-1}$	$2.3x10^{-4}$	$6.2x10^{-3}$

U-235 (all lung absorption types) [a d e f]		Unlimited	Unlimited	Unlimited	Unlimited	$8.0x10^{-8}$	$2.2x10^{-6}$
U-236 (fast lung absorption) [d]		Unlimited	Unlimited	Unlimited	Unlimited	$2.4x10^{-6}$	$6.5x10^{-5}$
U-236 (medium lung absorption) [e]		$4.0x10^{1}$	$1.1x10^{3}$	$2.0x10^{-2}$	$5.4x10^{-1}$	$2.4x10^{-6}$	$6.5x10^{-5}$
U-236 (slow lung absorption) [f]		$4.0x10^{1}$	$1.1x10^{3}$	$6.0x10^{-3}$	$1.6x10^{-1}$	$2.4x10^{-6}$	$6.5x10^{-5}$
U-238 (all lung absorption types) [d e f]		Unlimited	Unlimited	Unlimited	Unlimited	$1.2x10^{-8}$	$3.4x10^{-7}$
U (nat)		Unlimited	Unlimited	Unlimited	Unlimited	$2.6x10^{-8}$	$7.1x10^{-7}$
U (enriched to 20% or less) [g]		Unlimited	Unlimited	Unlimited	Unlimited	See Table A-4	See Table A-4
U (dep)		Unlimited	Unlimited	Unlimited	Unlimited	See Table A-4	(See Table A-3)
V-48	Vanadium (23)	$4.0x10^{-1}$	$1.1x10^{1}$	$4.0x10^{-1}$	$1.1x10^{1}$	$6.3x10^{3}$	$1.7x10^{5}$
V-49		$4.0x10^{1}$	$1.1x10^{3}$	$4.0x10^{1}$	$1.1x10^{3}$	$3.0x10^{2}$	$8.1x10^{3}$
W-178 [a]	Tungsten (74)	9.0	$2.4x10^{2}$	5.0	$1.4x10^{2}$	$1.3x10^{3}$	$3.4x10^{4}$
W-181		$3.0x10^{1}$	$8.1x10^{2}$	$3.0x10^{1}$	$8.1x10^{2}$	$2.2x10^{2}$	$6.0x10^{3}$
W-185		$4.0x10^{1}$	$1.1x10^{3}$	$8.0x10^{-1}$	$2.2x10^{1}$	$3.5x10^{2}$	$9.4x10^{3}$
W-187		2.0	$5.4x10^{1}$	$6.0x10^{-1}$	$1.6x10^{1}$	$2.6x10^{4}$	$7.0x10^{5}$
W-188 [a]		$4.0x10^{-1}$	$1.1x10^{1}$	$3.0x10^{-1}$	8.1	$3.7x10^{2}$	$1.0x10^{4}$
Xe-122 [a]	Xenon (54)	$4.0x10^{-1}$	$1.1x10^{1}$	$4.0x10^{-1}$	$1.1x10^{1}$	$4.8x10^{4}$	$1.3x10^{6}$
Xe-123		2.0	$5.4x10^{1}$	$7.0x10^{-1}$	$1.9x10^{1}$	$4.4x10^{5}$	$1.2x10^{7}$

