DRAFT 1 04/02/14

DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT

Hazardous Materials and Waste Management Division

RADIATION CONTROL - TRANSPORTATION OF RADIOACTIVE MATERIAL

6 CCR 1007-1 Part 17

[Editor's Notes follow the text of the rules at the end of this CCR Document.]

PART 17: TRANSPORTATION OF RADIOACTIVE MATERIAL

GENERAL PROVISIONS

17.1 Purpose and Scope.

17.1.1 Authority.

Rules and regulations set forth herein are adopted pursuant to the provisions of sections 25-1-108, 25-1.5-101(1)(l), and 25-11-104, CRS.

17.1.2 Basis and Purpose.

A statement of basis and purpose accompanies this part and changes to this part. A copy may be obtained from the Department.

17.1.3 Scope.

This part establishes requirements for packaging, preparation for shipment, and transportation of radioactive material.

17.1.4 Applicability.

17.1.4.1 This part applies to any person who transports radioactive material or delivers radioactive material to a carrier for transport.

(1) This part applies in particular to any licensee authorized by specific or general license to receive, possess, use, or transfer licensed material, if the licensee delivers that material to a carrier for transport, transports the material outside the site of usage as specified in the license, or transports that material on a public highway.

(2) The transport of licensed material or delivery of licensed material to a carrier for transport is subject to the:

(a) General provisions of 17.1 through 17.5, including referenced DOT regulations;

(b) Quality assurance requirements of 17.10; and

(c) Operating controls and procedures requirements of 17.11 through 17.17.

(3) No provision of this part authorizes possession of licensed material.

(4) Exemptions from the requirement in 17.3 for a license are specified in 17.4.

Comment [JJ1]: EDITORIAL NOTE 1: ALL COMMENTS (SUCH AS THIS ONE) SHOWN IN THE RIGHT SIDE MARGIN OF THIS DOCUMENT ARE FOR INFORMATION PURPOSES ONLY TO PROVIDE ADDITIONAL INFORMATION AND TO AID THE READER IN UNDERSTANDING THE PROPOSED CHANGE DURING THE DRAFT REVIEW PROCESS.

THESE COMMENTS ARE **NOT** PART OF THE RULE AND ALL COMMENTS WILL BE DELETED PRIOR TO FINAL SUBMISSION TO THE COLORADO SECRETARY OF STATE'S OFFICE FOR FINAL PUBLISHING IN THE COLORADO CODE OF REGULATIONS.

EDITORIAL NOTE 2: THE ACRONYM "CRCPD" IN THE SIDE MARGIN NOTES REFERS TO THE CONFERENCE OF RADIATION CONTROL PROGRAM DIRECTORS (CRCPD), INC., WHICH DEVELOPS SUGGESTED STATE REGULATIONS FOR CONTROL OF RADIATION (SSRCR). UNLESS OTHERWISE DETERMINED BY THE BOARD OF HEALTH, COLORADO'S RULES ARE TO BE CONSISTENT WITH THE SSRCR REGULATIONS. THE SSRCRS MAY BE FOUND ONLINE AT: http://www.crcpd.org/ssrcrs/default.aspx

NOTE THAT THE SSRCR's MAY NOT REFLECT CURRENT REGULATORY CHANGES MADE BY THE U.S. NUCLEAR REGULATORY COMMISSION (NRC) IN THE CODE OF FEDERAL REGULATIONS (CFR's). COMPATIBILITY WITH FEDERAL (NRC) REQUIREMENTS IS ALSO REQUIRED TO MAINTAIN AGREEMENT STATE STATUS. PROPOSED CHANGES IN COLORADO RULES MAY THEREFORE DEFAULT TO THE NRC RATHER THAN THOSE CONTAINED WITHIN AN SSRCR THAT IS NOT CURRENT. THE CRCPD SSRCR PART T (TRANSPORTATION) WAS LAST REVISED IN 1999 AND IS NOT CURRENT OR COMPATIBILE WITH ALL NRC REGULATORY REQUIREMENTS. THEREFORE, THE PROPOSED CHANGES HEREIN ARE FOR CONSISTENCY WITH NRC REGULATIONS.

EDITORIAL NOTE 3: INFORMATION ON NRC COMPATIBILITY CATEGORIES MAY BE FOUND AT: http://nrc-stp.ornl.gov/procedures/sa200.pdf

EDITORIAL NOTE 4: INFORMATION ON NRC REGULATORY ACTION TRACKING SYSTEM (RATS) MAY BE FOUND AT: http://nrc-stp.ornl.gov/regtoolbox.html

(5) The general license under 17.7 requires that a NRC certificate of compliance or other package approval be issued for the package to be used under the general license.

(6) General licenses for which no package approval is required are issued in 17.8 and 17.9.

(7) These rules apply to any person required to obtain a certificate of compliance or an approved compliance plan from the NRC pursuant to 10 CFR 71 if the person delivers radioactive material to a common or contract carrier for transport or transports the material outside the confines of the person's plant or other authorized place of use.

17.1.4.2 The packaging and transport of radioactive material are also subject to other parts of these regulations and to the regulations of other agencies (such as the DOT, the United States Postal Service and the NRC) having jurisdiction over means of transport.

17.1.4.3 The requirements of this part are in addition to, and not in substitution for, other requirements.

17.1.5 Published Material Incorporated by Reference.

Published material incorporated in Part 17 by reference is available in accord with Part 1, Section 1.4.

17.2 Definitions.

17.2.1 Definitions of general applicability to these regulations are in Part 1, Section 1.2.2.

17.2.2 Terms used in Part 17 have the definitions set forth as follows.

“Carrier” means a person engaged in the transportation of passengers or property by land or water as a common, contract, or private carrier, or by civil aircraft.

"Certificate holder" means a person who has been issued a certificate of compliance or other package approval by the NRC.

"Certificate of Compliance" (COC) means the certificate issued by the NRC under subpart D of 10 CFR 71 (January 1, 20~~07~~14) which approves the design of a package for the transportation of radioactive material.

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

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

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

“Conveyance” means:

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

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

(3) For transport by any aircraft.

"Criticality Safety Index (CSI)" means the dimensionless number (rounded up to the next tenth) assigned to and placed on the label of a fissile material package, to designate the degree of control of accumulation of packages containing fissile material during transportation. Determination of the criticality safety index is described in 10 CFR 71.22, 71.23, and 71.59.

"Deuterium" means, for the purposes of Part 17, deuterium and any deuterium compound, including heavy water, in which the ratio of deuterium atoms to hydrogen atoms exceeds 1:5000.

"Exclusive use" means the sole use by a single consignor of a conveyance for which all initial, intermediate, and final loading and unloading are carried out in accordance with the direction of the consignor or consignee. The consignor and the carrier must ensure that any loading or unloading is performed by personnel having radiological training and resources appropriate for safe handling of the consignment. The consignor must issue specific instructions, in writing, for maintenance of exclusive use shipment controls, and include them with the shipping paper information provided to the carrier by the consignor.

"Fissile material package" means a fissile material packaging together with its fissile material contents.

"Graphite" means, for the purposes of Part 17, graphite with a boron equivalent content less than 5 parts per million and density greater than 1.5 grams per cubic centimeter.

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

Comment [JJ2]: Definition added for compatibility with the requirements of 10 CFR Part 71.4

NRC Ref = 10 CFR 71.4
Compatibility = B
NRC Regulatory Action Tracking System (RATS) 2012-2 (#1)
[Due for state adoption = 08/10/2015]

"Low specific activity material" (LSA material) means radioactive material with limited specific activity which is nonfissile or except under Part 17 and which satisfies the descriptions and limits set forth below. Shielding materials surrounding the LSA material may not be considered in determining the estimated average specific activity of the package contents. LSA material must be in one of three groups:

(1) LSA-I .

(a) Uranium and thorium ores, concentrates of uranium and thorium ores, and other ores containing naturally occurring radionuclides which are not intended to be processed for the use of these radionuclides; or

(b) **Solid unirradiated natural uranium or depleted uranium or natural thorium or their solid or liquid compounds or mixtures.**

Comment [JJ3]: Language added at the request of NRC, consistent with the requirements of 10 CFR Part 71.4. This language was omitted during a prior revision to Part 17.

NRC Ref = 10 CFR 71.4
NRC Ltr 10/15/07 (#1)
Compatibility = B
NRC RATS 2004-1

(c) Radioactive material, other than fissile material, for which the A_2 value in Appendix 17A is unlimited; or

(d~~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 17A.

(2) LSA-II .

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

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

(3) LSA-III . Solids in and for which:

(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 (such as concrete, bitumen, or ceramic); 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 x A_2 ;

(c) The estimated average specific activity of the solid does not exceed 2 x 10^{-3} A_2 /g; and

(d) A specimen of the material has passed a leaching test, provided also that any differences between the specimen tested and the material to be transported were taken into account in determining whether the test requirements have been met.

