

Readopt with amendment He-P 4037, effective 10/22/03 (Document #7980), cited and to read as follows:

CHAPTER He-P 4000 NEW HAMPSHIRE RULES FOR THE CONTROL OF RADIATION

Statutory Authority RSA 125-F:5,V

PART He-P 4037 TRANSPORTATION OF RADIOACTIVE MATERIAL

He-P 4037.01 Purpose. The purpose of this rule is to set forth the requirements for packaging, preparation for shipment, and transportation of radioactive material. The requirements of this section are in addition to, and not in substitution for, the requirements of He-P 4003, 4019, 4020, 4021, 4022, 4023, 4024, and 4030 of this chapter.

He-P 4037.02 Scope. This part shall apply to any person who transports radioactive material or delivers radioactive material to a carrier for transport, including common and contract carriers not subject to the requirements of the U.S. Department of Transportation or U.S. Postal Service, as specified in Title 10, Code of Federal Regulations (CFR), Part 71, "Relating to Packaging and Transportation of Radioactive Material."

He-P 4037.03 Definitions. To reconcile differences between this part and the incorporated sections of 10 CFR Part 71 relating to packaging, preparation for shipment, and transportation of radioactive material, the following words and phrases shall be substituted for the language in 10 CFR Part 71 as follows:

(a) All references to "NRC" or "Commission" shall mean the New Hampshire department of health and human services;

(b) All references to "NRC or Agreement State" shall mean the New Hampshire department of health and human services, NRC, Agreement State or Licensing State;

(c) The definition of "licensed material" shall be as defined in He-P 4003 of this chapter; and

(d) The definition of "sealed source" shall be as defined in Part He-P 4003 of this chapter.

He-P 4037.04 Incorporation of 10 CFR Part 71.

(a) Except for the sections noted in (b) below, all persons who transport radioactive material or deliver radioactive material to a carrier for transport, including common and contract carriers not subject to the requirements of the U.S. Department of Transportation or U.S. Postal Service, shall comply with Title 10, Code of Federal Regulations (CFR), Part 71, "Relating to Packaging and Transportation of Radioactive Material."

(b) The following sections of the Title 10 CRF Part 71 shall not apply to all persons who transport radioactive material or deliver radioactive material to a carrier for transport, including common and contract carriers not subject to the requirements of the U.S. Department of Transportation or U.S. Postal Service:

(1) Title 10 CFR Part 71.2, relating to interpretations;

(2) Title 10 CFR Part 71.6, relating to information collection;

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- (3) Title 10 CFR Part 71.13, relating to exemption of physician;
- (4) Title 10 CFR Part 71.14, relating to low level material exemptions;
- (5) Title 10 CFR Part 71.19, relating to previously approved packages;
- (6) Title 10 CFR Part 71.22, relating to general license, fissile material;
- (7) Title 10 CFR Part 71 Subpart D, relating to application for package approval;
- (8) Title 10 CFR Part 71 Subpart E, relating to package approval standards;
- (9) Title 10 CFR Part 71 Subpart F, relating to package, special form, and LSA-III tests;
- (10) Title 10 CFR Part 71.99, relating to violations; and
- (11) Title 10 CFR Part 71.103, relating to criminal penalties.

~~PART He P 4037 TRANSPORTATION OF RADIOACTIVE MATERIAL~~

~~He P 4037.01 Purpose. The rules in this part establish requirements for packaging, preparation for shipment, and transportation of radioactive material.~~

~~He P 4037.02 Scope.~~

~~(a) Except as provided below, the rules in this part shall apply to any person who transports radioactive material or delivers radioactive material to a carrier for transport, including common and contract carriers not subject to the requirements of the U.S. Department of Transportation or U.S. Postal Service.~~

~~(b) Common and contract carriers, freight forwarders, and warehousemen subject to the requirements of the U.S. Department of Transportation in 49 CFR 170 through 189, the U.S. Postal Service in the Postal Service Manual "Domestic Mail Manual", Section C-023.9.0, and the U.S. Postal Service, shall be exempt from the requirements of this part to the extent that they transport or store radioactive material in the regular course of their carriage for others or storage incident thereto.~~

~~(c) Any licensee shall be exempt from the requirements of this part to the extent that the licensee delivers to a carrier for transport a package containing radioactive material having a specific activity not greater than 0.002 microcuries per gram ($\mu\text{Ci}/\text{g}$) or 74 becquerels per gram (Bq/g).~~

~~(d) A licensee shall be exempt from all requirements of this part, with the exception of He P 4037.05 and He P 4037.11, with respect to shipment or carriage of the following:~~

~~(1) A package containing no more than a Type A quantity of radioactive material if the package contains no fissile material; or~~

~~(2) Packages transported between locations within the United States which contain only americium or plutonium in special form with an aggregate radioactivity not to exceed 20 curies (Ci) or 740 gigabecquerels (GBq).~~

~~He P 4037.03 Definitions.~~

~~(a) "Alpha Emitters" means the radioactive atoms that decay by the emission of alpha particles.~~

~~(b) "Beta emitters" means radioactive atoms that decay by the emission of beta particles."~~

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

~~(d) "Exclusive use" means the sole use or full load of a conveyance by a single consignor and for which all initial, intermediate, and final loading and unloading are carried out in accordance with the direction of the consignor or consignee.~~

~~(e) "Fissile material" means any special nuclear material whose quantity is capable of undergoing fission by interaction with slow neutrons consisting of or containing one or more fissile radionuclides such as plutonium 238, plutonium 239, plutonium 241, uranium 233, and uranium 235 but neither natural nor depleted uranium.~~

~~(f) "Fissile class II" means fissile material contained in a package which can be transported together with other packages in any arrangement but, for criticality control, in numbers which individual packages have a transport index of not less than 0.1 and not more than 10 and the aggregate transport index does not exceed 50.~~

~~(g) "Gamma emitters" means radioactive atoms that decay by the emission of electromagnetic energy.~~

~~(h) "General license" means "general license" as defined in RSA 125-F:3, IX(a), namely "a license pursuant to rules adopted by the program without the filing of an application with the program, or the issuance of licensing documents to particular persons to transfer, acquire, own, possess or use quantities of, or devices or equipment utilizing radioactive material."~~

~~(i) "Normal form radioactive material" means radioactive material that has not been demonstrated to qualify as special form radioactive material as defined by (k) below.~~

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

~~(k) "Packaging" means the assembly of one or more receptacles, absorbent materials, spacing structures, thermal insulation, radiation shielding, and devices for cooling or absorbing mechanical shocks, the tie-down system, and any auxiliary equipment necessary to ensure compliance with the packaging requirements of this part.~~

~~(l) "Regulations of the U.S. Department of Transportation" means the regulations in 49 CFR 100-189.~~

~~(m) "Special form radioactive material" means radioactive material that:~~

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

~~(2) Has at least one dimension not less than 5 millimeters (0.2 inches); and~~

~~(3) Falls within the test requirements specified by the Nuclear Regulatory Commission (NRC) in 10 CFR 71.75, "Qualification of Special Form Radioactive Material".~~

~~(n) "Specific activity" means the radioactivity of a radionuclide per unit mass.~~

~~(o) "Specific license" means "special license" as defined in RSA 125-F:3, IX(b), namely "a license issued to a named person upon application filed pursuant to the rules adopted under this chapter, to use, manufacture, produce, transfer receive, acquire, own or possess quantities of, or devices or equipment utilizing, radioactive material."~~

~~(p) "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 one meter (3.3 feet) from the external surface of the package in millisievert (mSv) per hour multiplied by 100, which the equivalent to the maximum radiation level in millirem per hour at one meter.~~

~~(q) "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 He P 4037.21 and He P 4037.22 or as determined by procedures described in He P 4037.21 and He P 4037.22.~~

~~(r) "Type B package" means a Type B packaging together with its radioactive contents.~~

~~(s) "Type B packaging" means a packaging designed to retain the integrity of containment and shielding when subjected to the normal conditions of transport as stated in 10 CFR 71.71 and hypothetical accident test conditions set forth in 10 CFR 71.73.~~

~~He P 4037.04 License Required. No person shall transport radioactive material or deliver radioactive material to a carrier for transport except as authorized in a general license, as described in He P 4031, or a specific license, as described in He P 4030.06(e), issued by the New Hampshire department of health and human services, bureau of radiological health (DHHS/BRH) in accordance with He P 4030 or as exempted in He P 4037.02 below.~~

~~He P 4037.05 Transportation of Radioactive Material.~~

~~(a) Each licensee who transports licensed material outside the site of usage, as specified in the their license, or where transport is on public highways, or who delivers licensed material to a carrier for transport, shall:~~

~~(1) Comply with the applicable requirements, appropriate to the mode of transport, of the regulations of the U.S. Department of Transportation as follows:~~

- ~~a. Packaging in accordance with 49 CFR 173, A, B and I;~~
- ~~b. Marking and labeling in accordance with 49 CFR 172, D, §§ 172.400 through 172.407, §§ 172.436 through 172.440, and E;~~
- ~~c. Placarding in accordance with 49 CFR 172, F, and Appendices B and C;~~
- ~~d. Accident reporting in accordance with 49 CFR 171, §§ 171.15 and 171.16;~~
- ~~e. Shipping papers and emergency information in accordance with 49 CFR 172, C and G;~~
- ~~f. Hazardous material employee training in accordance with 49 CFR 172, H; and~~
- ~~g. Hazardous material shipper/carrier registration in accordance with 49 CFR 107, G;~~

~~(2) Comply with applicable U.S. Department of Transportation regulations pertaining to the following modes of transportation:~~