Xe-127		4.0	$1.1x10^{2}$	2.0	$5.4x10^{1}$	$1.0x10^{3}$	$2.8x10^{4}$
Xe-131m		$4.0x10^{1}$	$1.1x10^{3}$	$4.0x10^{1}$	$1.1x10^{3}$	$3.1x10^{3}$	$8.4x10^{4}$
Xe-133		$2.0x10^{1}$	$5.4x10^{2}$	$1.0x10^{1}$	$2.7x10^{2}$	$6.9x10^{3}$	$1.9x10^{5}$
Xe-135		3.0	$8.1x10^{1}$	2.0	$5.4x10^{1}$	$9.5x10^{4}$	$2.6x10^{6}$
Y-87 [a]	Yttrium (39)	1.0	$2.7x10^{1}$	1.0	$2.7x10^{1}$	$1.7x10^{4}$	$4.5x10^{5}$
Y-88		$4.0x10^{-1}$	$1.1x10^{1}$	$4.0x10^{-1}$	$1.1x10^{1}$	$5.2x10^{2}$	$1.4x10^{4}$
Y-90		$3.0x10^{-1}$	8.1	$3.0x10^{-1}$	8.1	$2.0x10^{4}$	$5.4x10^{5}$
Y-91		$6.0x10^{-1}$	$1.6x10^{1}$	$6.0x10^{-1}$	$1.6x10^{1}$	$9.1x10^{2}$	$2.5x10^{4}$
Y-91m		2.0	$5.4x10^{1}$	2.0	$5.4x10^{1}$	$1.5x10^{6}$	$4.2x10^{7}$
Y-92		$2.0x10^{-1}$	5.4	$2.0x10^{-1}$	5.4	$3.6x10^{5}$	$9.6x10^{6}$
Y-93		$3.0x10^{-1}$	8.1	$3.0x10^{-1}$	8.1	$1.2x10^{5}$	$3.3x10^{6}$
Yb-169	Ytterbium (70)	4.0	$1.1x10^{2}$	1.0	$2.7x10^{1}$	$8.9x10^{2}$	$2.4x10^{4}$
Yb-175		$3.0x10^{1}$	$8.1x10^{2}$	$9.0x10^{-1}$	$2.4x10^{1}$	$6.6x10^{3}$	$1.8x10^{5}$
Zn-65	Zinc (30)	2.0	$5.4x10^{1}$	2.0	$5.4x10^{1}$	$3.0x10^{2}$	$8.2x10^{3}$
Zn-69		3.0	$8.1x10^{1}$	$6.0x10^{-1}$	$1.6x10^{1}$	$1.8x10^{6}$	$4.9x10^{7}$
Zn-69m [a]		3.0	$8.1x10^{1}$	$6.0x10^{-1}$	$1.6x10^{1}$	$1.2x10^{5}$	$3.3x10^{6}$
Zr-88	Zirconium (40)	3.0	$8.1x10^{1}$	3.0	$8.1x10^{1}$	$6.6x10^{2}$	$1.8x10^{4}$
Zr-93		Unlimited	Unlimited	Unlimited	Unlimited	$9.3x10^{-5}$	$2.5x10^{-3}$

Zr-95[a]	2.0	$5.4x10^{1}$	$8.0x10^{-1}$	$2.2x10^{1}$	$7.9x10^{2}$	$2.1x10^{4}$
Zr-97[a]	$4.0x10^{-1}$	$1.1x10^{1}$	$4.0x10^{-1}$	$1.1x10^{1}$	$7.1x10^{4}$	$1.9x10^{6}$

a. A_1 and/or A_2 values include contributions from daughter nuclides with half-lives less than 10 days.

b. The values of A_1 and A_2 in Curies (Ci) are approximate and for information only; the regulatory standard units are Terabecquerels (TBq), (see Appendix A to Part 71 - Determination of A_1 and A_2, Section I.).

c. The quantity may be determined from a measurement of the rate of decay or a measurement of the radiation level at a prescribed distance from the source.

d. These values apply only to compounds of uranium that take the chemical form of UF_6, UO_2F_2 and $UO_2(NO_3)_2$ in both normal and accident conditions of transport.

e. These values apply only to compounds of uranium that take the chemical form of UO_3, UF_4, UCl_4 and hexavalent compounds in both normal and accident conditions of transport.

f. These values apply to all compounds of uranium other than those specified in notes (d) and (e) of this table.

g. These values apply to unirradiated uranium only.

h. A_1 = 0.1 TBq (2.7 Ci) and A_2 = 0.001 TBq (0.027 Ci) for Cf-252 for domestic use.

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

TABLE A-2

EXEMPT MATERIAL ACTIVITY CONCENTRATIONS AND EXEMPT CONSIGNMENT ACTIVITY LIMITS FOR RADIONUCLIDES

Symbol of radionuclide	Element and atomic number	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
Ac-225	Actinium (89)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{4}$	$2.7x10^{-7}$
Ac-227		$1.0x10^{-1}$	$2.7x10^{-12}$	$1.0x10^{3}$	$2.7x10^{-8}$
Ac-228		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$

Ag-105	Silver (47)	$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Ag-108m [b]		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Ag-110m		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Ag-111		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{6}$	$2.7x10^{-5}$
Al-26	Aluminum (13)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$
Am-241	Americium (95)	1.0	$2.7x10^{-11}$	$1.0x10^{4}$	$2.7x10^{-7}$
Am-242m [b]		1.0	$2.7x10^{-11}$	$1.0x10^{4}$	$2.7x10^{-7}$
Am-243 [b]		1.0	$2.7x10^{-11}$	$1.0x10^{3}$	$2.7x10^{-8}$
Ar-37	Argon (18)	$1.0x10^{6}$	$2.7x10^{-5}$	$1.0x10^{8}$	$2.7x10^{-3}$
Ar-39		$1.0x10^{7}$	$2.7x10^{-4}$	$1.0x10^{4}$	$2.7x10^{-7}$
Ar-41		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{9}$	$2.7x10^{-2}$
As-72	Arsenic (33)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$
As-73		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{7}$	$2.7x10^{-4}$
As-74		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
As-76		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{5}$	$2.7x10^{-6}$
As-77		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{6}$	$2.7x10^{-5}$
At-211	Astatine (85)	$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{7}$	$2.7x10^{-4}$
Au-193	Gold (79)	$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{7}$	$2.7x10^{-4}$