(i) The specimen, representing no less than the entire contents of the package, must be immersed for 7 days in water at ambient temperature;

(ii) The volume of water to be used in the test must be sufficient to ensure that at the end of the test period the free volume of the unabsorbed and unreacted water remaining will be at least 10% of the volume of the specimen itself;

(iii) The water must have an initial pH of 6-8 and a maximum conductivity 10 micromho/cm at 20°C (68°F); and

(iv) The total activity of the free volume of water must be measured following the 7-day immersion test and must not exceed 0.1x A_2 .

"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.

"Nuclear waste" means, for the purposes of Part 17, a quantity of source, byproduct or special nuclear material required to be in NRC-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.

"Packaging" means the assembly of components necessary to ensure compliance with the packaging requirements of 10 CFR 71. It may consist of one or more receptacles, absorbent materials, spacing structures, thermal insulation, radiation shielding, and devices for cooling or

absorbing mechanical shocks. The vehicle, tie-down system, and auxiliary equipment may be designated as part of the packaging.

"Quality assurance", for the purposes of Part 17, comprises all those planned and systematic actions necessary to provide adequate confidence that a system or component will perform satisfactorily in service.

"Quality control", for the purposes of Part 17, comprises those quality assurance actions that relate to control of the physical characteristics and quality of the material or component to predetermined requirements.

"Regulations of the DOT" means the regulations in 49 CFR Parts 100-189 and Parts 390-397 (October 1, 2006).

"Regulations of the NRC" means the regulations in 10 CFR 71 (January 1, 20~~07~~14) for purposes of Part 17.

"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. The SCO must be in one of two groups with surface activity not exceeding the following limits:

(1) 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 Bq/cm^2 (10^{-4} microcurie/cm^2) for beta, gamma and low toxicity alpha emitters, or 0.4 Bq/cm^2 (10^{-5} microcurie/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 4 x 10^4 Bq/cm^2 (1.0 microcurie/cm^2) for beta, gamma and low toxicity alpha emitters, or 4 x 10^3 Bq/cm^2 (0.1 microcurie/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 4 x 10^4 Bq/cm^2 (1 microcurie/cm^2) for beta, gamma and low toxicity alpha emitters, or 4 x 10^3 Bq/cm^2 (0.1 microcurie/cm^2) for all other alpha emitters.

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

(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 Bq/cm^2 (10^{-2} microcurie/cm^2) for beta, gamma and low toxicity alpha emitters or 40 Bq/cm^2 (10^{-3} microcurie/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 8 x 10^5 Bq/cm^2 (20 microcuries/cm^2) for beta, gamma and low toxicity alpha emitters, or 8 x 10^4 Bq/cm^2 (2 microcuries/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 8 x 10^5 Bq/cm^2 (20 microcuries/cm^2) for beta, gamma and low toxicity alpha emitters, or 8 x 10^4 Bq/cm^2 (2 microcuries/cm^2) for all other alpha emitters.

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

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

Comment [JJ4]: Definition added for compatibility with the requirements of 10 CFR Part 71.4

NRC Ref = 10 CFR 71.4
Compatibility = B
NRC RATS 2012-2 (#2)
[Due for state adoption = 08/10/2015]

"Type A package" means a Type A packaging that, together with its radioactive contents limited to A1 or A2 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 Part 17 under normal conditions of transport as demonstrated by the tests set forth in 49 CFR 173.465 or 173.466, as appropriate.

"Type A packaging" means a packaging designed for a Type A package.

"Type AF package", "Type BF package", "Type B(U)F package", and "Type B(M)F package" each means a fissile material packaging together with its fissile material contents.

"Type A quantity" means a quantity of radioactive material, the aggregate radioactivity of which does not exceed A1 for special form radioactive material or A2 for normal form radioactive material, where A1 and A2 are given in Appendix 17A or may be determined by procedures described in Appendix 17A.

"Type B package" means a Type B packaging together with its radioactive contents.2

2 A Type B package design is designated as B(U) or B(M). On approval, a Type B package design is designated by NRC as B(U) unless the package has a maximum normal operating pressure of more than 700kPa (100 lb/in2) gauge or a pressure relief device that would allow the release of radioactive material to the environment under the tests specified in 10 CFR 71.73 (hypothetical accident conditions), in which case it will receive a designation B(M). B(U) refers to the need for unilateral approval of international shipments; B(M) refers to the need for multilateral approval of international shipments. No distinction is made in how packages with these designations may be used in domestic transportation. To determine their distinction for international transportation, refer to 49 CFR Part 173. A Type B package approved prior to September 6, 1983 was designated only as Type B; limitations on its use are specified in 17.8.

"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 10 CFR Part 71.

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

LICENSE-RELATED REGULATORY REQUIREMENTS

17.3 Requirement for License.

No person shall transport radioactive material or deliver radioactive material to a carrier for transport except as authorized in a general or specific license issued by the Department, an Agreement State, a Licensing State, or NRC, or as exempted in 17.4

17.4 Exemptions.

17.4.1 Common and contract carriers, freight forwarders, and warehouse workers which are subject to the requirements of the DOT in 49 CFR 170 through 189, or the U.S. Postal Service in the Postal Service Manual (Domestic Mail Manual), are exempt from the requirements of Part 17 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 DOT or U.S. Postal Service are subject to 17.3 and other applicable requirements of these regulations.

17.4.2 Any licensee is exempt from the requirements of Part 17 with respect to shipment or carriage of the following low-level materials:

17.4.2.1 Natural material and ores containing naturally occurring radionuclides that are not intended to be processed for use of these radionuclides, provided the activity concentration of the material does not exceed 10 times the values specified in Appendix 17A, Table 17A2.

17.4.2.2 Materials for which the activity concentration is not greater than the activity concentration values specified in Appendix 17A, Table 17A2, or for which the consignment activity is not greater than the limit for an exempt consignment found in Appendix 17A, Table 17A2.

17.4.3 Fissile materials meeting the requirements of one of the paragraphs (a) through (f) in 10 CFR 71.15 are exempt from classification as fissile material, and from the fissile material package standards of 10 CFR 71.55 and 10 CFR 71.59, but are subject to all other requirements of 10 CFR 71, except as noted in paragraphs (a) through (f) in 10 CFR 71.15.

17.4.4 Any physician licensed by a state to dispense drugs in the practice of medicine is exempt from 17.5 with respect to transport by the physician of licensed material for use in the practice of medicine. However, any physician operating under this exemption must be licensed under Part 7 or equivalent requirements of another Agreement State or NRC.

17.5 Transportation of Licensed Material.

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

17.5.1.1 Comply with the applicable requirements, appropriate to the mode of transport, of the regulations of the DOT, particularly the regulations of the DOT in the following areas:

(1) Packaging - 49 CFR Part 173: Subparts A and B and I.

(2) Marking and labeling - 49 CFR Part 172: Subpart D, § § 172.400 through 172.407, § § 172.436 through 172.441, and Subpart E.

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

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

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

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

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

Comment [JJ5]: Language added at the request of NRC, consistent with the requirements of 10 CFR Part 71.13.

The added language provides an exemption from (standard) requirements and allows physicians to transport radioactive materials (typically radioactive drugs and/or certain devices containing radioactive materials) outside of U.S. Department of Transportation (DOT) requirements. The US DOT does not have an equivalent exception in their rules - only NRC has the exception in their rule.

This provision has been in place in NRC rule (10 CFR 71.13) for many years (~1972) and may have been put in place prior to the establishment of centralized nuclear pharmacy facilities. All new Agreement States are required to have the provision in their rules. Colorado and one other state may be the only Agreement States who have not implemented this provision.

This exemption was considered but expressly excluded by staff, and the Radiation Advisory Committee during the prior amendment(s) to Part 17 (most recently in 2007). The State Board of Health (BOH) concurred with the opinion of the staff and RAC to exclude this provision and did not adopt the change at that time.

Upon further evaluation It has been the experience of the Radiation Program that transportation of radioactive materials directly by physicians is rare.

Excluding the proposed provision (as has been done with prior amendments to Part 17) would continue to make Colorado's regulation not fully compatible with NRC regulations.

As a matter of compatibility and consistency with NRC rule and those of other Agreement States, the Radiation Program and Radiation Advisory Committee support inclusion of the proposed provision in Part 17 based upon the fact that such transport by physicians is a very infrequent event.

NRC Ref = 10 CFR 71.13
NRC Ltr 10/15/07 (#2)
Compatibility = [B]
NRC RATS 2004-1

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

17.5.1.2 The licensee shall also comply with applicable regulations of the DOT pertaining to the following modes of transportation:

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

(2) Air - 49 CFR Part 175.

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

(4) Public highway - 49 CFR Part 177 and Parts 390 through 397.

17.5.1.3 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 4.32.5.2.

17.5.2 If, for any reason, the regulations of the DOT 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 was subject to these regulations.

GENERAL LICENSES

17.6 General Licenses for Carriers.

17.6.1 A general license is hereby issued to any common or contract carrier not exempt under 17.4 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 DOT insofar as such requirements relate to the loading and storage of packages, placarding of the transporting vehicle, and incident reporting. [3]

3 Notification of an incident shall be filed with, or made to, the Department as prescribed in 49 CFR, regardless of and in addition to the notification made to the DOT or other agencies.