- ~~a. Rail in accordance with 49 CFR 174, A through D and K;~~
- ~~b. Air in accordance with 49 CFR 175;~~
- ~~c. Vessels in accordance with 49 CFR 176, A through F and M; and~~
- ~~d. Public Highways in accordance with 49 CFR 177 and 390 through 397;~~

~~(3) Provide or otherwise make available to the consignee any special instructions needed to safely open the package; and~~

~~(4) File notification of any incident with the DHHS/BRH in accordance with He P 4037.18.~~

~~(b) 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 170 through 189 appropriate to the mode of transport to the same extent as if the shipment were subject to the regulations.~~

~~He P 4037.06 General Licenses for Carriers.~~

~~(a) The DHHS/BRH shall deem a general license as having been granted to any common or contract carrier not exempt under He-P 4037.02 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 requirements of He-P 4037.05, to the extent that such requirements relate to the loading and storage of packages, placarding of the transporting vehicle, and incident reporting.~~

~~(b) The DHHS/BRH shall deem a general license as having been granted to any private carrier to transport radioactive material, provided the transportation is in accordance with the requirements of He-P 4037.05, to the extent that such requirements relate to the loading and storage of packages, placarding of the transporting vehicle, and incident reporting.~~

~~(c) Persons who transport radioactive material pursuant to the general licenses in (a) and (b) above shall be exempt from the requirements of He-P 4019, He-P 4020, He-P 4021 and He-P 4022 to the extent that they transport radioactive material.~~

~~He-P 4037.07 General License: NRC Approved Package:~~

~~(a) A general license shall be deemed as having been issued to any licensee of the NRC to transport, or to deliver to a carrier for transport, licensed material in a package for which a license, certificate of compliance, or letter of approval has been issued by the NRC.~~

~~(b) The general license under (a) above shall apply only to a licensee who:~~

- ~~(1) Has a copy of the specific license, certificate of compliance, or other approval of the package, letter of approval issued by the NRC, for the package and has the drawings and other documents referenced in the application for approval relating to the use and maintenance of the packaging and to the actions to be taken prior to shipment;~~
- ~~(2) Complies with the terms and conditions of the license, certificate, or other approval, as applicable, and the applicable requirements of 10 CFR 71, A, G, and H;~~
- ~~(3) Submits in writing to the Director, Spent Fuel Project Office, NRC, Washington, DC 20555-0001, before the licensee's first use of the package, the licensee's name and license number and the package identification number specified in the package approval; and~~
- ~~(4) Has a quality assurance program approved by the NRC as satisfying the provisions of 10 CFR 71, H.~~

~~(c) The general license in (a) above shall apply only when the package approval authorizes use of the package under the general license.~~

~~(d) For a type B or fissile material package, the design of which was approved by the NRC before April 1, 1996, this general license shall be subject to additional restrictions of 10 CFR 71.13 and as set forth in He-P 4037.08 below.~~

~~He-P 4037.08 Previously Approved Packages:~~

~~(a) A Type B package previously approved by the NRC, but not designated as B(U) or B(M) for in the identification number of the NRC certificate of compliance, may be used under the general license of 10 CFR 71.12 or He-P 4037.07 with the following additional conditions:~~

- ~~(1) Fabrication of the packaging shall have been satisfactorily completed before August 31, 1986, as demonstrated by application of its model number in accordance with 10 CFR 71.85(e);~~

~~(2) The 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;~~

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

~~(b) A Type B(U) package, a Type B(M) package, a low specific activity material package or a fissile material package, previously approved by the NRC but without the designation "85" in the identification number of the NRC certificate of compliance, may be used under the general license of 10 CFR 71.12 with the following additional conditions:~~

~~(1) Fabrication of the package is satisfactorily completed by April 1, 1999, as demonstrated by application of its model number in accordance with 10 CFR 71.85(e);~~

~~(2) A package used for a shipment to a location outside the United States shall be subject to multilateral approval as defined in US Department of Transportation regulations at 49 CFR 173.403; and~~

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

~~He P 4037.09 General License: DOT Specification Container.~~

~~(a) A general license shall be deemed as having been issued to any licensee of the NRC to transport, or to deliver to a carrier for transport, licensed material in a specification container for fissile material or for a Type B quantity of radioactive material as specified in 49 CFR Parts 173 and 178.~~

~~(b) The general license shall apply only to a licensee who:~~

~~(1) Has a copy of the specification;~~

~~(2) Complies with the terms and conditions of the specification and the applicable requirements of 10 CFR 71, A, G and H; and~~

~~(3) Has a quality assurance program approved by the NRC as satisfying the provisions of 10 CFR 71, H.~~

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

~~He P 4037.10 General License: Use of Foreign Approved Package.~~

~~(a) A general license shall be deemed as having been issued to any licensee of the NRC 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.~~

~~(b) The general license under (a) above shall apply to shipments made to or from locations outside the United States.~~

~~(c) A general license shall apply only to a licensee who:~~

~~(1) Has a copy of the applicable certificate, the revalidation, and the drawings and other documents referenced in the certificate relating to the use and maintenance of the packaging and to the actions to be taken before to shipment;~~

~~(2) Complies with the terms and conditions of the certificate and revalidation and with the applicable requirements of this part; and~~

~~(3) With respect to the quality assurance provisions of 10 CFR 71, H or this part, the licensee is exempt from design, construction, and fabrication considerations.~~

~~He P 4037.11 General License: Fissile Material, Limited Quantity Per Package.~~

~~(a) A general license shall be deemed as having been issued to any licensee of the NRC to transport fissile material, or to deliver fissile material to a carrier for transport, without complying with the package standards of 10 CFR 71, E and F and this part, if the material is shipped in accordance with this section.~~

~~(b) The general license to transport fissile material shall apply only to a licensee who has a quality assurance program approved by the NRC as required by 10 CFR 71, H and He P 4037.20.~~

~~(c) Except as provided in (d) below, the general license under (a) above shall apply only when a package contains no more than a Type A quantity of radioactive material, including only one of the following:~~

~~(1) Up to 40 grams of uranium-235;~~

~~(2) Up to 30 grams of uranium-233;~~

~~(3) Up to 25 grams of the fissile radionuclides of plutonium, except that for encapsulated plutonium-beryllium neutron sources in special form, an A₁ quantity of plutonium shall be present; or~~

~~(4) A combination of fissile radionuclides in which the sum of the ratios of the amount of each radionuclide to the corresponding maximum amounts in (1), (2), and (3) above and does not exceed unity.~~

~~(d) For packages where fissile material is mixed with substances having an average hydrogen density greater than water, the general license under (a) above shall apply only when a package contains no more than a Type A quantity of radioactive material, including only one of the following:~~

~~(1) Up to 29g of uranium-235;~~

~~(2) Up to 18g of uranium-233;~~

~~(3) Up to 18g of fissile radionuclides of plutonium; or~~

~~(4) A combination of fissile radionuclides in which the sum of the ratios of the amount of each radionuclide to the corresponding maximum amounts in (1) (2) and (3) above does not exceed unity.~~

~~(e) Except for the beryllium contained within the special form plutonium-beryllium sources authorized in (c) above, this general license shall apply only when beryllium, graphite or hydrogenous material enriched in deuterium is not present in quantities exceeding 0.1% of the fissile material mass.~~

~~(f) Except as specified in (g) below for encapsulated plutonium-beryllium sources, the general license under (a) above shall apply only when, a package is labeled with a transport index not less than the number given by the following equation where the package contains x grams of uranium-235, y grams of uranium-233, and z grams of fissile radionuclides of plutonium:~~

$$\text{Minimum Transport Index} = (0.25x + 0.22y + 0.4z).$$

~~(g) For package in which the only fissile material is in the form of encapsulated plutonium-beryllium neutron sources in special form, the transport index based on criticality considerations may be taken as 0.025 times the number of grams of fissile radionuclides of plutonium.~~

~~(h) Packages that have a transport index greater than 10 shall not be authorized under the general license conditions of this section.~~

~~He-P 4037.12 General License: Fissile Material, Limited Moderator Per Package.~~

~~(a) A general license shall be deemed as having been issued to any licensee to transport fissile material, or to deliver fissile material to a carrier for transport without complying with the package standards of this part if the material is shipped in accordance with this section.~~

~~(b) The general license under (a) above shall apply only when:~~

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

~~(2) Neither beryllium nor hydrogenous material enriched in deuterium shall be present;~~

~~(3) The total mass of graphite present shall not exceed 7.7 times the total mass of uranium-235 plus plutonium;~~

~~(4) Substances having a higher hydrogen density than water (e.g., certain hydrocarbon oils) are not present, except that polyethylene may be used for packing or wrapping;~~

~~(5) Uranium-233 shall not be present, and the amount of plutonium does not exceed 1 percent of the amount of uranium-235;~~

~~(6) The amount of uranium-235 shall be limited as follows:~~

~~a. If the fissile radionuclides are not uniformly distributed, the maximum amount of uranium-235 per package may not exceed the value given in Table 4037.1, Maximum Amounts of Uranium-235 For Non-Uniform Distribution of Radionuclides, below; or~~

~~b. If the fissile radionuclides are distributed uniformly, for example, cannot form a lattice arrangement within the packaging, the maximum amount of uranium-235 in the package may not exceed the value given in Table 4037.2, Maximum Amounts of Uranium-235 For Uniform Distribution of Radionuclides, below; and~~

~~(7) The transport index of each package based on criticality considerations shall be 10 times the number of grams of uranium-235 in the package, divided by the maximum allowable number of grams per package in accordance with Table 4037.1, Maximum Amounts of Uranium-235 For Non-Uniform Distribution of Radionuclides, or 4037.2, Maximum Amounts of Uranium-235 For Uniform Distribution of Radionuclides, below, as applicable.~~

Table 4037.1 Maximum Amounts of Uranium-235 For Non-Uniform Distribution of Radionuclides

Uranium enrichment in weight percent of uranium-235 not exceeding	Permissible maximum grams of uranium-235 per package
24	40
20	42
15	45
11	48
10	51
9.5	52
9	54
8.5	55
8	57
7.5	59
7	60
6.5	62
6	65
5.5	68
5	72
4.5	76
4	80
3.5	88
3	100
2.5	120
2	164
1.5	272
1.35	320

Table 4037.2 Maximum Amounts of Uranium-235 For Uniform Distribution of Radionuclides

Uranium enrichment in weight percent of uranium-235 not exceeding	Permissible maximum gram of uranium-235 per package-s
4	84
3.5	92
3	112
2.5	148
2	240

He P 4037.13 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 pack the fissile material as if the unknown properties had values that would cause the maximum nuclear reactivity.