Au-194		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Au-195		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{7}$	$2.7x10^{-4}$
Au-198		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Au-199		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Ba-131	Barium (56)	$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Ba-133		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Ba-133m		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Ba-140 [b]		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$
Be-7	Beryllium (4)	$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{7}$	$2.7x10^{-4}$
Be-10		$1.0x10^{4}$	$2.7x10^{-7}$	$1.0x10^{6}$	$2.7x10^{-5}$
Bi-205	Bismuth (83)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Bi-206		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$
Bi-207		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Bi-210		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{6}$	$2.7x10^{-5}$
Bi-210m		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$
Bi-212 [b]		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$
Bk-247	Berkelium (97)	1.0	$2.7x10^{-11}$	$1.0x10^{4}$	$2.7x10^{-7}$
Bk-249		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{6}$	$2.7x10^{-5}$

Br-76	Bromine (35)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$
Br-77		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Br-82		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
C-11	Carbon (6)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
C-14		$1.0x10^{4}$	$2.7x10^{-7}$	$1.0x10^{7}$	$2.7x10^{-4}$
Ca-41	Calcium (20)	$1.0x10^{5}$	$2.7x10^{-6}$	$1.0x10^{7}$	$2.7x10^{-4}$
Ca-45		$1.0x10^{4}$	$2.7x10^{-7}$	$1.0x10^{7}$	$2.7x10^{-4}$
Ca-47		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Cd-109	Cadmium (48)	$1.0x10^{4}$	$2.7x10^{-7}$	$1.0x10^{6}$	$2.7x10^{-5}$
Cd-113m		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{6}$	$2.7x10^{-5}$
Cd-115		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Cd-115m		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{6}$	$2.7x10^{-5}$
Ce-139	Cerium (58)	$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Ce-141		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{7}$	$2.7x10^{-4}$
Ce-143		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Ce-144 [b]		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{5}$	$2.7x10^{-6}$
Cf-248	Californium (98)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{4}$	$2.7x10^{-7}$
Cf-249		1.0	$2.7x10^{-11}$	$1.0x10^{3}$	$2.7x10^{-8}$

Cf-250		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{4}$	$2.7x10^{-7}$
Cf-251		1.0	$2.7x10^{-11}$	$1.0x10^{3}$	$2.7x10^{-8}$
Cf-252		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{4}$	$2.7x10^{-7}$
Cf-253		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{5}$	$2.7x10^{-6}$
Cf-254		1.0	$2.7x10^{-11}$	$1.0x10^{3}$	$2.7x10^{-8}$
Cl-36	Chlorine (17)	$1.0x10^{4}$	$2.7x10^{-7}$	$1.0x10^{6}$	$2.7x10^{-5}$
Cl-38		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$
Cm-240	Curium (96)	$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{5}$	$2.7x10^{-6}$
Cm-241		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Cm-242		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{5}$	$2.7x10^{-6}$
Cm-243		1.0	$2.7x10^{-11}$	$1.0x10^{4}$	$2.7x10^{-7}$
Cm-244		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{4}$	$2.7x10^{-7}$
Cm-245		1.0	$2.7x10^{-11}$	$1.0x10^{3}$	$2.7x10^{-8}$
Cm-246		1.0	$2.7x10^{-11}$	$1.0x10^{3}$	$2.7x10^{-8}$
Cm-247		1.0	$2.7x10^{-11}$	$1.0x10^{4}$	$2.7x10^{-7}$
Cm-248		1.0	$2.7x10^{-11}$	$1.0x10^{3}$	$2.7x10^{-8}$
Co-55	Cobalt (27)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Co-56		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$

Co-57		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Co-58		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Co-58m		$1.0x10^{4}$	$2.7x10^{-7}$	$1.0x10^{7}$	$2.7x10^{-4}$
Co-60		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$
Cr-51	Chromium (24)	$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{7}$	$2.7x10^{-4}$
Cs-129	Cesium (55)	$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{5}$	$2.7x10^{-6}$
Cs-131		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{6}$	$2.7x10^{-5}$
Cs-132		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$
Cs-134		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{4}$	$2.7x10^{-7}$
Cs-134m		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{5}$	$2.7x10^{-6}$
Cs-135		$1.0x10^{4}$	$2.7x10^{-7}$	$1.0x10^{7}$	$2.7x10^{-4}$
Cs-136		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$
Cs-137 [b]		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{4}$	$2.7x10^{-7}$
Cu-64	Copper (29)	$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Cu-67		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Dy-159	Dysprosium (66)	$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{7}$	$2.7x10^{-4}$
Dy-165		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{6}$	$2.7x10^{-5}$
Dy-166		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{6}$	$2.7x10^{-5}$