17.6.2 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 DOT insofar as such requirements relate to the loading and storage of packages, placarding of the transporting vehicle, and incident reporting. [3]

17.6.3 Persons who transport radioactive material pursuant to the general licenses in 17.6.1 and 17.6.2 are exempt from the requirements of Parts 4 and 10 of these regulations to the extent that they transport radioactive material.

17.7 General License: NRC-Approved Packages.

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

17.7.2 This general license applies only to a licensee who:

17.7.2.1 Has a quality assurance program approved by NRC as satisfying 10 CFR 71 Subpart H.

17.7.2.2 Has a copy of the specific license, certificate of compliance, or other approval by the NRC 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 action(s) to be taken prior to shipment;

17.7.2.3 Complies with the terms and conditions of the license, certificate, or other approval by the NRC, as applicable, and the applicable requirements of Part 17;

17.7.2.4 Prior to the licensee's first use of the package, has submitted to the NRC in writing in accordance with 10 CFR 71.1:

(1) The licensee's name and license number; and

(2) The package identification number specified in the package approval; and

17.7.3 The general license in 17.7.1 applies only when the package approval authorizes use of the package under this general license.

17.7.4 For a Type B or fissile material package, the design of which was approved by NRC before April 1, 1996, the general license in 17.7.1 is subject to additional restrictions of 10 CFR 71.19.

17.8 General Licenses: Use of Foreign-Approved and Other Approved Packages

17.8.1 A general license is issued to any licensee of the Department to transport, or to deliver to a carrier for transport, licensed material in a package the design of which has been approved in a foreign national competent authority certificate and revalidated by the DOT as meeting the applicable requirements of 49 CFR 171.12. This general license applies only to:

17.8.1.1 Shipments made to or from locations outside the United States; and

17.8.1.2 A licensee who:

(1) Has a quality assurance program approved by NRC;

(2) 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;

(3) Complies with the terms and conditions of the certificate and revalidation; and

(4) Complies with **the**~~each~~ applicable requirement**s** of Part 17**, sections 17.1 through 17.5, 17.10 through 17.17, and 10 CFR 71 Subparts A, G, and H. With respect to the quality assurance provisions of 10 CFR 71 Subpart H, the licensee is exempt from design, construction, and fabrication considerations**.

~~17.8.2 A general license is issued to any licensee of the Department to transport, or to deliver to a carrier for transport, licensed material in a specification container for fissile material or for a Type B quantity of radioactive material as specified in 49 CFR Parts 173 and 178. This general license, which expires October 1, 2008:~~

~~17.8.2.1 Is subject to the limitation that the specification container may not be used for a shipment to a location outside the United States except by multilateral approval as defined in 49 CFR 173.403;~~

~~17.8.2.2 Applies only to a licensee who:~~

Comment [JJ6]: Language added at the request of NRC, consistent with the requirements of 10 CFR Part 71.21(d)(2). This language was omitted during a prior revision to Part 17.

The added language incorporates specific requirements found in specific sections of the regulatory part which are essentially equivalent to those found in federal rule.

NRC Ref = 10 CFR 71.21(d)(2)
NRC Ltr 10/15/07 (#3)
Compatibility = [B]
NRC RATS 2004-1

Comment [JJ7]: This section is deleted as it expired on October 1, 2008, consistent with federal rules of 10 CFR Part 71.20(e).

~~(1) Has a quality assurance program approved by NRC as satisfying 10 CFR 71 Subpart H or equivalent approval satisfying the requirements of 17.10;~~

~~(2) Has a copy of the specification;~~

~~(3) Complies with the terms and conditions of the certificate and revalidation; and~~

~~(4) Complies with each applicable requirement of Part 17.~~

17.9 General Licenses: Fissile Material Transport

17.9.1 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 licensee meets the requirements of 10 CFR 71.22 and the material is shipped in accordance with 10 CFR 71.22 and each applicable requirement of Part 17.

17.9.2 A general license is hereby issued to any licensee to transport fissile material in the form of plutonium-beryllium (Pu-Be) special form sealed sources, or to deliver fissile material in the form of plutonium-beryllium (Pu-Be) special form sealed sources to a carrier for transport, if the licensee meets the requirements of 10 CFR 71.23 and the material is shipped in accordance with 10 CFR 71.23 and each applicable requirement of Part 17.

QUALITY ASSURANCE

17.10 Quality Assurance Requirements.

17.10.1 Quality assurance requirements apply to design, purchase, fabrication, handling, shipping, storing, cleaning, assembly, inspection, testing, operation, maintenance, repair, and modification of components of packaging that are important to safety.

17.10.1.1 The licensee, certificate holder, and applicant for a COC are responsible for complying with the quality assurance requirements which apply to design, fabrication, testing, and modification of packaging.

17.10.1.2 Each licensee is responsible for complying with each quality assurance provision which applies to the licensee's use of a packaging for the shipment of licensed material subject to the requirements of 10 CFR 71 and Part 17.

17.10.2 Each licensee, certificate holder, and applicant for a COC shall:

17.10.2.1 Be responsible to establish, maintain, and execute a quality assurance program that, using a graded approach to an extent that is commensurate with each quality assurance requirement's importance to safety, satisfies

(1) Each applicable criterion of 10 CFR 71.101 through 71.137; and

(2) Any specific provision that is applicable to the licensee's activities including procurement of packaging.

17.10.2.2 Be subject to each requirement that is applicable, whether the term "licensee" is or is not used in the requirement, for whatever design, fabrication, assembly, and testing of the package is accomplished with respect to a package before the time a package approval is issued.

17.10.3 Before the use of any package for the shipment of licensed material subject Part 17, each licensee shall obtain NRC approval of its quality assurance program.

17.10.4 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 10 CFR 34.31(b), or equivalent Agreement State requirements, is deemed to satisfy the requirements of 17.7 and 17.10.2.

17.10.5 The licensee, certificate holder, and applicant for a COC shall be responsible for the establishment and execution of the quality assurance program.

17.10.5.1 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.

17.10.5.2 The licensee shall clearly establish and delineate, in writing, the authority and duties of persons and organizations performing activities affecting the safety-related functions of structures, systems, and components, including performing the functions associated with attaining quality objectives and the quality assurance functions.

17.10.6 The quality assurance functions are:

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

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

17.10.7 The persons and organizations performing quality assurance functions must have sufficient authority and organizational freedom to:

17.10.7.1 Identify quality problems;

17.10.7.2 Initiate, recommend, or provide solutions; and

17.10.7.3 Verify implementation of solutions.

17.11 Advance Notification of Shipment of Irradiated Reactor Fuel and ~~Transport of~~ Nuclear Waste.

17.11.1 **As specified in 17.11.3, 17.11.4, and 17.11.5, each licensee shall provide advance notification to the governor of a state, or the governor's designee, of the shipment of licensed material (irradiated reactor fuel and nuclear waste), within or across the boundary of the state, before the transport, or delivery to a carrier, for transport, of licensed material outside the confines of the licensee's plant or other place of use or storage.** ~~Prior to the transport of any nuclear waste outside of the confines of the licensee's facility or other place of use or storage, or prior to the delivery of any nuclear waste to a carrier for transport, each licensee shall provide advance notification of such transport to the governor, or governor's designee [6], of each state through which the waste will be transported.~~

~~6 A list of the mailing addresses of the governors and governors' designees is available upon request from the Director, Office of State Programs, NRC, Washington, DC 20555. The list will be published annually in the Federal Register on or about June 30 to reflect any changes in information.~~

17.11.2 **As specified in 17.11.3, 17.11.4, and 17.11.5 of this section, after June 11, 2013, each licensee shall provide advance notification to the Tribal official of participating Tribes referenced in 17.11.4.3(3), or the official's designee, of the shipment of licensed material, within or across the boundary of the Tribe's reservation, before the transport, or delivery**

Comment [JJ8]: Language added/modified for consistency with the revised language of 10 CFR 71.97(a)(1).

NRC Ref = 10 CFR 71.97(a)(1)
Compatibility = B
NRC RATS 2012-2 (#3)
[Due for state adoption = 08/10/2015]

Comment [JJ9]: Deleted text is incorporated into paragraph above.

Comment [JJ10]: The information contained in this footnote has been incorporated into the body of the rule in new Section 17.11.4.3(3), which also addresses comments of NRC letter dated 10/15/07.

to a carrier, for transport, of licensed material outside the confines of the licensee's plant or other place of use or storage.

17.11.3 Advance notification is **also** required **under this section for the shipment of licensed material, other than irradiated fuel, meeting the following three conditions~~only when~~:**

17.11.~~2~~3.1 The ~~nuclear waste~~**licensed material** is required **by this part** to be in Type B packaging for transportation;

17.11.~~2~~3.2 The ~~nuclear waste~~ **licensed material** is being transported **to or across a state boundary** ~~into, within, or through, a state enroute~~**en route** to a disposal facility or to a collection point for transport to a disposal facility; and

17.11.~~2~~3.3 The quantity of licensed material in a single package exceeds ~~any one~~**the least** of the following:

(1) 3000 times the A_1~~A1~~ value of the radionuclides as specified in Appendix 17A, **Table A1** for special form radioactive material; or

(2) 3000 times the A_2~~A~~ ~~2~~ value of the radionuclides as specified in Appendix 17A, **Table A1** for normal form radioactive material; or

(3) 1000 TBq (27,000 Ci)~~;~~**.**

17.11.4 Procedures for submitting advance notification

17.11.4.1 The notification must be made in writing to:

(1) The office of each appropriate governor or governor's designee;

(2) The office of each appropriate Tribal official or Tribal official's designee;

(3) The NRC Director, Division of Security Policy, Office of Nuclear Security and Incident Response.