He P 4037.14 Preliminary Determinations. Prior to the first use of any packaging for the shipment of radioactive material the licensee shall:

~~(a) Ascertain that there are no defects which could reduce the effectiveness of the packaging;~~

~~(b) Where the maximum normal operating pressure will exceed 34.3 kilopascal (5 pounds per square inch) gauge, 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;~~

~~(c) Determine that the packaging has been approved by the NRC in accordance with 10 CFR 71.85(e); and~~

~~(d) Conspicuously and durably mark the packaging with its model number, gross weight, and a package identification number assigned by the NRC under 10 CFR 71.85(e).~~

~~He P 4037.15 Routine Determinations:~~

~~(a) Prior to each shipment of licensed material, the licensee shall ensure that the package satisfies the applicable requirements of this part and of the license.~~

~~(b) The licensee shall determine that:~~

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

~~(2) The packaging 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 the manufacturer's written procedures;~~

~~(6) The packaging has been loaded and closed;~~

~~(7) Any structural part of the packaging 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;~~

~~(8) The level of removable radioactive contamination on the external surfaces of each package offered for shipment is as low as reasonably achievable by either:~~

~~a. Wiping an area of 300 square centimeters on the surfaces most appropriate to yield a representative assessment of the removable contamination levels using an absorbent material, and moderate pressure and measuring the activity on the wiping material; or~~

~~b. Using any other method of assessment of equal or greater efficiency to the one described above;~~

~~(9) When using the method described in (8)a. above, the amount of radioactivity measured on any single wiping material, when averaged over the surface wiped, does not exceed the limits given in Table 4037.3, Removable External Radioactive Contamination Wipe Limits, at any time during transport;~~

~~(10) When using other methods as allowed by (8)b. above:~~

- a. ~~The detection efficiency of the method used has been taken into account; and~~
- b. ~~The removable contamination on the external surfaces of the package does not exceed 10 times the limits listed in Table 4037.3, Removable External Radioactive Contamination Wipe Limits, below:~~

Table 4037.3

REMOVABLE EXTERNAL RADIOACTIVE CONTAMINATION WIPE LIMITS

<u>Contaminant</u>	<u>Maximum Permissible Limits</u>		
	<u>Bq/cm²</u>	<u>µCi/cm²</u>	<u>dpm/cm²</u>
Beta & gamma emitters and low toxicity alpha emitters	0.4	10 ⁻⁵	22
All other alpha emitting radionuclides	0.04	10 ⁻⁶	2.2

(11) ~~In the case of packages transported as exclusive use shipments by rail or highway only, the removable radioactive contamination at any time at the beginning of or during transport shall not exceed 10 times the levels prescribed in (9) above;~~

(12) ~~External radiation levels around the package and around the vehicle do not exceed 200 millirems per hour (2 millisieverts per hour, mSv/h) at any point on the external surface of the package at any time during transportation, and the transport index does not exceed 10;~~

(13) ~~Radiation levels external to a package transported in exclusive use by rail, highway or water, shall not exceed any of the following:~~

- a. ~~Except as allowed by b. below, the accessible external surface of the package shall not exceed 2 mSv/h (200 millirem per hour);~~
- b. ~~When the following conditions are met, the limit for accessible external surface of the package shall be 10 mSv/h (1000 millirems per hour):~~
 - 1. ~~The shipment is made in a closed transport vehicle that is equipped with a securely attached exterior enclosure, that restricts unauthorized persons from accessing the cargo space containing the radioactive material;~~
 - 2. ~~Provisions are made to secure the package so that its position within the vehicle remains fixed during transportation; and~~
 - 3. ~~There is no loading or unloading operations between the beginning and end of the transportation;~~
- e. ~~The outer surface of the vehicle shall not exceed 2 mSv/h (200 millirem per hour) at any point including the upper and lower surfaces, or, in the case of a flat bed style vehicle, at any point on the vertical planes projected from the outer edges of the vehicle, on the upper surface of the load, or enclosure, if used, and on the lower external surface of the vehicle;~~
- d. ~~The exposure levels shall not exceed 0.1 mSv/h (10 millirems per hour) 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~~

~~e. Exposure level shall not exceed 0.02 mSv/h (2 millirems per hour) in any normally occupied positions of the vehicle, except when it is a private motor carrier and the persons occupying these positions are:~~

- ~~1. Equipped with personnel radiation exposure monitoring devices;~~
- ~~2. Have training in accordance with He P 4019.04; and~~
- ~~3. Have other health physics controls in place, where applicable, that can be used to control exposure and in minimize worker dose;~~

~~(14) A package shall be prepared for transport so that:~~

~~a. 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; and~~

~~b. Accessible package surface temperatures shall not exceed the limits in a above at any time during transportation; and~~

~~(15) A package shall not incorporate a feature intended to allow continuous venting during transport.~~

~~He P 4037.16 Air Transport of Plutonium. Notwithstanding the provisions of any general licenses and notwithstanding any exemptions stated directly in this part or included indirectly by citation of the U.S. Department of Transportation regulations, the licensee shall not transport plutonium in any form by air, or deliver to a carrier for air transport, unless:~~

- ~~— (a) The plutonium is contained in a medical device designed for individual human application;~~
- ~~— (b) The plutonium is contained in a material in which the specific activity is not greater than 0.002 microcuries per gram ($\mu\text{Ci/g}$), or 74 becquerel per gram (Bq/g) of material and in which the radioactivity is essentially uniformly distributed;~~
- ~~— (c) 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 He P 4037.05;~~
- ~~— (d) The plutonium is shipped in packaging specifically authorized, in the certificate of compliance, issued by the NRC, for the shipment of plutonium by air; and~~
- ~~— (e) The licensee requires, through special arrangement with the carrier, compliance with 49 CFR 175.704, the US Department of Transportation regulations applicable to the air transport of plutonium.~~

~~He P 4037.17 Shipment Records.~~

~~(a) Each licensee shall maintain for a period of 4 years after shipment a record of each shipment of licensed material not exempt under He P 4037.02.~~

~~(b) Shipment records required pursuant to (a) above shall contain:~~

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

- ~~(2) Verification that there were no significant defects in the packaging, as shipped;~~
- ~~(3) Volume and identification of coolant;~~
- ~~(4) Type and quantity of licensed material in each package, and the total quantity of each shipment;~~
- ~~(5) 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 He-P 4037.15(b) 8.~~

~~He-P 4037.18 Reports:~~

- ~~(a) The licensee shall report to the DHHS/BRH within 30 days any instance in which there is any reduction in the effectiveness of any packaging during use.~~
- ~~(b) The report shall contain 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 stated.~~
- ~~(c) The licensee shall report any incident in which the conditions of approval in the certificate of compliance were not observed in making a shipment.~~

~~He-P 4037.19 Advance Notification of Transport of Nuclear Waste:~~

~~(a) As specified in paragraphs (b) (d) below, each licensee, transporting nuclear waste originating in New Hampshire, shall provide advance notification to the governor of a state, or the governor's designee, of the shipment of licensed material, through, or across the boundary of the state, before the transport, or delivery to a carrier, for transport, of licensed material outside the confines of the licensee's plant or other place of use or storage.~~

~~(b) Advance notification is required for shipments of:~~

- ~~(1) Irradiated reactor fuel in quantities less than that subject to advance notification requirements of 10 CFR 73.37(f); and~~
- ~~(2) Licensed material, other than irradiated fuel, meeting the following 3 conditions:~~
 - ~~a. The licensed material is required by He-P 4037 to be in Type B packaging for transportation;~~
 - ~~b. The licensed material is being transported to or across a state boundary en route to a disposal facility or to a collection point for transport to a disposal facility; and~~
 - ~~c. The quantity of licensed material in a single package exceeds the least of the following:~~
 - ~~1. 3000 times the A₁ value of the radionuclides as specified in Table 4037.22 "A₁ and A₂ Values for Radionuclides" for special form radioactive material;~~
 - ~~2. 3000 times the A₂ value of the radionuclides as specified in Table 4037.22 "A₁ and A₂ Values for Radionuclides" for normal form radioactive material; or~~

~~3. 1000 TBq (27,000 Ci):~~

~~(c) Procedures for submitting advance notification shall be as follows:~~

- ~~(1) The notification shall be made in writing to the office of each appropriate governor or governor's designee and to the DHHS/BRH;~~
- ~~(2) A notification delivered by mail shall be postmarked at least 7 days before the beginning of the 7-day period during which departure of the shipment is estimated to occur; and~~
- ~~(3) A notification delivered by messenger shall reach the office of the governor or of the governor's designee at least 4 days before the beginning of the 7-day period during which departure of the shipment is estimated to occur.~~