Er-169	Erbium (68)	$1.0x10^{4}$	$2.7x10^{-7}$	$1.0x10^{7}$	$2.7x10^{-4}$
Er-171		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Eu-147	Europium (63)	$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Eu-148		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Eu-149		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{7}$	$2.7x10^{-4}$
Eu-150 (short lived)		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{6}$	$2.7x10^{-5}$
Eu-150 (long lived)		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Eu-152		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Eu-152m		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Eu-154		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Eu-155		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{7}$	$2.7x10^{-4}$
Eu-156		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
F-18	Fluorine (9)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Fe-52	Iron (26)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Fe-55		$1.0x10^{4}$	$2.7x10^{-7}$	$1.0x10^{6}$	$2.7x10^{-5}$
Fe-59		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Fe-60		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{5}$	$2.7x10^{-6}$
Ga-67	Gallium (31)	$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$

Ga-68		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$
Ga-72		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$
Gd-146	Gadolinium (64)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Gd-148		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{4}$	$2.7x10^{-7}$
Gd-153		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{7}$	$2.7x10^{-4}$
Gd-159		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{6}$	$2.7x10^{-5}$
Ge-68	Germanium (32)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$
Ge-71		$1.0x10^{4}$	$2.7x10^{-7}$	$1.0x10^{8}$	$2.7x10^{-3}$
Ge-77		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$
Hf-172	Hafnium (72)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Hf-175		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Hf-181		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Hf-182		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Hg-194	Mercury (80)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Hg-195m		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Hg-197		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{7}$	$2.7x10^{-4}$
Hg-197m		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Hg-203		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{5}$	$2.7x10^{-6}$

Ho-166	Holmium (67)	$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{5}$	$2.7x10^{-6}$
Ho-166m		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
I-123	Iodine (53)	$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{7}$	$2.7x10^{-4}$
I-124		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
I-125		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{6}$	$2.7x10^{-5}$
I-126		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
I-129		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{5}$	$2.7x10^{-6}$
I-131		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
I-132		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$
I-133		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
I-134		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$
I-135		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
In-111	Indium (49)	$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
In-113m		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
In-114m		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
In-115m		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Ir-189	Iridium (77)	$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{7}$	$2.7x10^{-4}$
Ir-190		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$

Ir-192		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{4}$	$2.7x10^{-7}$
Ir-194		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{5}$	$2.7x10^{-6}$
K-40	Potassium (19)	$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
K-42		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
K-43		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Kr-81	Krypton (36)	$1.0x10^{4}$	$2.7x10^{-7}$	$1.0x10^{7}$	$2.7x10^{-4}$
Kr-85		$1.0x10^{5}$	$2.7x10^{-6}$	$1.0x10^{4}$	$2.7x10^{-7}$
Kr-85m		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{10}$	$2.7x10^{-1}$
Kr-87		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{9}$	$2.7x10^{-2}$
La-137	Lanthanum (57)	$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{7}$	$2.7x10^{-4}$
La-140		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$
Lu-172	Lutetium (71)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Lu-173		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{7}$	$2.7x10^{-4}$
Lu-174		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{7}$	$2.7x10^{-4}$
Lu-174m		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{7}$	$2.7x10^{-4}$
Lu-177		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{7}$	$2.7x10^{-4}$
Mg-28	Magnesium (12)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$
Mn-52	Manganese (25)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$

Mn-53		$1.0x10^{4}$	$2.7x10^{-7}$	$1.0x10^{9}$	$2.7x10^{-2}$
Mn-54		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Mn-56		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$
Mo-93	Molybdenum (42)	$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{8}$	$2.7x10^{-3}$
Mo-99		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
N-13	Nitrogen (7)	$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{9}$	$2.7x10^{-2}$
Na-22	Sodium (11)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Na-24		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$
Nb-93m	Niobium (41)	$1.0x10^{4}$	$2.7x10^{-7}$	$1.0x10^{7}$	$2.7x10^{-4}$
Nb-94		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Nb-95		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Nb-97		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Nd-147	Neodymium (60)	$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Nd-149		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Ni-59	Nickel (28)	$1.0x10^{4}$	$2.7x10^{-7}$	$1.0x10^{8}$	$2.7x10^{-3}$
Ni-63		$1.0x10^{5}$	$2.7x10^{-6}$	$1.0x10^{8}$	$2.7x10^{-3}$
Ni-65		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Np-235	Neptunium (93)	$1.0x10^{3}$	$2.7x10^{-8}$	1.0x107M	$2.7x10^{-4}$