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

17.11.4.3 A notification delivered by any other means than mail must reach the office of the governor or of the governor's designee or the Tribal official, or Tribal official's designee at least 4 days before the beginning of the 7-day period during which departure of the shipment is estimated to occur.

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

(2) The list of governor's designees and Tribal official's designees of participating Tribes will be published annually in the Federal Register on or about June 30th to reflect any changes in information.

(3) A list of the names and mailing addresses of the governor's designees and Tribal official's designees of participating Tribes is available on request from the Director, Division of Intergovernmental Liaison and Rulemaking, Office of Federal

Comment [JJ11]: Language of this paragraph added consistent with 10 CFR 71.97(a)(2).

The added language requires notifications to Tribal officials of participating Tribes when passing within or across a Tribal reservation.

NRC Ref = 10 CFR 71.97(a)(2)
Compatibility = B
NRC RATS 2012-2 (#3)
[Due for state adoption = 08/10/2015]

Comment [JJ12]: Language added/clarified in this section for consistency with 10 CFR 71.97(b).

Comment [JJ13]: Language added to section 17.11.4, for consistency with 10 CFR 71.97(c).

The added language provides for additional specific requirements related to notifications.

NRC Ref = 10 CFR 71.97(c)
Compatibility = B
NRC RATS 2012-2 (#4)
[Due for state adoption = 08/10/2015]

and State Materials and Environmental Management Programs, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001.

17.11.4.4 The licensee shall retain a copy of the notification as a record for 3 years.

17.11.5 Information to be furnished in advance notification of shipment.

17.11.3**5.1** Each advance notification **of shipment of irradiated reactor fuel or nuclear waste** ~~required by 17.11.1~~ shall contain the following information:

~~17.11.3.~~**(1)** The name, address, and telephone number of the shipper, carrier, and receiver of the **irradiated reactor fuel or nuclear waste** shipment;

~~17.11.3.~~**(2)** A description of the **irradiated reactor fuel or** nuclear waste contained in the shipment**,** as required by 49 CFR 172.202 and 172.203(d);

~~17.11.3.~~**(3)** The point of origin of the shipment and the 7-day period during which departure of the shipment is estimated to occur;

~~17.11.3.~~**(4)** The 7-day period during which arrival of the shipment at state boundaries **or Tribal reservation boundaries** is estimated to occur;

~~17.11.3.~~**(5)** The destination of the shipment, and the 7-day period during which arrival of the shipment is estimated to occur; and

~~17.11.3.~~**(6)** A point of contact with a telephone number for current shipment information.

~~17.11.4 The notification required by 17.11.1 shall be made in writing to the office of each appropriate governor, or governor's designee, and to the Department. 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 messenger 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.~~

17.11.~~5~~**6 Revision notice**

17.11.6.1 A~~The~~ licensee **who finds that schedule information previously furnished to a governor or governor's designee or a Tribal official or Tribal official's designee, in accordance with this section, will not be met, shall:**

(1) Telephone a responsible individual in the office of the governor of the state or of the governor's designee or the Tribal official or Tribal official's designee an inform that individual of the extent of the delay beyond the schedule originally reported; and

(2) Maintain a record of the name of the individual contacted for 3 years.~~shall notify each appropriate governor, or governor's designee, and the Department of any changes to schedule information provided pursuant to 17.11.1. 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.~~

Comment [JJ14]: The addition/revision of this section is to correct a reference for the appropriate program within NRC.

NRC Letter 10/15/07 (#5)
NRC Ref = 10 CFR 71.97
Compatibility = B
NRC RATS 2004-1

Comment [JJ15]: Language added consistent with the requirements of 10 CFR Part 71.97(d).

The added language clarifies that the notification requirements apply to irradiated reactor fuel or nuclear waste. The added language also clarifies the Tribal notification requirements.

NRC Ref = 10 CFR 71.97(d)
Compatibility = B
NRC RATS 2012-2 (#6)
[Due for state adoption = 08/10/2015]

Comment [JJ16]: The requirements of this section are incorporated, with required modifications, into Section 17.11.4 (above).

Comment [JJ17]: Language added to section 17.11.6, for consistency with 10 CFR 71.97(e).

The added language clarifies what is required when a modifications pertaining to a shipment must be made.

NRC Ref = 10 CFR 71.97(e)
Compatibility = B
NRC RATS 2012-2 (#7)
[Due for state adoption = 08/10/2015]

17.11.7 Cancellation notice

17.11.67.1 Each licensee who cancels an irradiated reactor fuel or nuclear waste shipment, for which advance notification has been sent, shall:

(1) Ssend a cancellation notice to the governor of each state, or governor's designee previously notified, each Tribal official or Tribal official's designee previously notifiedof each appropriate state and to the Department;.

(2) State in the notice that it is a cancellation and identify the advance notification that is being cancelled; and

(3) Retain Aa copy of the notice shall be retained by the licensee for 3 years.

Comment [JJ18]: Language added/clarified in section 17.11.7, for consistency with 10 CFR 71.97(f).

The added/revised language clarifies what is required when a reactor fuel or nuclear waste shipment is cancelled.

NRC Ref = 10 CFR 71.97(f)
Compatibility = B
NRC RATS 2012-2 (#8)
[Due for state adoption = 08/10/2015]

17.12 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 regulations of the DOT, as may be applicable, the licensee shall assure that plutonium in any form is not transported by air, or delivered to a carrier for air transport, unless:

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

17.12.2 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 17A, Table 17A-1, and in which the radioactivity is essentially uniformly distributed; or

17.12.3 The plutonium is shipped in a single package containing no more than an A2 quantity of plutonium in any isotope or form and is shipped in accordance with 17.5; or

17.12.4 The plutonium is shipped in a package specifically authorized (in the certificate of compliance issued by the NRC for that package) for the shipment of plutonium by air and the licensee requires, through special arrangement with the carrier, compliance with 49 CFR 175.704, the regulations of the DOT applicable to the air transport of plutonium.

OPERATING CONTROLS AND PROCEDURES

17.13 Fissile Material: 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 had credible values that would cause the maximum neutron multiplication.

17.14 Preliminary Determinations.

Prior to the first use of any packaging for the shipment of radioactive material:

17.14.1 The licensee shall ascertain that there are no defects which could significantly reduce the effectiveness of the packaging;

17.14.2 Where the maximum normal operating pressure will exceed 35 kilopascal (5 pounds per square inch) gauge, the licensee shall test the containment systems 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;

17.14.3 The licensee shall determine that the packaging has been fabricated in accordance with the design approved by the NRC; and

17.14.4 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 NRC.

17.15 Routine Determinations.

Prior to each shipment of licensed material, the licensee shall determine that:

17.15.1 The package is proper for the contents to be shipped;

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

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

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

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

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

17.15.7 Any structural part of the package which could be used to lift or tie down the package during transport is rendered inoperable for the purpose unless it satisfies design requirements specified in 10 CFR 71.45;

17.15.8 The level of non-fixed (removable) radioactive contamination on the external surfaces of each package offered for shipment is as low as reasonably achievable and within the limits specified in 49 CFR 173.443.

17.15.8.1 Determination of the level of non-fixed (removable) contamination shall be based upon 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.

(1) The number and location of measurements shall be sufficient to yield a representative assessment of the removable contamination levels.

(2) Other methods of assessment of equal or greater detection efficiency may be used.

17.15.8.2 In the case of packages transported as exclusive use shipments by rail or highway only, the non-fixed (removable) radioactive contamination:

(1) At the beginning of transport shall not exceed the levels specified in 49 CFR 173.443; and

(2) At any time during transport shall not exceed 10 times the levels specified in 49 CFR 173.443.

17.15.9 External radiation levels around the package and around the vehicle, if applicable, shall not exceed:

17.15.9.1 2 mSv/h (200 millirem per hour) at any point on the external surface of the package at any time during transportation;

17.15.9.2 A transport index of 10.0.

17.15.10 For a package transported in exclusive use by rail, highway or water, radiation levels external to the package may exceed the limits specified in 17.15.9 but shall not exceed any of the following:

17.15.10.1 2 mSv/h (200 millirem per hour) on the accessible external surface of the package unless the following conditions are met, in which case the limit is 10 mSv/h (1000 millirem per hour);

(1) The shipment is made in a closed transport vehicle,

(2) Provisions are made to secure the package so that its position within the vehicle remains fixed during transportation, and

(3) No loading or unloading operation occurs between the beginning and end of the transportation.

17.15.10.2 2 mSv/h (200 millirem per hour) at any point on the outer surface of the vehicle, including the upper and lower surfaces, 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;

(1) A flat bed style vehicle with a personnel barrier shall have radiation levels determined at vertical planes.