~~(d) Each advance notification of shipment of irradiated reactor fuel or nuclear waste shall contain the following information:~~

- ~~(1) The name, address, and telephone number of the shipper, carrier, and receiver of the irradiated reactor fuel or nuclear waste shipment;~~
- ~~(2) A description of the irradiated reactor fuel or nuclear waste contained in the shipment, as specified in the regulations of DOT in 49 CFR 172.202 and 172.203(d);~~
- ~~(3) The point of origin of the shipment and the 7-day period during which departure of the shipment is estimated to occur;~~
- ~~(4) The 7-day period during which arrival of the shipment at state boundaries is estimated to occur;~~
- ~~(5) The destination of the shipment, and the 7-day period during which arrival of the shipment is estimated to occur; and~~
- ~~(6) A point of contact, with a telephone number, for current shipment information.~~

~~(e) A licensee who finds that schedule information previously furnished to a governor or governor's designee, in accordance with this section, will not be met, shall telephone the office of the governor of the state or the governor's designee and inform that individual of the extent of the delay beyond the schedule originally reported.~~

~~(f) Each licensee who cancels an irradiated reactor fuel or nuclear waste shipment for which advance notification has been sent shall send a cancellation notice to the governor of each state or to the governor's designee previously notified, and to the DHHS/BRH.~~

~~(g) The licensee shall state in the notice required by (f) above that it is a cancellation and identify the advance notification that is being canceled.~~

~~(h) The licensee shall retain a copy of the notice required by (b)(e) and (f) above as a record for 3 years.~~

~~He-P 4037.20 Quality Assurance Requirements:~~

~~(a) Each licensee shall establish, maintain, and execute a quality assurance program to verify by procedures such as checking, auditing, and inspection that deficiencies, deviations, and defective material and equipment relating to the shipment of packages containing radioactive material shall be promptly identified and corrected.~~

~~(b) Before the use of any packaging for the shipment of licensed material subject to these rules, the licensee shall have a program that complies with the applicable requirements of 10 CFR 71.101 through 71.137.~~

~~(c) The licensee shall identify the material and components to be covered by the quality assurance program.~~

~~(d) Each licensee shall document the quality assurance program by written procedures or instructions and shall carry out the program in accordance with those procedures throughout the period during which packaging is used.~~

~~(e) The licensee shall maintain written records to demonstrate compliance with the quality assurance program.~~

~~(f) Records of quality assurance pertaining to the use of a package for shipment of radioactive material shall be maintained for a period of 3 years after shipment.~~

~~He P 4037.21 Determination of A_1 and A_2 values:~~

~~(a) Values of A_1 and A_2 for individual radionuclides shall be as stated in Table 4037.4, A_1 and A_2 Values For Radionuclides.~~

~~(b) For nuclear criticality safety, some materials, as indicated in Table 4037.4, A_1 and A_2 Values for Radionuclides, shall be subject to controls placed on fissile material:~~

~~(c) For individual radionuclides whose identities are known, but which are not listed in Table 4037.4, A_1 and A_2 Values For Radionuclides, the determination of the values of A_1 and A_2 from Table 4037.5, General Values for A_1 and A_2 , shall be used.~~

~~(d) In the calculations of A_1 and A_2 for a radionuclide not in Table 4037.4, A_1 and A_2 Values For Radionuclides, the following shall apply:~~

~~(1) The A_1 or A_2 value to be applied shall be those corresponding to the parent nuclide; and:~~

~~(2) The single radioactive decay chain shall be considered as a single radionuclide, if:~~

~~a. The radionuclides within the chain are present in their naturally occurring proportions; and~~

~~b. No daughter nuclide has a half life that is either:~~

~~1. Longer than 10 days; or~~

~~2. Longer than that of the parent nuclide.~~

~~(e) 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.~~

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

~~(1) The symbols found in the formulas in (2) (5) below shall be defined as follows:~~

~~a. " Σ_r " means the summation of all radionuclide activities divided by the activity limits;~~

- b. " $A_1(i)$ " means the appropriate A_1 value of the radionuclide I ;
- c. " $A_2(i)$ " means the appropriate A_2 values for the radionuclide I ;
- d. " $B(i)$ " means the activity of radionuclide I ; and
- e. " $f(i)$ " means the fraction of activity of nuclide I in the mixture;

(2) The maximum quantity for transport in Type A packages of special form radioactive material is calculated by dividing $B(i)$ by $A_1(i)$ for each of the radionuclides in the material and then adding the results of each of these calculations to obtain the total quantity for the material as described in the formula below:

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

(3) The maximum quantity for transport in Type A packages of normal form radioactive material is calculated by dividing $B(i)$ by $A_2(i)$ for each of the radionuclides in the material and then adding the results of each of these calculations to obtain the total quantity for the material as described in the formula below:

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

(4) Alternatively, an A_1 value for mixtures of special form material shall be determined by dividing $f(i)$ by $A_1(i)$ for each of the radionuclides in the material and then adding the results of each of these calculations combined to obtain the total together to obtain the sum for the material and then dividing one into this number as described in the formula below:

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

(5) An A_2 value for mixtures of normal form material may be determined by dividing $f(i)$ by $A_2(i)$ for each of the radionuclides in the material and then adding the results of each of these calculations to obtain the total together to obtain the sum for the material and then dividing one into this number as described in the formula below:

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

(g) 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.

(h) Groups may be based on the total alpha activity, those atoms that decay through the discharge of positively charged particles from the nucleus of an atom, and the total beta/gamma activity, those radioactive atoms that decay through the discharge of negatively charged particles and electromagnetic radiation, when these are known, using the lowest A_1 or A_2 values for the alpha emitters and beta/gamma emitters.

He-P 4037.22 A_1 and A_2 Values for Radionuclides.

(a) A_1 and A_2 values for radionuclides shall be as stated in Table 4037.4, A_1 and A_2 Values For Radionuclides, below:

Table 4037.4 A_1 and A_2 Values For Radionuclides

Symbol of Radionuclide	Element of Atomic No.	A_1 (TBq)	A_1 (Ci)	A_2 (TBq)	A_2 (Ci)	Specific Activity	
						(TBq/g)	(Ci/g)
Ac-225	Actinium(89)	0.6	16.2	1×10^{-3}	0.270	2.1×10^4	5.8×10^4
Ac-227		40	1080	2×10^{-5}	5.41×10^{-4}	2.7	7.2×10^4
Ac-228		0.6	16.2	0.4	10.8	8.4×10^4	2.2×10^6
Ag-105	Silver(47)	2	54.1	2	54.1	1.1×10^3	3.0×10^4
Ag-108m		0.6	16.2	0.6	16.2	9.7×10^4	2.6×10^4
Ag-110m		0.4	10.8	0.4	10.8	1.8×10^3	4.7×10^3
Ag-111		0.6	16.2	0.5	13.5	5.8×10^3	1.6×10^5
Al-26	Aluminum(13)	0.4	10.8	0.4	10.8	7.0×10^4	1.9×10^2
Am-241	Americium(95)	2	54.1	2×10^{-4}	5.41×10^{-3}	1.3×10^4	3.4
Am-242m		2	54.1	2×10^{-4}	5.41×10^{-3}	3.6×10^4	1.0×10^4
Am-243		2	54.1	2×10^{-4}	5.41×10^{-3}	7.4×10^3	2.0×10^4
Ar-37	Argon(18)	40	1080	40	1080	3.7×10^3	9.9×10^4
Ar-39		20	541	20	541	1.3	3.4×10^4
Ar-41		0.6	16.2	0.6	16.2	1.5×10^6	4.2×10^7
Ar-42		0.2	5.41	0.2	5.41	9.6	2.6×10^3
As-72	Arsenic(33)	0.2	5.41	0.2	5.41	6.2×10^4	1.7×10^6
As-73		40	1080	40	1080	8.2×10^3	2.2×10^4
As-74		1	27.0	0.5	13.5	3.7×10^3	9.9×10^4
As-76		0.2	5.41	0.2	5.41	5.8×10^4	1.6×10^6
As-77		20	541	0.5	13.5	3.9×10^4	1.0×10^6
At-211	Astatine(85)	30	811	2	54.1	7.6×10^4	2.1×10^6
Au-193	Gold(79)	6	162	6	162	3.4×10^4	9.2×10^5
Au-194		1	27.0	1	27.0	1.5×10^4	4.1×10^5
Au-195		10	270	10	270	1.4×10^3	3.7×10^3
Au-196		2	54.1	2	54.1	4.0×10^3	1.1×10^5
Au-198		3	81.1	0.5	13.5	9.0×10^3	2.4×10^5
Au-199		10	270	0.9	24.3	7.7×10^3	2.1×10^5
Ba-131	Barium(56)	2	54.1	2	54.1	3.1×10^3	8.4×10^4