Np-236 (short-lived)		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{7}$	$2.7x10^{-4}$
Np-236 (long-lived)		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{5}$	$2.7x10^{-6}$
Np-237 [b]		1.0	$2.7x10^{-11}$	$1.0x10^{3}$	$2.7x10^{-8}$
Np-239		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{7}$	$2.7x10^{-4}$
Os-185	Osmium (76)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Os-191		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{7}$	$2.7x10^{-4}$
Os-191m		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{7}$	$2.7x10^{-4}$
Os-193		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Os-194		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{5}$	$2.7x10^{-6}$
P-32	Phosphorus (15)	$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{5}$	$2.7x10^{-6}$
P-33		$1.0x10^{5}$	$2.7x10^{-6}$	$1.0x10^{8}$	$2.7x10^{-3}$
Pa-230	Protactinium (91)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Pa-231		1.0	$2.7x10^{-11}$	$1.0x10^{3}$	$2.7x10^{-8}$
Pa-233		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{7}$	$2.7x10^{-4}$
Pb-201	Lead (82)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Pb-202		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{6}$	$2.7x10^{-5}$
Pb-203		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Pb-205		$1.0x10^{4}$	$2.7x10^{-7}$	$1.0x10^{7}$	$2.7x10^{-4}$

Pb-210 [b]		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{4}$	$2.7x10^{-7}$
Pb-212 [b]		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$
Pd-103	Palladium (46)	$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{8}$	$2.7x10^{-3}$
Pd-107		$1.0x10^{5}$	$2.7x10^{-6}$	$1.0x10^{8}$	$2.7x10^{-3}$
Pd-109		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{6}$	$2.7x10^{-5}$
Pm-143	Promethium (61)	$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Pm-144		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Pm-145		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{7}$	$2.7x10^{-4}$
Pm-147		$1.0x10^{4}$	$2.7x10^{-7}$	$1.0x10^{7}$	$2.7x10^{-4}$
Pm-148m		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Pm-149		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{6}$	$2.7x10^{-5}$
Pm-151		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Po-210	Polonium (84)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{4}$	$2.7x10^{-7}$
Pr-142	Praseodymium (59)	$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{5}$	$2.7x10^{-6}$
Pr-143		$1.0x10^{4}$	$2.7x10^{-7}$	$1.0x10^{6}$	$2.7x10^{-5}$
Pt-188	Platinum (78)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Pt-191		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Pt-193		$1.0x10^{4}$	$2.7x10^{-7}$	$1.0x10^{7}$	$2.7x10^{-4}$

Pt-193m		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{7}$	$2.7x10^{-4}$
Pt-195m		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Pt-197		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{6}$	$2.7x10^{-5}$
Pt-197m		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Pu-236	Plutonium (94)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{4}$	$2.7x10^{-7}$
Pu-237		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{7}$	$2.7x10^{-4}$
Pu-238		1.0	$2.7x10^{-11}$	$1.0x10^{4}$	$2.7x10^{-7}$
Pu-239		1.0	$2.7x10^{-11}$	$1.0x10^{4}$	$2.7x10^{-7}$
Pu-240		1.0	$2.7x10^{-11}$	$1.0x10^{3}$	$2.7x10^{-8}$
Pu-241		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{5}$	$2.7x10^{-6}$
Pu-242		1.0	$2.7x10^{-11}$	$1.0x10^{4}$	$2.7x10^{-7}$
Pu-244		1.0	$2.7x10^{-11}$	$1.0x10^{4}$	$2.7x10^{-7}$
Ra-223 [b]	Radium (88)	$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{5}$	$2.7x10^{-6}$
Ra-224 [b]		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$
Ra-225		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{5}$	$2.7x10^{-6}$
Ra-226 [b]		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{4}$	$2.7x10^{-7}$
Ra-228 [b]		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$
Rb-81	Rubidium (37)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$

Rb-83		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Rb-84		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Rb-86		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{5}$	$2.7x10^{-6}$
Rb-87		$1.0x10^{4}$	$2.7x10^{-7}$	$1.0x10^{7}$	$2.7x10^{-4}$
Rb(nat)		$1.0x10^{4}$	$2.7x10^{-7}$	$1.0x10^{7}$	$2.7x10^{-4}$
Re-184	Rhenium (75)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Re-184m		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Re-186		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{6}$	$2.7x10^{-5}$
Re-187		$1.0x10^{6}$	$2.7x10^{-5}$	$1.0x10^{9}$	$2.7x10^{-2}$
Re-188		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{5}$	$2.7x10^{-6}$
Re-189		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Re(nat)		$1.0x10^{6}$	$2.7x10^{-5}$	$1.0x10^{9}$	$2.7x10^{-2}$
Rh-99	Rhodium (45)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Rh-101		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{7}$	$2.7x10^{-4}$
Rh-102		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Rh-102m		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Rh-103m		$1.0x10^{4}$	$2.7x10^{-7}$	$1.0x10^{8}$	$2.7x10^{-3}$
Rh-105		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{7}$	$2.7x10^{-4}$