(2) If no personnel barrier is in place, the package cannot exceed 2 mSv/h (200 millirem per hour) at any accessible surface.

17.15.10.3 0.1 mSv/h (10 millirem 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

17.15.10.4 0.02 mSv/h (2 millirem per hour) 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 10.3; and

17.15.11 **For shipments made under the provisions of Section 17.15.10, 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.**

17.15.12 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:

17.15.12.1 Unnecessarily delay delivery; or

17.15.12.2 Unnecessarily result in increased radiation levels or radiation exposures to transport workers or members of the general public.

Comment [JJ19]: The added language of 17.15.11, and 17.15.12 are at the request of NRC and are consistent with 10 CFR Part 71.47(c), and 71.47(d)

The added language specifies additional requirements for exclusive use shipments as required by federal rule. Refer to the definition for "exclusive use" in section 17.2, as similar requirements are also contained in the definition.

NRC Ref = 10 CFR 71.47(c), and 71.47(d)
NRC Ltr 10/15/07 (#4)
Compatibility = [B]
NRC RATS 2004-1

17.15.13 A package must be prepared for transport so that in still air at 100 degrees Fahrenheit (38 degrees Celsius) and in the shade, no accessible surface of a package would have a temperature exceeding 50 degrees Celsius (122 degrees Fahrenheit) in a nonexclusive use shipment or 82 degrees Celsius (185 degrees Fahrenheit) in an exclusive use shipment. Accessible package surface temperatures shall not exceed these limits at any time during transportation.

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

17.15.153 Before delivery of a package to a carrier for transport, the licensee shall ensure that any special instructions needed to safely open the package have been sent to the consignee, or otherwise made available to the consignee, for the consignee's use in accordance with 4.32.5.2.

REPORTS AND RECORDS

17.16 Reports.

The licensee shall report to the Department within 30 days:

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

17.16.2 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; and

17.16.3 Instances in which the conditions of approval in the certificate of compliance were not observed in making a shipment.

17.17 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 17.4 showing, where applicable:

17.17.1 Identification of the packaging by model number and serial number;

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

17.17.3 Volume and identification of coolant;

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

17.17.5 Date of the shipment;

17.17.6 Name and address of the transferee;

17.17.7 Address to which the shipment was made; and

17.17.8 Results of the determinations required by 17.15 and by the conditions of the package approval.

Appendix 17A - Determination of A_1 and A_2

17A1 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 17A1. The curie (Ci) values specified are obtained by converting from the Terabecquerel (TBq) figure. The Terabecquerel values are the regulatory standard. The curie values are for information only and are not intended to be the regulatory standard. 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.

17A2 For individual radionuclides whose identities are known, but which are:

17A2.1 Not listed in Table 17A1:

(1) The A_1 and A_2 values Table 17A3 may be used.

(2) Otherwise, the licensee shall obtain prior NRC approval of the A_1 and A_2 values for radionuclides not listed in Table 17A1, before shipping the material. The licensee shall submit such request for prior approval to NRC in accordance with 10 CFR 71.1.

17A2.2 Not listed in Table 17A2:

(1) The exempt material activity concentration and exempt consignment activity values contained in Table 17A3 may be used.

(2) Otherwise, the licensee shall obtain prior NRC approval of the exempt material activity concentration and exempt consignment activity values for radionuclides not listed in Table 17A2, before shipping the material. The licensee shall submit such request for prior approval to NRC in accordance with 10 CFR 71.1.

17A3 In the calculations of A_1 and A_2 for a radionuclide not in Table 17A1, a single radioactive decay chain, in which radionuclides are present in their naturally occurring proportions, and in which no radioactive decay product 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 radioactive decay product nuclide has a half-life either longer than 10 days, or greater than that of the parent nuclide, the parent and those radioactive decay product nuclides shall be considered as mixtures of different nuclides.

17A4 For mixtures of radionuclides whose identities and respective activities are known, the following conditions apply:

17A4.1 For special form radioactive material, the maximum quantity transported in a Type A package is as follows:

1007-1_2007-00573_inline1.jpg

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

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

Comment [JJ20]:
EDITORIAL NOTE: The document used to generate this draft was downloaded from the Colorado Secretary of State (SOS) website. When downloaded, graphic images (such as symbols and equations) are not carried with the document and are instead treated as ".jpg"text in the document. Throughout this section there are multiple ".jpg" references. The ".jpg" references will not appear in the final rule as published by the SOS, and instead the actual symbol or equation will appear. Unless specifically shown, the symbols/equations will be shown as a ".jpg" text reference. ***There are no changes to these symbols or equations beyond the one specified in 17A4.1 (line 691) .***

Comment [JJ21]: At the request of NRC, the prior equation is deleted and replaced with the current equation to address a prior typographical error. The revised equation is equivalent to the equation found in 10 CFR 71, Appendix A, IV(a). The revised equation is equivalent to the deleted equation with the exception of the "≤"replacing the "-" symbol.

EDITORIAL NOTE: The equation shown is generated by a symbol/equation generator and "strikeout" and "bold" text/fonts cannot be used with such equation generators. Therefore, a line is placed through the old equation to represent strikeout text. The equations were inserted into the document obtained from the SOS website and corrected to illustrate the proposed change.

NRC Ltr 10/15/07 (#7)
Compatibility = B
NRC RATS 2004-1

17A4.2 For normal form radioactive material, the maximum quantity transported in a Type A package is as follows:

1007-1_2007-00573_inline2.jpg

where B(i) is the activity of radionuclide i, and A_2 (i) is the A_2 value for radionuclide i.

17A4.3 Alternatively, an A_1 value for mixtures of special form material may be determined as follows:

1007-1_2007-00573_inline3.jpg

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.

17A4.4 Alternatively, the A_2 value for mixtures of normal form material may be determined as follows:

1007-1_2007-00573_inline4.jpg

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.

17A4.5 The exempt activity concentration for mixtures of nuclides may be determined as follows:

1007-1_2007-00573_inline5.jpg

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.

17A4.6 The activity limit for an exempt consignment for mixtures of radionuclides may be determined as follows:

1007-1_2007-00573_inline6.jpg

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.

17A5 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 17A4. 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 17A1: A_1 AND A_2 VALUES FOR RADIONUCLIDES – Part 1 of 4

Symbol of radionuclide	Element and atomic number	A_1 (TBq)	A_1 (Ci)b	A_2 (Tab)	A_2 (Ci)b	Specific activity	Specific activity
.	.	.	.	.	.	(TBq/g)	(Ci/g)
Ac-225 (a)	Actinium (89)	$8.0X10^{-1}$	$2.2X10^{1}$	$6.0X10^{-3}$	$1.6X10^{-1}$	$2.1X10^{3}$	$5.8X10^{4}$

DRAFT 1 04/02/14

Ac-227 (a)	.	$9.0X10^{-1}$	$2.4X10^{1}$	$9.0X10^{-5}$	$2.4X10^{-3}$	2.7	$7.2X10^{1}$
Ac-228	.	$6.0X10^{-1}$	$1.6X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$8.4X10^{4}$	$2.2X10^{6}$
Ag-105	Silver (47)	2.0	$5.4X10^{1}$	2.0	$5.4X10^{1}$	$1.1X10^{3}$	$3.0X10^{4}$
Ag-108m (a)	.	$7.0X10^{-1}$	$1.9X10^{1}$	$7.0X10^{-1}$	$1.9X10^{1}$	$9.7X10^{-1}$	$2.6X10^{1}$
Ag-110m (a)	.	$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$1.8X10^{2}$	$4.7X10^{3}$
Ag-111	.	2.0	$5.4X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$5.8X10^{3}$	$1.6X10^{5}$
Al-26	Aluminum (13)	$1.0X10^{-1}$	2.7	$1.0X10^{-1}$	2.7	$7.0X10^{-4}$	$1.9X10^{-2}$
Am-241	Americium (95)	$1.0X10^{1}$	$2.7X10^{2}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$1.3X10^{-1}$	3.4
Am-242m (a)	.	$1.0X10^{1}$	$2.7X10^{2}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$3.6X10^{-1}$	$1.0X10^{1}$
Am-243 (a)	.	5.0	$1.4X10^{2}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$7.4X10^{-3}$	$2.0X10^{-1}$
Ar-37	Argon (18)	$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	$3.7X10^{3}$	$9.9X10^{4}$
Ar-39	.	$4.0X10^{1}$	$1.1X10^{3}$	$2.0X10^{1}$	$5.4X10^{2}$	1.3	$3.4X10^{1}$
Ar-41	.	$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$1.5X10^{6}$	$4.2X10^{7}$
As-72	Arsenic (33)	$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$6.2X10^{4}$	$1.7X10^{6}$
As-73	.	$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	$8.2X10^{2}$	$2.2X10^{4}$
As-74	.	1.0	$2.7X10^{1}$	$9.0X10^{-1}$	$2.4X10^{1}$	$3.7X10^{3}$	$9.9X10^{4}$
As-76	.	$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$5.8X10^{4}$	$1.6X10^{6}$
As-77	.	$2.0X10^{1}$	$5.4X10^{2}$	$7.0X10^{-1}$	$1.9X10^{1}$	$3.9X10^{4}$	$1.0X10^{6}$
At-211 (a)	Astatine (85)	$2.0X10^{1}$	$5.4X10^{2}$	$5.0X10^{-1}$	$1.4X10^{1}$	$7.6X10^{4}$	$2.1X10^{6}$
Au-193	Gold (79)	7.0	$1.9X10^{2}$	2.0	$5.4X10^{1}$	$3.4X10^{4}$	$9.2X10^{5}$
Au-194	.	1.0	$2.7X10^{1}$	1.0	$2.7X10^{1}$	$1.5X10^{4}$	$4.1X10^{5}$
Au-195	.	$1.0X10^{1}$	$2.7X10^{2}$	6.0	$1.6X10^{2}$	$1.4X10^{2}$	$3.7X10^{3}$