Ba-133m		10	270	0.9	24.3	2.2×10^4	6.1×10^5
Ba-133		3	81.1	3	81.1	9.4	2.6×10^3
Ba-140		0.4	10.8	0.4	10.8	2.7×10^3	7.3×10^4
Be-7	Beryllium(4)	20	541	20	541	1.3×10^4	3.5×10^5
Be-10		20	541	0.5	13.5	8.3×10^4	2.2×10^2
Bi-205	Bismuth(83)	0.6	16.2	0.6	16.2	1.5×10^3	4.2×10^4
Bi-206		0.3	8.11	0.3	8.11	3.8×10^3	1.0×10^5
Bi-207		0.7	18.9	0.7	18.9	1.9	5.2×10^1
Bi-210m		0.3	8.11	3×10^{-3}	0.811	2.1×10^{-5}	5.7×10^4
Bi-210		0.6	16.2	0.5	13.5	4.6×10^3	1.2×10^5
Bi-212		0.3	8.11	0.3	8.11	5.4×10^5	1.5×10^7
Bk-247	Berkelium(97)	2	54.1	2×10^{-4}	5.41×10^{-3}	3.8×10^{-2}	1.0
Bk-249		40	1080	8×10^{-3}	2.16	6.1×10^1	1.6×10^3
Br-76	Bromine(35)	0.3	8.11	0.3	8.11	9.4×10^4	2.5×10^6
Br-77		3	81.1	3	81.1	2.6×10^4	7.1×10^5
Br-82		0.4	10.8	0.4	10.8	4.0×10^4	1.1×10^6
C-11	Carbon(6)	1	27	0.5	13.5	3.1×10^7	8.4×10^8
C-14		40	1080	2	54.1	1.6×10^1	4.5
Ca-41	Calcium(20)	40	1080	40	1080	3.1×10^{-3}	8.5×10^{-2}
Ca-45		40	1080	0.9	24.3	6.6×10^3	1.8×10^4
Ca-47		0.9	24.3	0.5	13.5	2.3×10^4	6.1×10^5
Cd-109	Cadmium(48)	40	1080	1	27.0	9.6×10^1	2.6×10^3
Cd-113m		20	541	9×10^{-3}	2.43	8.3	2.2×10^3
Cd-115m		0.3	8.11	0.3	8.11	9.4×10^3	2.5×10^4
Cd-115		4	108	0.5	13.5	1.9×10^4	5.1×10^5
Ce-139	Cerium(58)	6	162	6	162	2.5×10^3	6.8×10^3
Ce-141		10	270	0.5	13.5	1.1×10^3	2.8×10^4
Ce-143		0.6	16.2	0.5	13.5	2.5×10^4	6.6×10^5
Ce-144		0.2	5.41	0.2	5.41	1.2×10^3	3.2×10^3
Cf-248	Californium(98)	30	811	3×10^{-3}	8.11×10^{-2}	5.8×10^1	1.6×10^3
Cf-249		2	54.1	2×10^{-4}	5.41×10^{-3}	1.5×10^1	4.1
Cf-250		5	135	5×10^{-4}	1.35×10^{-2}	4.0	1.1×10^3
Cf-251		2	54.1	2×10^{-4}	5.41×10^{-3}	5.9×10^{-2}	1.6

Cf-252		0.1	2.70	1×10^{-3}	2.70×10^{-2}	2.0×10^1	5.4×10^3
Cf-253		40	1080	6×10^{-3}	1.62	1.1×10^3	2.9×10^4
Cf-254		3×10^{-3}	8.11×10^{-2}	6×10^{-4}	1.62×10^{-2}	3.1×10^3	8.5×10^3
Cl-36	Chlorine(17)	20	541	0.5	13.5	1.2×10^3	3.3×10^2
Cl-38		0.2	5.41	0.2	5.41	4.9×10^6	1.3×10^8
Cm-240	Curium(96)	40	1080	2×10^{-3}	0.541	7.5×10^3	2.0×10^4
Cm-241		2	54.1	0.9	24.3	6.1×10^3	1.7×10^4
Cm-242		40	1080	1×10^{-3}	0.270	1.2×10^3	3.3×10^3
Cm-243		3	81.1	3×10^{-4}	8.11×10^{-3}	1.9	5.2×10^1
Cm-244		4	108	4×10^{-4}	1.08×10^{-2}	3.0	8.1×10^5
Cm-245		2	54.1	2×10^{-4}	5.41×10^{-3}	6.4×10^{-3}	1.7×10^1
Cm-246		2	54.1	2×10^{-4}	5.41×10^{-3}	1.1×10^{-2}	3.1×10^1
Cm-247		2	54.1	2×10^{-4}	5.41×10^{-3}	3.4×10^{-6}	9.3×10^{-5}
Cm-248		4×10^{-2}	1.08	5×10^{-5}	1.35×10^{-3}	1.6×10^{-4}	4.2×10^{-3}
Co-55	Cobalt(27)	0.5	13.5	0.5	13.5	1.1×10^5	3.1×10^6
Co-56		0.3	8.11	0.3	8.11	1.1×10^3	3.0×10^4
Co-57		8	216	8	216	3.1×10^3	8.4×10^3
Co-58m		40	1080	40	1080	2.2×10^5	5.9×10^6
Co-58		1	27.0	1	27.0	1.2×10^3	3.2×10^4
Co-60		0.4	10.8	0.4	10.8	4.2×10^1	1.1×10^3
Cr-51	Chromium(24)	30	811	30	811	3.4×10^3	9.2×10^4
Cs-129	Cesium(55)	4	108	4	108	2.8×10^1	7.6×10^5
Cs-131		40	1080	40	1080	3.8×10^3	1.0×10^5
Cs-132		1	27.0	1	27.0	5.7×10^3	1.5×10^5
Cs-134m		40	1080	9	243	3.0×10^5	8.0×10^6
Cs-134		0.6	16.2	0.5	13.5	4.8×10^1	1.3×10^3
Cs-135		40	1080	0.9	24.3	4.3×10^{-5}	1.2×10^{-3}
Cs-136		0.5	13.5	0.5	13.5	2.7×10^3	7.3×10^4
Cs-137		2	54.1	0.5	13.5	3.2	8.7×10^1
Cu-64	Copper(29)	5	135	0.9	24.3	1.4×10^5	3.9×10^6
Cu-67		9	243	0.9	24.3	2.8×10^4	7.6×10^5
Dy-159	Dysprosium(66)	20	541	20	541	2.1×10^3	5.7×10^3
Dy-165		0.6	16.2	0.5	13.5	3.0×10^5	8.2×10^6

Dy-166		0.3	8.11	0.3	8.11	8.6×10^3	2.3×10^5
Er-169	Erbium(68)	40	1080	0.9	24.3	3.1×10^3	8.3×10^4
Er-171		0.6	16.2	0.5	13.5	9.0×10^4	2.4×10^6
Es-253	Einsteinium(99)*	200	5400	2×10^{-3}	5.41×10^{-1}	--	--
Es-254		30	811	3×10^{-3}	8.11×10^{-2}	--	--
Es-254m		0.6	16.2	0.4	10.8	--	--
Es-255		--	--	--	--	--	--
Eu-147	Europium(63)	2	54.1	2	54.1	1.4×10^3	3.7×10^4
Eu-148		0.5	13.5	0.5	13.5	6.0×10^3	1.6×10^4
Eu-149		20	541	20	541	3.5×10^3	9.4×10^3
Eu-150		0.7	18.9	0.7	18.9	6.1×10^4	1.6×10^6
Eu-152m		0.6	16.2	0.5	13.5	8.2×10^4	2.2×10^6
Eu-152		0.9	24.3	0.9	24.3	6.5	1.8×10^3
Eu-154		0.8	21.6	0.5	13.5	9.8	2.6×10^3
Eu-155		20	541	2	54.1	1.8×10^4	4.9×10^3
Eu-156		0.6	16.2	0.5	13.5	2.0×10^3	5.5×10^4
F-18	Fluorine(9)	1	27.0	0.5	13.5	3.5×10^6	9.5×10^7
Fe-52	Iron(26)	0.2	5.41	0.2	5.41	2.7×10^5	7.3×10^6
Fe-55		40	1080	40	1080	8.8×10^4	2.4×10^3
Fe-59		0.8	21.6	0.8	21.6	1.8×10^3	5.0×10^4
Fe-60		40	1080	0.2	5.41	7.4×10^{-4}	2.0×10^{-2}
Fm-255	Fermium(100)*	40	1080	0.8	21.6	--	--
Fm-257		10	270	8×10^{-3}	2.16×10^{-1}	--	--
Ga-67	Gallium(31)	6	162	6	162	2.2×10^4	6.0×10^5
Ga-68		0.3	8.11	0.3	8.11	1.5×10^6	4.1×10^7
Ga-72		0.4	10.8	0.4	10.8	1.1×10^5	3.1×10^6
Gd-146	Gadolinium(64)	0.4	10.8	0.4	10.8	6.9×10^3	1.9×10^4
Gd-148		3	81.1	3×10^{-4}	8.11×10^{-3}	1.2	3.2×10^1
Gd-153		10	270	5	135	1.3×10^3	3.5×10^3
Gd-159		4	108	0.5	13.5	3.9×10^4	1.1×10^6
Ge-68	Germanium(32)	0.3	8.11	0.3	8.11	2.6×10^3	7.1×10^3
Ge-71		40	1080	40	1080	5.8×10^3	1.6×10^5
Ge-77		0.3	8.11	0.3	8.11	1.3×10^5	3.6×10^6