Rn-222 [b]	Radon (86)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{8}$	$2.7x10^{-3}$
Ru-97	Ruthenium (44)	$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{7}$	$2.7x10^{-4}$
Ru-103		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Ru-105		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Ru-106 [b]		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{5}$	$2.7x10^{-6}$
S-35	Sulphur (16)	$1.0x10^{5}$	$2.7x10^{-6}$	$1.0x10^{8}$	$2.7x10^{-3}$
Sb-122	Antimony (51)	$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{4}$	$2.7x10^{-7}$
Sb-124		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Sb-125		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Sb-126		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$
Sc-44	Scandium (21)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$
Sc-46		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Sc-47		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Sc-48		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$
Se-75	Selenium (34)	$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Se-79		$1.0x10^{4}$	$2.7x10^{-7}$	$1.0x10^{7}$	$2.7x10^{-4}$
Si-31	Silicon (14)	$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{6}$	$2.7x10^{-5}$
Si-32		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{6}$	$2.7x10^{-5}$

Sm-145	Samarium (62)	$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{7}$	$2.7x10^{-4}$
Sm-147		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{4}$	$2.7x10^{-7}$
Sm-151		$1.0x10^{4}$	$2.7x10^{-7}$	$1.0x10^{8}$	$2.7x10^{-3}$
Sm-153		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Sn-113	Tin (50)	$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{7}$	$2.7x10^{-4}$
Sn-117m		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Sn-119m		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{7}$	$2.7x10^{-4}$
Sn-121m		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{7}$	$2.7x10^{-4}$
Sn-123		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{6}$	$2.7x10^{-5}$
Sn-125		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{5}$	$2.7x10^{-6}$
Sn-126		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$
Sr-82	Strontium (38)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$
Sr-85		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Sr-85m		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{7}$	$2.7x10^{-4}$
Sr-87m		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Sr-89		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{6}$	$2.7x10^{-5}$
Sr-90 [b]		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{4}$	$2.7x10^{-7}$
Sr-91		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$

Sr-92		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
T(H-3)	Tritium (1)	$1.0x10^{6}$	$2.7x10^{-5}$	$1.0x10^{9}$	$2.7x10^{-2}$
Ta-178 (long-lived)	Tantalum (73)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Ta-179		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{7}$	$2.7x10^{-4}$
Ta-182		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{4}$	$2.7x10^{-7}$
Tb-157	Terbium (65)	$1.0x10^{4}$	$2.7x10^{-7}$	$1.0x10^{7}$	$2.7x10^{-4}$
Tb-158		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Tb-160		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Tc-95m	Technetium (43)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Tc-96		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Tc-96m		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{7}$	$2.7x10^{-4}$
Tc-97		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{8}$	$2.7x10^{-3}$
Tc-97m		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{7}$	$2.7x10^{-4}$
Tc-98		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Tc-99		$1.0x10^{4}$	$2.7x10^{-7}$	$1.0x10^{7}$	$2.7x10^{-4}$
Tc-99m		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{7}$	$2.7x10^{-4}$
Te-121	Tellurium (52)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Te-121m		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{5}$	$2.7x10^{-6}$

Te-123m		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{7}$	$2.7x10^{-4}$
Te-125m		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{7}$	$2.7x10^{-4}$
Te-127		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{6}$	$2.7x10^{-5}$
Te-127m		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{7}$	$2.7x10^{-4}$
Te-129		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Te-129m		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{6}$	$2.7x10^{-5}$
Te-131m		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Te-132		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{7}$	$2.7x10^{-4}$
Th-227	Thorium (90)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{4}$	$2.7x10^{-7}$
Th-228 [b]		1.0	$2.7x10^{-11}$	$1.0x10^{4}$	$2.7x10^{-7}$
Th-229 [b]		1.0	$2.7x10^{-11}$	$1.0x10^{3}$	$2.7x10^{-8}$
Th-230		1.0	$2.7x10^{-11}$	$1.0x10^{4}$	$2.7x10^{-7}$
Th-231		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{7}$	$2.7x10^{-4}$
Th-232		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{4}$	$2.7x10^{-7}$
Th-234 [b]		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{5}$	$2.7x10^{-6}$
Th (nat) [b]		1.0	$2.7x10^{-11}$	$1.0x10^{3}$	$2.7x10^{-8}$
Ti-44	Titanium (22)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$
Tl-200	Thallium (81)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$