DRAFT 1 04/02/14

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

DRAFT 1 04/02/14

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	.	$4.0X10^{1}$	$1.1X10^{3}$	$1.0X10^{-2}$	$2.7X10^{-1}$	$1.2X10^{2}$	$3.3X10^{3}$

DRAFT 1 04/02/14

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

722

723 **TABLE 17A1: A_1 AND A_2 VALUES FOR RADIONUCLIDES – Part 2 of 4**

Symbol. of. radionuclide	Element.and. atomic.number	A_1 .(Tab)	A_1 (Ci)b	A_2 .(TBq)	A_2 (Ci)b	Specific.activity	Specific.activity
.	.	.	.	.	.	(TBq/g)	(Ci/g)
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

DRAFT 1 04/02/14

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-	.	1.0X1	2.7X1	4.0X1	1.1X1	2.5X10 ^{4}	6.7X10 ^{5}

DRAFT 1 04/02/14

197m		0^{1}	0^{2}	0^{-1}	0^{1}		
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	$3.1X10^{4}$	$8.4X10^{5}$

DRAFT 1 04/02/14

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	9.0X1	2.4X1	6.0X1	1.6X1	5.4X10 ^{7}	1.5X10 ^{9}

DRAFT 1 04/02/14

	)	0^{-1}	0^{1}	0^{-1}	0^{1}		
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-	.	3.0X1	8.1	3.0X1	8.1	$1.1X10^{1}$	$3.1X10^{2}$

194.(a)		0^{-1}		0^{-1}			

724

725 **TABLE 17A1: A_1 AND A_2 VALUES FOR RADIONUCLIDES – Part 3 of 4**

Symbol . of . radionuclide	Element.and. atomic.number	A_1 . (TBq)	A_1 (Ci)b	A_2 . (Tab)	A_2 (Ci)b	Specific.activity	Specific.activity
.	.	.	.	.	.	(TBq/g)	(Ci/g)
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	.	4.0X1	1.1X1	2.0	5.4X1	$3.4X10^{1}$	$9.3X10^{2}$

DRAFT 1 04/02/14

		0^{1}	0^{3}		0^{1}		
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 .	.	4.0X1	1.1X1	1.0X1	2.7X1	$6.7X10^{-7}$	$1.8X10^{-5}$

DRAFT 1 04/02/14

(a)		0^{-1}	0^{1}	0^{-3}	0^{-2}		
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}

DRAFT 1 04/02/14

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	$8.1X10^{1}$	$4.8X10^{5}$	$1.3X10^{7}$

726

727 **TABLE 17A1: A_1 AND A_2 VALUES FOR RADIONUCLIDES – Part 4 of 4**

Symbol.of. radionuclide	**Element.and. atomic.number**	**A_1 .(TBq)**	**A_1 (Ci)b**	**A_2 .(Tab)**	**A_2 (Ci)b**	**Specific. activity**	**Specific. activity**
.	.	.	.	.	.	**(TBq/g)**	**(Ci/g)**
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	$1.3X10^{5}$	$3.6X10^{6}$

DRAFT 1 04/02/14

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	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

DRAFT 1 04/02/14

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	31.1X10 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	Uranium . (92)	4.0X10 1	1.1X10 3	1.0X10 -1	2.7	1.0X10 3	2.7X10 4

Comment [JJ22]: The change is necessary for compatibility with equivalent NRC requirements in 10 CFR Part 71, Table A-1.

Compatibility = B
NRC RATS = 2012-3

DRAFT 1 04/02/14

) . (a)(d)							
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	.	4.0X10 1	1.1X10 3	9.0X10 -2	2.4	2.3X10 -4	6.2X10 -3

) . (d)							
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 .	.	Unlimited	Unlimited	Unlimited	Unlimited	See . Table . 17A-4	See . Table . 17A-4

Comment [JJ23]: Correction of reference to appropriate table.

less) . (g)							
U . (dep)	.	Unlimited	Unlimited	Unlimited	Unlimited	See . Table . 17A–4	(See . Table . 17A–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	8.1	3.0X10	8.1	1.2X1	3.3X1

Comment [JJ24]: Correction of reference to appropriate table.

		-1		-1		0^{5}	0^{6}
Yb-169	Ytterbium . (70)	4.0	$1.1X10^{2}$	1.0	$2.7X10^{1}$	$8.9X10^{2}$	$2.4X10^{4}$
Yb-175	.	$3.0X10^{1}$	$8.1X10^{2}$	$9.0X10^{-1}$	$2.4X10^{1}$	$6.6X10^{3}$	$1.8X10^{5}$
Zn-65	Zinc . (30)	2.0	$5.4X10^{1}$	2.0	$5.4X10^{1}$	$3.0X10^{2}$	$8.2X10^{3}$
Zn-69	.	3.0	$8.1X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$1.8X10^{6}$	$4.9X10^{7}$
Zn-69m . (a)	.	3.0	$8.1X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$1.2X10^{5}$	$3.3X10^{6}$
Zr-88	Zirconium . (40)	3.0	$8.1X10^{1}$	3.0	$8.1X10^{1}$	$6.6X10^{2}$	$1.8X10^{4}$
Zr-93	.	Unlimited	Unlimited	Unlimited	Unlimited	$9.3X10^{-5}$	$2.5X10^{-3}$
Zr-95 . (a)	.	2.0	$5.4X10^{1}$	$8.0X10^{-1}$	$2.2X10^{1}$	$7.9X10^{2}$	$2.1X10^{4}$
Zr-97 . (a)	.	$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$7.1X10^{4}$	$1.9X10^{6}$

Notes:

a A1 and/or A2 values include contributions from daughter nuclides with half-lives less than 10 days.

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 17A – Determination of A_1 and A_2, Section 17A1)

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

~~Sr-90 Y-90~~

~~Zr-93 Nb-93m~~

~~Zr-97 Nb-97~~

~~Ru-106 Rh-106~~

~~Cs-137 Ba-137m~~

~~Ce-134 La-134~~

~~Ce-144 Pr-144~~

~~Ba-140 La-140~~

~~Bi-212 Tl-208 0.36 , Po-212 0.64~~

~~Pb-210 Bi-210, Po-210~~

~~Pb-212 Bi-212, Tl-208 0.36 , Po-212 0.64~~

~~Rn-220 Po-216~~

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

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

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

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

~~Ra-228 Ac-228~~

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

Comment [JJ25]: The new footnote "b" is added, consistent with 10 CFR 71, Appendix A, Table A-1.

The added footnote effectively restates the information contained in the introductory text of Section 17A1.

NRC Compatibility = [B]
NRC RATS = 2012-3

Comment [JJ26]: Footnote "b" is deleted here and relocated to Table 17A2. The original reference here was incorrect as there are no items in Table 17A1 originally referenced this footnote.

The approach here is consistent with the footnotes of 10 CFR 71, Appendix A, Table A-1.

~~Th-228 Ra-224, Rn-220, Po-216, Pb212, Bi-212, Tl208 0.36 , Po-212 0.64~~

~~Th-229 Ra-225, Ac-225, Fr-221, At-217, Bi-213, Po-213, Pb-209~~

~~Th-nat Ra-228, Ac-228, Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208 0.36 , Po-12 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,~~

~~U-240 Np-240m~~

~~Np-237 Pa-233~~

~~Am-242m Am-242~~

~~Am-243 Np-239~~

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

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

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

f These values apply to all compounds of uranium other than those specified in d and e, above.

g These values apply to unirradiated uranium only.

h These values apply to domestic transport only. For international transport, use the values in the table below.