H-3	Hydrogen (see Tritium)						
Hf-172	Hafnium(72)	0.5	13.5	0.3	8.11	4.1×10^4	1.1×10^3
Hf-175		3	81.1	3	81.1	3.9×10^3	1.1×10^4
Hf-181		2	54.1	0.9	24.3	6.3×10^3	1.7×10^4
Hf-182		4	108	3×10^{-3}	0.811	8.1×10^{-6}	2.2×10^{-4}
Hg-194	Mercury(80)	1	27.0	1	27.0	1.3×10^4	3.5
Hg-195m		5	135	5	135	1.5×10^4	4.0×10^5
Hg-197m		10	270	0.9	24.3	2.5×10^4	6.7×10^5
Hg-197		10	270	10	270	9.2×10^3	2.5×10^5
Hg-203		4	108	0.9	24.3	5.1×10^3	1.4×10^4
Ho-163	Holmium(67)	40	1080	40	1080	2.7	7.6×10^4
Ho-166m		0.6	16.2	0.3	8.11	6.6×10^3	1.8
Ho-166		0.3	8.11	0.3	8.11	2.6×10^4	7.0×10^5
I-123	Iodine(53)	6	162	6	162	7.1×10^4	1.9×10^6
I-124		0.9	24.3	0.9	24.3	9.3×10^3	2.5×10^5
I-125		20	541	2	54.1	6.4×10^3	1.7×10^4
I-126		2	54.1	0.9	24.3	2.9×10^3	8.0×10^4
I-129		Unltd.	Unlimited	Unltd.	Unlimited	6.5×10^{-6}	1.8×10^{-4}
I-131		3	81.1	0.5	13.5	4.6×10^3	1.2×10^5
I-132		0.4	10.8	0.4	10.8	3.8×10^5	1.0×10^7
I-133		0.6	16.2	0.5	13.5	4.2×10^4	1.1×10^6
I-134		0.3	8.11	0.3	8.11	9.9×10^5	2.7×10^7
I-135		0.6	16.2	0.5	13.5	1.3×10^5	3.5×10^6
In-111	Indium(49)	2	54.1	2	54.1	1.5×10^4	4.2×10^5
In-113m		4	108	4	108	6.2×10^5	1.7×10^7
In-114m		0.3	8.11	0.3	8.11	8.6×10^3	2.3×10^4
In-115m		6	162	0.9	24.3	2.2×10^5	6.1×10^6
Ir-189	Iridium(77)	10	270	10	270	1.9×10^3	5.2×10^4
Ir-190		0.7	18.9	0.7	18.9	2.3×10^3	6.2×10^4
Ir-192		1	27.0	0.5	13.5	3.4×10^3	9.2×10^3
Ir-193m		10	270	10	270	2.4×10^3	6.4×10^4
Ir-194		0.2	5.41	0.2	5.41	3.1×10^4	8.4×10^5
K-40	Potassium(19)	0.6	16.2	0.6	16.2	2.4×10^{-7}	6.4×10^{-6}

K-42		0.2	5.41	0.2	5.41	2.2×10^5	6.0×10^6
K-43		1.0	27.0	0.5	13.5	1.2×10^5	3.3×10^6
Kr-81	Krypton(36)	40	1080	40	1080	7.8×10^4	2.1×10^7
Kr-85m		6	162	6	162	3.0×10^5	8.2×10^6
Kr-85		20	541	10	270	1.5×10^4	3.9×10^7
Kr-87		0.2	5.41	0.2	5.41	1.0×10^6	2.8×10^7
La-137	Lanthanum(57)	40	1080	2	54.1	1.6×10^3	4.4×10^7
La-140		0.4	10.8	0.4	10.8	2.1×10^4	5.6×10^5
Lu-172	Lutetium(71)	0.5	13.5	0.5	13.5	4.2×10^3	1.1×10^5
Lu-173		8	216	8	216	5.6×10^4	1.5×10^7
Lu-174m		20	541	8	216	2.0×10^3	5.3×10^7
Lu-174		8	216	4	108	2.3×10^4	6.2×10^7
Lu-177		30	811	0.9	24.3	4.1×10^3	1.1×10^5
MFP							
—— For mixed-fission products, use formula for mixtures or general value table							
Mg-28	Magnesium(12)	0.2	5.41	0.2	5.41	2.0×10^5	5.4×10^6
Mn-52	Manganese(25)	0.3	8.11	0.3	8.11	1.6×10^4	4.4×10^5
Mn-53		Unltd.	Unlimited	Unlimited	Unlimited	6.8×10^5	1.8×10^7
Mn-54		1	27.0	1	27.0	2.9×10^3	7.7×10^7
Mn-56		0.2	5.41	0.2	5.41	8.0×10^5	2.2×10^7
Mo-93	Molybdenum(42)	40	1080	7	189	4.1×10^3	1.1
Mo-99		0.6	16.2	0.5	13.5*	1.8×10^4	4.8×10^5
N-13	Nitrogen(7)	0.6	16.2	0.5	13.5	5.4×10^7	1.5×10^9
Na-22	Sodium(11)	0.5	13.5	0.5	13.5	2.3×10^3	6.3×10^7
Na-24		0.2	5.41	0.2	5.41	3.2×10^5	8.7×10^6
Nb-92m	Niobium(41)	0.7	18.9	0.7	18.9	5.2×10^3	1.4×10^5
Nb-93m		40	1080	6	162	8.8	2.4×10^7
Nb-94		0.6	16.2	0.6	16.2	6.9×10^3	1.9×10^7
Nb-95		1	27.0	1	27.0	1.5×10^3	3.9×10^7
Nb-97		0.6	16.2	0.5	13.5	9.9×10^5	2.7×10^7
Nd-147	Neodymium(60)	4	108	0.5	13.5	3.0×10^3	8.1×10^7
Nd-149		0.6	16.2	0.5	13.5	4.5×10^5	1.2×10^7
Ni-59	Nickel(28)	40	1080	40	1080	3.0×10^3	8.0×10^7

Ni-63		40	1080	30	811	2.1	5.7x10 ⁴
Ni-65		0.3	8.11	0.3	8.11	7.1x10 ⁵	1.9x10 ⁷
Np-235	Neptunium(93)	40	1080	40	1080	5.2x10 ⁴	1.4x10 ³
Np-236		7	189	1x10 ⁻³	2.70x10 ⁻³	4.7x10 ⁻⁴	1.3x10 ⁻²
Np-237		2	54.1	2x10 ⁻⁴	5.41x10 ⁻³	2.6x10 ⁻⁵	7.1x10 ⁻⁴
Np-239		6	162	0.5	13.5	8.6x10 ³	2.3x10 ⁵
Os-185	Osmium(76)	1	27.0	1	27.0	2.8x10 ³	7.5x10 ³
Os-191m		40	1080	40	1080	4.6x10 ⁴	1.3x10 ⁶
Os-191		10	270	0.9	24.3	1.6x10 ³	4.4x10 ⁴
Os-193		0.6	16.2	0.5	13.5	2.0x10 ⁴	5.3x10 ⁵
Os-194		0.2	5.41	0.2	5.41	1.1x10 ⁴	3.1x10 ³
P-32	Phosphorus(15)	0.3	8.11	0.3	8.11	1.1x10 ⁴	2.9x10 ⁵
P-33		40	1080	0.9	24.3	5.8x10 ³	1.6x10 ⁵
Pa-230	Protactinium(91)	2	54.1	0.1	2.70	1.2x10 ³	3.3x10 ⁴
Pa-231		0.6	16.2	6x10 ⁻⁵	1.62x10 ⁻³	1.7x10 ⁻³	4.7x10 ⁻²
Pa-233		5	135	0.9	24.3	7.7x10 ³	2.1x10 ⁴
Pb-201	Lead(82)	1	27.0	1	27.0	6.2x10 ⁴	1.7x10 ⁶
Pb-202		40	1080	2	54.1	1.2x10 ⁻⁴	3.4x10 ⁻³
Pb-203		3	81.1	3	81.1	1.1x10 ⁴	3.0x10 ⁵
Pb-205		Unltd.	Unlimited	Unlimited	Unlimited	4.5x10 ⁻⁶	1.2x10 ⁻⁴
Pb-210		0.6	16.2	9x10 ⁻³	0.243	2.8	7.6x10 ¹
Pb-212		0.3	8.11	0.3	8.11	5.1x10 ⁴	1.4x10 ⁶
Pd-103	Palladium(46)	40	1080	40	1080	2.8x10 ³	7.5x10 ⁴
Pd-107		Unltd.	Unlimited	Unlimited	Unlimited	1.9x10 ⁻⁵	5.1x10 ⁻⁴
Pd-109		0.6	16.2	0.5	13.5	7.9x10 ⁴	2.1x10 ⁶
Pm-143	Promethium(61)	3	81.1	3	81.1	1.3x10 ³	3.4x10 ³
Pm-144		0.6	16.2	0.6	16.2	9.2x10 ⁴	2.5x10 ³
Pm-145		30	811	7	189	5.2	1.4x10 ³
Pm-147		40	1080	0.9	24.3	3.4x10 ⁴	9.3x10 ³
Pm-148m		0.5	13.5	0.5	13.5	7.9x10 ³	2.1x10 ⁴
Pm-149		0.6	16.2	0.5	13.5	1.5x10 ⁴	4.0x10 ⁵
Pm-151		3	81.1	0.5	13.5	2.7x10 ⁴	7.3x10 ⁵
Po-208	Polonium(84)	40	1080	2x10 ⁻²	0.541	2.2x10 ⁴	5.9x10 ³