Tl-201		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Tl-202		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Tl-204		$1.0x10^{4}$	$2.7x10^{-7}$	$1.0x10^{4}$	$2.7x10^{-7}$
Tm-167	Thulium (69)	$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Tm-170		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{6}$	$2.7x10^{-5}$
Tm-171		$1.0x10^{4}$	$2.7x10^{-7}$	$1.0x10^{8}$	$2.7x10^{-3}$
U-230 (fast lung absorption) [b] [d]	Uranium (92)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$
U-230 (medium lung absorption) [e]		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{4}$	$2.7x10^{-7}$
U-230 (slow lung absorption) [f]		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{4}$	$2.7x10^{-7}$
U-232 (fast lung absorption) [b] [d]		1.0	$2.7x10^{-11}$	$1.0x10^{3}$	$2.7x10^{-8}$
U-232 (medium lung absorption) [e]		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{4}$	$2.7x10^{-7}$
U-232 (slow lung absorption) [f]		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{4}$	$2.7x10^{-7}$
U-233 (fast lung absorption) [d]		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{4}$	$2.7x10^{-7}$
U-233 (medium lung absorption) [e]		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{5}$	$2.7x10^{-6}$
U-233 (slow lung absorption) [f]		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$

U-234 (fast lung absorption) [d]		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{4}$	$2.7x10^{-7}$
U-234 (medium lung absorption) [e]		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{5}$	$2.7x10^{-6}$
U-234 (slow lung absorption) [f]		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$
U-235 (all lung absorption types) [b d e f]		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{4}$	$2.7x10^{-7}$
U-236 (fast lung absorption) [d]		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{4}$	$2.7x10^{-7}$
U-236 (medium lung absorption) [e]		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{5}$	$2.7x10^{-6}$
U-236 (slow lung absorption) [f]		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{4}$	$2.7x10^{-7}$
U-238 (all lung absorption types) [b d e f]		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{4}$	$2.7x10^{-7}$
U (nat) [b]		1.0	$2.7x10^{-11}$	$1.0x10^{3}$	$2.7x10^{-8}$
U (enriched to 20% or less) [g]		1.0	$2.7x10^{-11}$	$1.0x10^{3}$	$2.7x10^{-8}$
U (dep)		1.0	$2.7x10^{-11}$	$1.0x10^{3}$	$2.7x10^{-8}$
V-48	Vanadium (23)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$
V-49		$1.0x10^{4}$	$2.7x10^{-7}$	$1.0x10^{7}$	$2.7x10^{-4}$
W-178	Tungsten (74)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
W-181		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{7}$	$2.7x10^{-4}$

W-185		$1.0x10^{4}$	$2.7x10^{-7}$	$1.0x10^{7}$	$2.7x10^{-4}$
W-187		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
W-188		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{5}$	$2.7x10^{-6}$
Xe-122	Xenon (54)	$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{9}$	$2.7x10^{-2}$
Xe-123		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{9}$	$2.7x10^{-2}$
Xe-127		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{5}$	$2.7x10^{-6}$
Xe-131m		$1.0x10^{4}$	$2.7x10^{-7}$	$1.0x10^{4}$	$2.7x10^{-7}$
Xe-133		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{4}$	$2.7x10^{-7}$
Xe-135		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{10}$	$2.7x10^{-1}$
Y-87	Yttrium (39)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Y-88		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Y-90		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{5}$	$2.7x10^{-6}$
Y-91		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{6}$	$2.7x10^{-5}$
Y-91m		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Y-92		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{5}$	$2.7x10^{-6}$
Y-93		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{5}$	$2.7x10^{-6}$
Yb-169	Ytterbium (70)	$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{7}$	$2.7x10^{-4}$
Yb-175		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{7}$	$2.7x10^{-4}$

Zn-65	Zinc (30)	$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Zn-69		$1.0x10^{4}$	$2.7x10^{-7}$	$1.0x10^{6}$	$2.7x10^{-5}$
Zn-69m		$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Zr-88	Zirconium (40)	$1.0x10^{2}$	$2.7x10^{-9}$	$1.0x10^{6}$	$2.7x10^{-5}$
Zr-93 [b]		$1.0x10^{3}$	$2.7x10^{-8}$	$1.0x10^{7}$	$2.7x10^{-4}$
Zr-95		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{6}$	$2.7x10^{-5}$
Zr-97 [b]		$1.0x10^{1}$	$2.7x10^{-10}$	$1.0x10^{5}$	$2.7x10^{-6}$

a. [Reserved]

Sr-90 Y-90

Zr-93 Nb-93m

Zr-97 Nb-97

Ru-106 Rh-106

Cs-137 Ba-137m

Ce-134 La-134

Ce-144 Pr-144

Ba-140 La-140

Bi-212 Tl-208 (0.36), Po-212 (0.64)

Pb-210 Bi-210, Po-210

Pb-212 Bi-212, Tl-208 (0.36), Po-212 (0.64)

Rn-220 Po-216

Rn-222 Po-218, Pb-214, Bi-214, Po-214

Ra-223 Rn-219, Po-215, Pb-211, Bi-211, Tl-207

Ra-224 Rn-220, Po-216, Pb-212, Bi-212, Tl-208(0.36), Po-212 (0.64)