TABLE 17A1 (SUPPLEMENT): A 1 AND A 2 VALUES FOR RADIONUCLIDES FOR INTERNATIONAL SHIPMENTS

Symbol of radionuclide	Element and atomic number	A_1 (TBq)	A_1 (Ci)	A_2 (TBq)	A_2 (Ci)	Specific activity (TBq/g)	Specific activity (Ci/g)
Cf-252	Californium (98)	5.0×10^{-2}	1.4	3.0×10^{-3}	8.1×10^{-2}	2.0×10^{1}	5.4×10^{2}
Mo-99 [c]	Molybdenum (42)	1.0	2.7×10^{1}	6.0×10^{-1}	1.6×10^{1}	1.8×10^{4}	4.8×10^{5}

TABLE 17A2: EXEMPT MATERIAL ACTIVITY CONCENTRATIONS AND EXEMPT CONSIGNMENT ACTIVITY LIMITS FOR RADIONUCLIDES Part 1 of 4

Symbol of radionuclide	Element and atomic number	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
Ac-225 (a)	Actinium (89)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{4}	2.7×10^{-7}

Ac-227 (a)	.	1.0×10^{-1}	2.7×10^{-12}	1.0×10^{3}	2.7×10^{-8}
Ac-228	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Ag-105	Silver (47)	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Ag-108m (a)	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Ag-110m (a)	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Ag-111	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{6}	2.7×10^{-5}
Al-26	Aluminum (13)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
Am-241	Americium (95)	1.0	2.7×10^{-11}	1.0×10^{4}	2.7×10^{-7}
Am-242m (a)	.	1.0	2.7×10^{-11}	1.0×10^{4}	2.7×10^{-7}
Am-243 (a)	.	1.0	2.7×10^{-11}	1.0×10^{3}	2.7×10^{-8}
Ar-37	Argon (18)	1.0×10^{6}	2.7×10^{-5}	1.0×10^{8}	2.7×10^{-3}
Ar-39	.	1.0×10^{7}	2.7×10^{-4}	1.0×10^{4}	2.7×10^{-7}
Ar-41	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{9}	2.7×10^{-2}
As-72	Arsenic (33)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
As-73	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{7}	2.7×10^{-4}
As-74	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
As-76	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{5}	2.7×10^{-6}
As-77	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{6}	2.7×10^{-5}
At-211 (a)	Astatine (85)	1.0×10^{3}	2.7×10^{-8}	1.0×10^{7}	2.7×10^{-4}
Au-193	Gold (79)	1.0×10^{2}	2.7×10^{-9}	1.0×10^{7}	2.7×10^{-4}
Au-194	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Au-195	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{7}	2.7×10^{-4}
Au-198	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Au-199	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Ba-131 (a)	Barium (56)	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Ba-133	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Ba-133m	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Ba-140 (a)	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
Be-7	Beryllium (4)	1.0×10^{3}	2.7×10^{-8}	1.0×10^{7}	2.7×10^{-4}
Be-10	.	1.0×10^{4}	2.7×10^{-7}	1.0×10^{6}	2.7×10^{-5}
Bi-205	Bismuth	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}

	(83)				
Bi-206	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
Bi-207	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Bi-210	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{6}	2.7×10^{-5}
Bi-210m (a)	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
Bi-212 (a)	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
Bk-247	Berkelium (97)	1.0	2.7×10^{-11}	1.0×10^{4}	2.7×10^{-7}
Bk-249 [5]	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{6}	2.7×10^{-5}
Br-76	Bromine (35)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
Br-77	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Br-82	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
C-11	Carbon (6)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
C-14	.	1.0×10^{4}	2.7×10^{-7}	1.0×10^{7}	2.7×10^{-4}
Ca-41	Calcium (20)	1.0×10^{5}	2.7×10^{-6}	1.0×10^{7}	2.7×10^{-4}
Ca-45	.	1.0×10^{4}	2.7×10^{-7}	1.0×10^{7}	2.7×10^{-4}
Ca-47 (a)	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Cd-109	Cadmium (48)	1.0×10^{4}	2.7×10^{-7}	1.0×10^{6}	2.7×10^{-5}
Cd-113m	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{6}	2.7×10^{-5}
Cd-115 (a)	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Cd-115m	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{6}	2.7×10^{-5}
Ce-139	Cerium (58)	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Ce-141	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{7}	2.7×10^{-4}
Ce-143	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Ce-144 (a)	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{5}	2.7×10^{-6}
Cf-248	Californium (98)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{4}	2.7×10^{-7}
Cf-249	.	1.0	2.7×10^{-11}	1.0×10^{3}	2.7×10^{-8}
Cf-250	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{4}	2.7×10^{-7}
Cf-251	.	1.0	2.7×10^{-11}	1.0×10^{3}	2.7×10^{-8}
Cf-252	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{4}	2.7×10^{-7}
Cf-253 (a)	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{5}	2.7×10^{-6}
Cf-254	.	1.0	2.7×10^{-11}	1.0×10^{3}	2.7×10^{-8}
Cl-36	Chlorine (17)	1.0×10^{4}	2.7×10^{-7}	1.0×10^{6}	2.7×10^{-5}
Cl-38	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
Cm-240	Curium (96)	1.0×10^{2}	2.7×10^{-9}	1.0×10^{5}	2.7×10^{-6}

Cm-241	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Cm-242	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{5}	2.7×10^{-6}
Cm-243	.	1.0	2.7×10^{-11}	1.0×10^{4}	2.7×10^{-7}
Cm-244	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{4}	2.7×10^{-7}
Cm-245	.	1.0	2.7×10^{-11}	1.0×10^{3}	2.7×10^{-8}
Cm-246	.	1.0	2.7×10^{-11}	1.0×10^{3}	2.7×10^{-8}
Cm-247 (a)	.	1.0	2.7×10^{-11}	1.0×10^{4}	2.7×10^{-7}
Cm-248	.	1.0	2.7×10^{-11}	1.0×10^{3}	2.7×10^{-8}
Co-55	Cobalt (27)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Co-56	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
Co-57	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Co-58	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Co-58m	.	1.0×10^{4}	2.7×10^{-7}	1.0×10^{7}	2.7×10^{-4}
Co-60	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
Cr-51	Chromium (24)	1.0×10^{3}	2.7×10^{-8}	1.0×10^{7}	2.7×10^{-4}
Cs-129	Cesium (55)	1.0×10^{2}	2.7×10^{-9}	1.0×10^{5}	2.7×10^{-6}
Cs-131	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{6}	2.7×10^{-5}
Cs-132	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
Cs-134	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{4}	2.7×10^{-7}
Cs-134m	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{5}	2.7×10^{-6}
Cs-135	.	1.0×10^{4}	2.7×10^{-7}	1.0×10^{7}	2.7×10^{-4}
Cs-136	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
Cs-137 (a)	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{4}	2.7×10^{-7}
Cu-64	Copper (29)	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Cu-67	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Dy-159	Dysprosium (66)	1.0×10^{3}	2.7×10^{-8}	1.0×10^{7}	2.7×10^{-4}
Dy-165	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{6}	2.7×10^{-5}
Dy-166 (a)	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{6}	2.7×10^{-5}
Er-169	Erbium (68)	1.0×10^{4}	2.7×10^{-7}	1.0×10^{7}	2.7×10^{-4}
Er-171	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}

TABLE 17A2: EXEMPT MATERIAL ACTIVITY CONCENTRATIONS AND EXEMPT CONSIGNMENT ACTIVITY LIMITS FOR RADIONUCLIDES Part 2 of 4

Symbol of radionuclide	Element and atomic number	Activity concentration for exempt material	Activity concentration for exempt material	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)

DRAFT 1 04/02/14

		(Bq/g)	(Ci/g)		
Eu-147	Europium (63)	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Eu-148	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Eu-149	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{7}	2.7×10^{-4}
Eu-150 (short-lived)	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{6}	2.7×10^{-5}
Eu-150 (long-lived)	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{6}	2.7×10^{-5}
Eu-152	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Eu-152 m	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Eu-154	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Eu-155	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{7}	2.7×10^{-4}
Eu-156	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
F-18	Fluorine (9)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Fe-52 (a)	Iron (26)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Fe-55	.	1.0×10^{4}	2.7×10^{-7}	1.0×10^{6}	2.7×10^{-5}
Fe-59	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Fe-60 (a)	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{5}	2.7×10^{-6}
Ga-67	Gallium (31)	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Ga-68	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
Ga-72	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
Gd-146 (a)	Gadolinium (64)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Gd-148	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{4}	2.7×10^{-7}
Gd-153	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{7}	2.7×10^{-4}
Gd-159	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{6}	2.7×10^{-5}
Ge-68 (a)	Germanium (32)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
Ge-71	.	1.0×10^{4}	2.7×10^{-7}	1.0×10^{8}	2.7×10^{-3}
Ge-77	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
Hf-172 (a)	Hafnium (72)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Hf-175	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Hf-181	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Hf-182	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Hg-194 (a)	Mercury (80)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Hg-195m (a)	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Hg-197	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{7}	2.7×10^{-4}
Hg-197m	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Hg-203	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{5}	2.7×10^{-6}