Po-209		40	1080	2×10^{-2}	0.541	6.2×10^{-4}	1.7×10^{-4}
Po-210		40	1080	2×10^{-2}	0.541	1.7×10^{-3}	4.5×10^{-3}
Pr-142	Praseodymium (59)	0.2	5.41	0.2	5.41	4.3×10^{-4}	1.2×10^{-6}
Pr-143		4	108	0.5	13.5	2.5×10^{-3}	6.7×10^{-4}
Pt-188	Platinum(78)	0.6	16.2	0.6	16.2	2.5×10^{-3}	6.8×10^{-4}
Pt-191		3	81.1	3	81.1	8.7×10^{-3}	2.4×10^{-5}
Pt-193m		40	1080	9	243	5.8×10^{-3}	1.6×10^{-5}
Pt-193		40	1080	40	1080	1.4	3.7×10^{-4}
Pt-195m		10	270	2	54.1	6.2×10^{-3}	1.7×10^{-5}
Pt-197m		10	270	0.9	24.3	3.7×10^{-3}	1.0×10^{-7}
Pt-197		20	541	0.5	13.5	3.2×10^{-4}	8.7×10^{-5}
Pu-236	Plutonium(94)	7	189	7×10^{-4}	1.89×10^{-2}	2.0×10^{-4}	5.3×10^{-3}
Pu-237		20	541	20	541	4.5×10^{-3}	1.2×10^{-4}
Pu-238		2	54.1	2×10^{-4}	5.41×10^{-3}	6.3×10^{-4}	1.7×10^{-4}
Pu-239		2	54.1	2×10^{-4}	5.41×10^{-3}	2.3×10^{-3}	6.2×10^{-2}
Pu-240		2	54.1	2×10^{-4}	5.41×10^{-3}	8.4×10^{-3}	2.3×10^{-4}
Pu-241		40	1080	1×10^{-2}	0.270	3.8	1.0×10^{-3}
Pu-242		2	54.1	2×10^{-4}	5.41×10^{-3}	1.5×10^{-4}	3.9×10^{-3}
Pu-244		0.3	8.11	2×10^{-4}	5.41×10^{-3}	6.7×10^{-7}	1.8×10^{-3}
Ra-223	Radium(88)	0.6	16.2	3×10^{-2}	0.811	1.9×10^{-3}	5.1×10^{-4}
Ra-224		0.3	8.11	6×10^{-2}	1.62	5.9×10^{-3}	1.6×10^{-5}
Ra-225		0.6	16.2	2×10^{-2}	0.541	1.5×10^{-3}	3.9×10^{-4}
Ra-226		0.3	8.11	2×10^{-2}	0.541	3.7×10^{-3}	1.0
Ra-228		0.6	16.2	4×10^{-2}	1.08	1.0×10^{-4}	2.7×10^{-3}
Rb-81	Rubidium(37)	2	54.1	0.9	24.3	3.1×10^{-5}	8.4×10^{-6}
Rb-83		2	54.1	2	54.1	6.8×10^{-3}	1.8×10^{-4}
Rb-84		1	27.0	0.9	24.3	1.8×10^{-3}	4.7×10^{-4}
Rb-86		0.3	8.11	0.3	8.11	3.0×10^{-3}	8.1×10^{-4}
Rb-87		Unltd.	Unlimited	Unlimited	Unlimited	3.2×10^{-3}	8.6×10^{-8}
Rb (natural)		Unltd.	Unlimited	Unlimited	Unlimited	6.7×10^{-6}	1.8×10^{-8}
Re-183	Rhenium(75)	5	135	5	135	3.8×10^{-3}	1.0×10^{-4}
Re-184m		3	81.1	3	81.1	1.6×10^{-3}	4.3×10^{-3}
Re-184		1	27.0	1	27.0	6.9×10^{-3}	1.9×10^{-4}

Re-186		4	108	0.5	13.5	6.9×10^3	1.9×10^5
Re-187		Unltd.	Unlimited	Unlimited	Unlimited	1.4×10^3	3.8×10^8
Re-188		0.2	5.41	0.2	5.41	3.6×10^4	9.8×10^5
Re-189		4	108	0.5	13.5	2.5×10^4	6.8×10^5
Re-(natural)		Unltd.	Unlimited	Unlimited	Unlimited		2.4×10^8
Rh-99	Rhodium(45)	2	54.1	2	54.1	3.0×10^3	8.2×10^4
Rh-101		4	108	4	108	4.1×10^4	1.1×10^3
Rh-102m		2	54.1	0.9	24.3	2.3×10^3	6.2×10^3
Rh-102		0.5	13.5	0.5	13.5	4.5×10^4	1.2×10^3
Rh-103m		40	1080	40	1080	1.2×10^6	3.3×10^2
Rh-105		10	270	0.9	24.3	3.1×10^4	8.4×10^5
Rn-222	Radon(86)	0.2	5.41	4×10^{-3}	0.108	5.7×10^3	1.5×10^5
Ru-97	Ruthenium(44)	4	108	4	108	1.7×10^4	4.6×10^5
Ru-103		2	54.1	0.9	24.3	1.2×10^3	3.2×10^4
Ru-105		0.6	16.2	0.5	13.5	2.5×10^5	6.7×10^6
Ru-106		0.2	5.41	0.2	5.41	1.2×10^3	3.3×10^3
S-35	Sulfur(16)	40	1080	2	54.1	1.6×10^3	4.3×10^4
Sb-122	Antimony(51)	0.3	8.11	0.3	8.11	1.5×10^4	4.0×10^5
Sb-124		0.6	16.2	0.5	13.5	6.5×10^3	1.7×10^4
Sb-125		2	54.1	0.9	24.3	3.9×10^4	1.0×10^3
Sb-126		0.4	10.8	0.4	10.8	3.1×10^3	8.4×10^4
Sc-44	Scandium(21)	0.5	13.5	0.5	13.5	6.7×10^5	1.8×10^2
Sc-46		0.5	13.5	0.5	13.5	1.3×10^3	3.4×10^4
Sc-47		9	243	0.9	24.3	3.1×10^4	8.3×10^5
Sc-48		0.3	8.11	0.3	8.11	5.5×10^4	1.5×10^6
Se-75	Selenium(34)	3	81.1	3	81.1	5.4×10^3	1.5×10^4
Se-79		40	1080	2	54.1	2.6×10^{-3}	7.0×10^{-2}
Si-31	Silicon(14)	0.6	16.2	0.5	13.5	1.4×10^6	3.9×10^2
Si-32		40	1080	0.2	5.41	3.9	1.1×10^3
Sm-145	Samarium(62)	20	541	20	541	9.8×10^4	2.6×10^3
Sm-147		Unltd.	Unlimited	Unlimited	Unlimited	8.5×10^4	2.3×10^8
Sm-151		40	1080	4	108	9.7×10^4	2.6×10^4
Sm-153		4	108	0.5	13.5	1.6×10^4	4.4×10^5

Sn-113	Tin(50)	4	108	4	108	3.7×10^3	1.0×10^4
Sn-117m		6	162	2	54.1	3.0×10^3	8.2×10^4
Sn-119m		40	1080	40	1080	1.4×10^3	3.7×10^3
Sn-121m		40	1080	0.9	24.3	2.0	5.4×10^1
Sn-123		0.6	16.2	0.5	13.5	3.0×10^3	8.2×10^3
Sn-125		0.2	5.41	0.2	5.41	4.0×10^3	1.1×10^5
Sn-126		0.3	8.11	0.3	8.11	1.0×10^{-3}	2.8×10^{-2}
Sr-82	Strontium(38)	0.2	5.41	0.2	5.41	2.3×10^3	6.2×10^4
Sr-85m		5	135	5	135	1.2×10^6	3.3×10^7
Sr-85		2	54.1	2	54.1	8.8×10^3	2.4×10^4
Sr-87m		3	81.1	3	81.1	4.8×10^3	1.3×10^7
Sr-89		0.6	16.2	0.5	13.5	1.1×10^3	2.9×10^4
Sr-90		0.2	5.41	0.1	2.70	5.1	1.4×10^3
Sr-91		0.3	8.11	0.3	8.11	1.3×10^5	3.6×10^6
Sr-92		0.8	21.6	0.5	13.5	4.7×10^3	1.3×10^7
T	Tritium(1)	40	1080	40	1080	3.6×10^3	9.7×10^3
Ta-178	Tantalum(73)	1	27.0	1	27.0	4.2×10^6	1.1×10^8
Ta-179		30	811	30	811	4.1×10^1	1.1×10^3
Ta-182		0.8	21.6	0.5	13.5	2.3×10^3	6.2×10^3
Tb-157	Terbium(65)	40	1080	10	270	5.6×10^1	1.5×10^1
Tb-158		1	27.0	0.7	18.9	5.6×10^1	1.5×10^1
Tb-160		0.9	24.3	0.5	13.5	4.2×10^3	1.1×10^4
Te-95m	Technetium(43)	2	54.1	2	54.1	8.3×10^3	2.2×10^4
Te-96m		0.4	10.8	0.4	10.8	1.4×10^6	3.8×10^7
Te-96		0.4	10.8	0.4	10.8	1.2×10^4	3.2×10^5
Te-97m		40	1080	40	1080	5.6×10^3	1.5×10^4
Te-97		Unltd.	Unlimited	Unlimited	Unlimited	5.2×10^{-5}	1.4×10^{-3}
Te-98		0.7	18.9	0.7	18.9	3.2×10^5	8.7×10^4
Te-99m		8	216	8	216	1.9×10^3	5.3×10^6
Te-99		40	1080	0.9	24.3	6.3×10^4	1.7×10^2
Te-118	Tellurium(52)	0.2	5.41	0.2	5.41	6.8×10^3	1.8×10^5
Te-121m		5	135	5	135	2.6×10^3	7.0×10^3
Te-121		2	54.1	2	54.1	2.4×10^3	6.4×10^4