Ra-226 Rn-222, Po-218, Pb-214, Bi-214, Po-214, Pb-210, Bi-210, Po-210

Ra-228 Ac-228

Th-226 Ra-222, Rn-218, Po-214

Th-228 Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212 (0.64)

Th-229 Ra-225, Ac-225, Fr-221, At-217, Bi-213, Po-213, Pb-20

Th-nat Ra-228, Ac-228, Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208 0.36), Po-212 (0.64)

Th-234 Pa-234m

U-230 Th-226, Ra-222, Rn-218, Po-214

U-232 Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212 (0.64)

U-235 Th-231

U-238 Th-234, Pa-234m

U-nat Th-234, Pa-234m, U-234, Th-230, Ra-226, Rn-222, Po-218, Pb-214, Bi-214, Po-214, Pb-210, Bi-210, Po-210

U-240 Np-240m

Np-237 Pa-233

Am-242m Am-242

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Am-243 Np-239

c. [Reserved]

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

d. These values apply only to compounds of uranium that take the chemical form of UF6, UO2F2 and UO2(NO3)2 in both normal and accident conditions of transport.

e. These values apply only to compounds of uranium that take the chemical form of UO3, UF4, UCl4 and hexavalent compounds in both normal and accident conditions of transport.

f. These values apply to all compounds of uranium other than those specified in notes (d) and (e) of this table.

g. These values apply to unirradiated uranium only.

TABLE A-3

GENERAL VALUES FOR A_1 AND A_2

Contents	A_1	A_2	Activity concentration for exempt material (Bq/g)		Activity concentration for exempt material (Ci/g)		Activity limits for exempt consignments (Bq)		Activity limits for exempt consignments (Ci)	
			(TBq)	(Ci)	(TBq)	(Ci)				
Only beta or gamma emitting radionuclides are known to be present	1×10^{-1}	2.7×10^{0}	2×10^{-2}	5.4×10^{-1}	1×10^{1}	2.7×10^{-10}	1×10^{4}	2.7×10^{-7}		
Only alpha emitting radionuclides are known to be present	2×10^{-1}	5.4×10^{0}	9×10^{-5}	2.4×10^{-3}	1×10^{-1}	2.7×10^{-12}	1×10^{3}	2.7×10^{-8}		
No relevant data are available	1×10^{-3}	2.7×10^{-2}	9×10^{-5}	2.4×10^{-3}	1×10^{-1}	2.7×10^{-12}	1×10^{3}	2.7×10^{-8}		

TABLE A-4

ACTIVITY-MASS RELATIONSHIPS FOR URANIUM

Uranium Enrichment * **weight -235 present**	**Specific Activity**

	TBq/g	Ci/g
0.45	$1.8x10^{-8}$	$5.0x10^{-7}$
0.72	$2.6x10^{-8}$	$7.1x10^{-7}$
1.0	$2.8x10^{-8}$	$7.6x10^{-7}$
1.5	$3.7x10^{-8}$	$1.0x10^{-6}$
5.0	$1.0x10^{-7}$	$2.7x10^{-6}$
10.0	$1.8x10^{-7}$	$4.8x10^{-6}$
20.0	$3.7x10^{-7}$	$1.0x10^{-5}$
35.0	$7.4x10^{-7}$	$2.0x10^{-5}$
50.0	$9.3x10^{-7}$	$2.5x10^{-5}$
90.0	$2.2x10^{-6}$	$5.8x10^{-5}$
93.0	$2.6x10^{-6}$	$7.0x10^{-5}$
95.0	$3.4x10^{-6}$	$9.1x10^{-5}$

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

Credits

Amended May 8, 2009; Feb. 29, 2012; June 20, 2012.

[FN1]

Agency jurisdiction extends only to special nuclear material in quantities not sufficient to form a critical mass@ as defined in Section 100 of these regulations.

[FN2]

For example, uranium or thorium decay series radionuclides

[FN3]

For example, consolidated wastes, or activated materials.

[FN4]
For example, concrete, bitumen, or ceramic.
[FN5]
The definition of nuclear waste in this section is used in the same way as in 49 CFR 173.403.
[FN6]
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 U.S. Department of Transportation or other agencies.
[FN7]
A list of the mailing addresses of the governors and governors' designees is available upon request from the Director, Office of State Programs, U.S. Nuclear Regulatory Commission Washington, DC 20555. The list will be published annually in the Federal Register on or about June 30 to reflect any changes in information.
[FN8]
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.

Current through the Mississippi Administrative Rules Listing of Filings, dated June 2016.

Miss. Admin. Code 15-21-78:1.13, MS ADC 15-21-78:1.13