Fe-123m		7	189	7	189	3.3×10^3	8.9×10^3
Fe-125m		30	811	9	243	6.7×10^3	1.8×10^4
Fe-127m		20	541	0.5	13.5	3.5×10^3	9.4×10^3
Fe-127		20	541	0.5	13.5	9.8×10^4	2.6×10^5
Fe-129m		0.6	16.2	0.5	13.5	1.1×10^3	3.0×10^4
Fe-129		0.6	16.2	0.5	13.5	7.7×10^5	2.1×10^7
Fe-131m		0.7	18.9	0.5	13.5	3.0×10^4	8.0×10^5
Fe-132		0.4	10.8	0.4	10.8	1.1×10^4	3.0×10^5
Th-227	Thorium(90)	9	243	1×10^{-2}	0.270	1.1×10^3	3.1×10^4
Th-228		0.3	8.11	4×10^{-4}	1.08×10^{-2}	3.0×10^1	8.2×10^3
Th-229		0.3	8.11	3×10^{-5}	8.11×10^{-4}	7.9×10^{-3}	2.1×10^1
Th-230		2	54.1	2×10^{-4}	5.41×10^{-3}	7.6×10^{-4}	2.1×10^2
Th-231		40	1080	0.9	24.3	2.0×10^4	5.3×10^5
Th-232		Unltd.	Unlimited	Unlimited	Unlimited	4.0×10^{13}	1.1×10^7
Th-234		0.2	5.41	0.2	5.41	8.6×10^3	2.3×10^4
Th (natural)		Unltd.	Unlimited	Unlimited	Unlimited	8.1×10^{13}	2.2×10^7
Ti-144	Titanium(22)	0.5	13.5	0.2	5.41	6.4	1.7×10^3
Tl-200	Thallium(81.1)	0.8	21.6	0.8	21.6	2.2×10^4	6.0×10^5
Tl-201		10	270	10	270	7.9×10^3	2.1×10^5
Tl-202		2	54.1	2	54.1	2.0×10^3	5.3×10^4
Tl-204		4	108	0.5	13.5	1.7×10^4	4.6×10^5
Tm-167	Thulium(69)	7	189	7	189	3.1×10^3	8.5×10^4
Tm-168		0.8	21.6	0.8	21.6	3.1×10^3	8.3×10^3
Tm-170		4	108	0.5	13.5	2.2×10^3	6.0×10^3
Tm-171		40	1080	10	270	4.0×10^4	1.1×10^5
U-230	Uranium(92)	40	1080	1×10^{-2}	0.270	1.0×10^3	2.7×10^4
U-232		3	81.1	3×10^{-4}	8.11×10^{-3}	8.3×10^{-4}	2.2×10^1
U-233		10	270	1×10^{-3}	2.70×10^{-2}	3.6×10^{-4}	9.7×10^{-3}
U-234		10	270	1×10^{-3}	2.70×10^{-2}	2.3×10^{-4}	6.2×10^{-3}
U-235		Unltd.	Unlimited	Unlimited	Unlimited	8.0×10^{13}	2.2×10^6
U-236		10	270	1×10^{-3}	2.70×10^{-2}	2.4×10^{-6}	6.5×10^{-5}
U-238		Unltd.	Unlimited	Unlimited	Unlimited	1.2×10^{13}	3.4×10^7
U-natural		Unltd.	Unlimited	Unlimited	Unlimited	2.6×10^{13}	7.1×10^7
U (enriched)	Unlimited	Unltd.	Unlimited	Unlimited		*	

5% or less)							
U (enriched more than 5%)	40	270	1×10^3	2.70×10^2		*	
U-depleted		Unltd.	Unlimited	Unlimited	Unlimited		*
V-48	Vanadium(23)	0.3	8.11	0.3	8.11	6.3×10^3	1.7×10^5
V-49		40	1080	40	1080	3.0×10^3	8.1×10^3
W-178	Tungsten(74)	1	27.0	1	27.0	1.3×10^3	3.4×10^4
W-181		30	811	30	811	2.2×10^3	6.0×10^3
W-185		40	1080	0.9	24.3	3.5×10^3	9.4×10^3
W-187		2	54.1	0.5	13.5	2.6×10^4	7.0×10^5
W-188		0.2	5.41	0.2	5.41	3.7×10^3	1.0×10^4
Xe-122	Xenon(54)	0.2	5.41	0.2	5.41	4.8×10^4	1.3×10^6
Xe-123		0.2	5.41	0.2	5.41	4.4×10^5	1.2×10^7
Xe-127		4	108	4	108	1.0×10^3	2.8×10^4
Xe-131m		40	1080	40	1080	3.1×10^3	8.4×10^4
Xe-133		20	541	20	541	6.9×10^3	1.9×10^5
Xe-135		4	108	4	108	9.5×10^4	2.6×10^6
Y-87	Yttrium(39)	2	54.1	2	54.1	1.7×10^4	4.5×10^5
Y-88		0.4	10.8	0.4	10.8	5.2×10^3	1.4×10^4
Y-90		0.2	5.41	0.2	5.41	2.0×10^4	5.4×10^5
Y-91m		2	54.1	2	54.1	1.5×10^6	4.2×10^7
Y-91		0.3	8.11	0.3	8.11	9.1×10^3	2.5×10^4
Y-92		0.2	5.41	0.2	5.41	3.6×10^5	9.6×10^6
Y-93		0.2	5.41	0.2	5.41	1.2×10^5	3.3×10^6
Yb-169	Ytterbium(70)	3	81.1	3	81.1	8.9×10^3	2.4×10^4
Yb-175		30	811	0.9	24.3	6.6×10^3	1.8×10^5
Zn-65	Zinc(30)	2	54.1	2	54.1	3.0×10^3	8.2×10^3
Zn-69m		2	54.1	0.5	13.5	1.2×10^5	3.3×10^6
Zn-69		4	108	0.5	13.5	1.8×10^6	4.9×10^7
Zr-88	Zirconium(40)	3	81.1	3	81.1	6.6×10^3	1.8×10^4
Zr-93		40	1080	0.2	5.41	9.3×10^3	2.5×10^3
Zr-95		1	27.0	0.9	24.3	7.9×10^3	2.1×10^4
Zr-97		0.3	8.11	0.3	8.11	7.1×10^4	1.9×10^6

~~(b) Radionuclides in Table 4037.4, A_1 And A_2 Values For Radionuclides, marked with "**", shall designate a gas at a pressure which exceeds the ambient atmospheric pressure at the location where the containment system was closed.~~

~~(c) Radionuclides in Table 4037.4, A_1 And A_2 Values For Radionuclides, marked with "***", shall designate the values of A_1 and A_2 which shall be calculated in accordance with the procedure specified in He-P 4037.22(b)(3), taking into account the activity of the fission products and of the uranium-233 in addition to that of the thorium.~~

~~(d) Radionuclides in Table 4037.4, A_1 And A_2 Values For Radionuclides, marked with "****", shall designate the values of A_1 and A_2 which shall be calculated in accordance with the procedure specified in He-P 4037.22(b)(3), taking into account the activity of the fission products and plutonium isotopes in addition to that of the uranium.~~

~~He-P 4037.23 General Values for A_1 And A_2 . For Individual radionuclides whose identities are known, but which are not listed in table 4037.4, A_1 And A_2 Values For Radionuclides, the determination of the A_1 and A_2 values from table 4037.5, General Values for A_1 and A_2 , may be used.~~

~~Table 4037.5 General Values for A_1 and A_2~~

Contents	A_1		A_2	
	TBq	Ci	TBq	Ci
Only beta or gamma emitting Nuclides are known to be present	0.2	5	0.02	0.5
Alpha emitting nuclides are known to be present or no relevant data available	0.10	2.70	2E-10⁻⁵	5.4E⁻⁴

~~He-P 4037.24 Activity-Mass Relationships for Uranium/Thorium. Activity-mass relationships for uranium/thorium shall be as indicated in Table 4037.6, Activity Mass Relationships For Uranium/Thorium, below.~~

~~Table 4037.6 Activity Mass Relationships For Uranium/Thorium~~

Thorium and Uranium Enrichment* wt % U-235 present	Specific Activity	
	Ci/g	g/Ci
0.45	5.0×10^{-7}	2.0×10^6
0.72 (natural)	7.06×10^{-7}	1.42×10^6
1.0	7.6×10^{-7}	1.3×10^6
1.5	1.0×10^{-6}	1.0×10^6
5.0	2.7×10^{-6}	3.7×10^5
10.0	4.8×10^{-6}	2.1×10^5
20.	1.0×10^{-5}	1.0×10^5
35.0	2.0×10^{-5}	5.0×10^4

50.0	2.5×10^{-5}	4.0×10^4
90.0	5.8×10^{-5}	1.7×10^4
93.0	7.0×10^{-5}	1.4×10^4
95.0	9.1×10^{-5}	1.1×10^4
Natural Thorium	2.2×10^{-7}	4.6×10^6

Appendix

<u>Rule Section</u>	<u>Federal Reg./RSA</u>
He-P 4037.01	RSA 125-F:1, RSA 125-F:2, & RSA 125-F:5 II and V; Section 274 of the Atomic Energy Act of 1954, as amended and Title 10, Code of Federal Regulations, Part 71, Section 71.0 (10 CFR 71.0)
He-P 4037.02	RSA 125-F:1, RSA 125-F:2, & RSA 125-F:5 II and V; Section 274 of the Atomic Energy Act of 1954, as amended and 10 CFR 71.0
He-P 4037.03	RSA 125-F:1, RSA 125-F:2, & RSA 125-F:5 II and V; Section 274 of the Atomic Energy Act of 1954, as amended and 10 CFR 71.4
He-P 4037.04	RSA 125-F:1, RSA 125-F:2, & RSA 125-F:5 II and V; Section 274 of the Atomic Energy Act of 1954, as amended and 10 CFR Part 71 (effectively, Sections 10 CFR 71.1 – 71.3, 71.5 – 71.137 and Appendix A to Part 71.)