DRAFT 1 04/02/14

Ho-166	Holmium (67)	1.0×10^{3}	2.7×10^{-8}	1.0×10^{5}	2.7×10^{-6}
Ho-166m	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
I-123	Iodine (53)	1.0×10^{2}	2.7×10^{-9}	1.0×10^{7}	2.7×10^{-4}
I-124	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
I-125	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{6}	2.7×10^{-5}
I-126	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
I-129	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{5}	2.7×10^{-6}
I-131	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
I-132	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
I-133	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
I-134	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
I-135 (a)	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
In-111	Indium (49)	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
In-113m	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
In-114m (a)	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
In-115m	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Ir-189 (a)	Iridium (77)	1.0×10^{2}	2.7×10^{-9}	1.0×10^{7}	2.7×10^{-4}
Ir-190	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Ir-192	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{4}	2.7×10^{-7}
Ir-194	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{5}	2.7×10^{-6}
K-40	Potassium (19)	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
K-42	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
K-43	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Kr-81	Krypton (36)	1.0×10^{4}	2.7×10^{-7}	1.0×10^{7}	2.7×10^{-4}
Kr-85	.	1.0×10^{5}	2.7×10^{-6}	1.0×10^{4}	2.7×10^{-7}
Kr-85m	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{10}	2.7×10^{-1}
Kr-87	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{9}	2.7×10^{-2}
La-137	Lanthanum (57)	1.0×10^{3}	2.7×10^{-8}	1.0×10^{7}	2.7×10^{-4}
La-140	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
Lu-172	Lutetium (71)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Lu-173	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{7}	2.7×10^{-4}
Lu-174	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{7}	2.7×10^{-4}
Lu-174m	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{7}	2.7×10^{-4}
Lu-177	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{7}	2.7×10^{-4}
Mg-28 (a)	Magnesium (12)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
Mn-52	Manganese	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}

	(25)				
Mn-53	.	1.0×10^{4}	2.7×10^{-7}	1.0×10^{9}	2.7×10^{-2}
Mn-54	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Mn-56	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
Mo-93	Molybdenum (42)	1.0×10^{3}	2.7×10^{-8}	1.0×10^{8}	2.7×10^{-3}
Mo-99 (a)	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
N-13	Nitrogen (7)	1.0×10^{2}	2.7×10^{-9}	1.0×10^{9}	2.7×10^{-2}
Na-22	Sodium (11)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Na-24	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
Nb-93m	Niobium (41)	1.0×10^{4}	2.7×10^{-7}	1.0×10^{7}	2.7×10^{-4}
Nb-94	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Nb-95	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Nb-97	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Nd-147	Neodymium (60)	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Nd-149	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Ni-59	Nickel (28)	1.0×10^{4}	2.7×10^{-7}	1.0×10^{8}	2.7×10^{-3}
Ni-63	.	1.0×10^{5}	2.7×10^{-6}	1.0×10^{8}	2.7×10^{-3}
Ni-65	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Np-235	Neptunium (93)	1.0×10^{3}	2.7×10^{-8}	1.0×10^{7}	2.7×10^{-4}
Np-236 (short-lived)	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{7}	2.7×10^{-4}
Np-236 (long-lived)	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{7}	2.7×10^{-4}
Np-237	.	1.0	2.7×10^{-11}	1.0×10^{3}	2.7×10^{-8}
Np-239	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{7}	2.7×10^{-4}
Os-185	Osmium (76)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Os-191	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{7}	2.7×10^{-4}
Os-191m	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{7}	2.7×10^{-4}
Os-193	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}

TABLE 17A2: EXEMPT MATERIAL ACTIVITY CONCENTRATIONS AND EXEMPT CONSIGNMENT ACTIVITY LIMITS FOR RADIONUCLIDES Part 3 of 4

Symbol of radionuclide	Element and atomic number	Activity concentration for exempt material	Activity concentration for exempt material	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)

DRAFT 1 04/02/14

		(Bq/g)	(Ci/g)		
Os-194 (a)	Osmium (76)	1.0×10^{2}	2.7×10^{-9}	1.0×10^{5}	2.7×10^{-6}
P-32	Phosphorus (15)	1.0×10^{3}	2.7×10^{-8}	1.0×10^{5}	2.7×10^{-6}
P-33	.	1.0×10^{5}	2.7×10^{-6}	1.0×10^{8}	2.7×10^{-3}
Pa-230(a)	Protactinium (91)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Pa-231	.	1.0	2.7×10^{-11}	1.0×10^{3}	2.7×10^{-8}
Pa-233	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{7}	2.7×10^{-4}
Pb-201	Lead (82)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Pb-202	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{6}	2.7×10^{-5}
Pb-203	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Pb-205	.	1.0×10^{4}	2.7×10^{-7}	1.0×10^{7}	2.7×10^{-4}
Pb-210 (a)	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{4}	2.7×10^{-7}
Pb-212 (a)	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
Pd-103 (a)	Palladium (46)	1.0×10^{3}	2.7×10^{-8}	1.0×10^{8}	2.7×10^{-3}
Pd-107	.	1.0×10^{5}	2.7×10^{-6}	1.0×10^{8}	2.7×10^{-3}
Pd-109	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{6}	2.7×10^{-5}
Pm-143	Promethium (61)	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Pm-144	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Pm-145	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{7}	2.7×10^{-4}
Pm-147	.	1.0×10^{4}	2.7×10^{-7}	1.0×10^{7}	2.7×10^{-4}
Pm-148m (a)	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Pm-149	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{6}	2.7×10^{-5}
Pm-151	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Po-210	Polonium (84)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{4}	2.7×10^{-7}
Pr-142	Praseodymium (59)	1.0×10^{2}	2.7×10^{-9}	1.0×10^{5}	2.7×10^{-6}
Pr-143	.	1.0×10^{4}	2.7×10^{-7}	1.0×10^{6}	2.7×10^{-5}
Pt-188 (a)	Platinum (78)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Pt-191	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Pt-193	.	1.0×10^{4}	2.7×10^{-7}	1.0×10^{7}	2.7×10^{-4}
Pt-193m	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{7}	2.7×10^{-4}
Pt-195m	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Pt-197	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{6}	2.7×10^{-5}
Pt-197m	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Pu-236	Plutonium (94)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{4}	2.7×10^{-7}

Pu-237	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{7}	2.7×10^{-4}
Pu-238	.	1.0	2.7×10^{-11}	1.0×10^{4}	2.7×10^{-7}
Pu-239	.	1.0	2.7×10^{-11}	1.0×10^{4}	2.7×10^{-7}
Pu-240	.	1.0	2.7×10^{-11}	1.0×10^{3}	2.7×10^{-8}
Pu-241 (a)	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{5}	2.7×10^{-6}
Pu-242	.	1.0	2.7×10^{-11}	1.0×10^{4}	2.7×10^{-7}
Pu-244 (a)	.	1.0	2.7×10^{-11}	1.0×10^{4}	2.7×10^{-7}
Ra-223 (a)	Radium (88)	1.0×10^{2}	2.7×10^{-9}	1.0×10^{5}	2.7×10^{-6}
Ra-224 (a)	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
Ra-225 (a)	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{5}	2.7×10^{-6}
Ra-226 (a)	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{4}	2.7×10^{-7}
Ra-228 (a)	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
Rb-81	Rubidium (37)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Rb-83 (a)	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Rb-84	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Rb-86	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{5}	2.7×10^{-6}
Rb-87	.	1.0×10^{4}	2.7×10^{-7}	1.0×10^{7}	2.7×10^{-4}
Rb (natural)	.	1.0×10^{4}	2.7×10^{-7}	1.0×10^{7}	2.7×10^{-4}
Re-184	Rhenium (75)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Re-184m	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Re-186	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{6}	2.7×10^{-5}
Re-187	.	1.0×10^{6}	2.7×10^{-5}	1.0×10^{9}	2.7×10^{-2}
Re-188	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{5}	2.7×10^{-6}
Re-189 (a)	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Re (natural)	.	1.0×10^{6}	2.7×10^{-5}	1.0×10^{9}	2.7×10^{-2}
Rh-99	Rhodium (45)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Rh-101	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{7}	2.7×10^{-4}
Rh-102	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Rh-102m	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Rh-103m	.	1.0×10^{4}	2.7×10^{-7}	1.0×10^{8}	2.7×10^{-3}
Rh-105	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{7}	2.7×10^{-4}
Rn-222 (a)	Radon (86)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{8}	2.7×10^{-3}

Ru-97	Ruthenium (44)	1.0×10^{2}	2.7×10^{-9}	1.0×10^{7}	2.7×10^{-4}
Ru-103 (a)	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Ru-105	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Ru-106 (a)	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{5}	2.7×10^{-6}
S-35	Sulphur (16)	1.0×10^{5}	2.7×10^{-6}	1.0×10^{8}	2.7×10^{-3}
Sb-122	Antimony (51)	1.0×10^{2}	2.7×10^{-9}	1.0×10^{4}	2.7×10^{-7}
Sb-124	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Sb-125	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Sb-126	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
Sc-44	Scandium (21)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
Sc-46	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Sc-47	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Sc-48	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
Se-75	Selenium (34)	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Se-79	.	1.0×10^{4}	2.7×10^{-7}	1.0×10^{7}	2.7×10^{-4}
Si-31	Silicon (14)	1.0×10^{3}	2.7×10^{-8}	1.0×10^{6}	2.7×10^{-5}
Si-32	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{6}	2.7×10^{-5}
Sm-145	Samarium (62)	1.0×10^{2}	2.7×10^{-9}	1.0×10^{7}	2.7×10^{-4}
Sm-147	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{4}	2.7×10^{-7}
Sm-151	.	1.0×10^{4}	2.7×10^{-7}	1.0×10^{8}	2.7×10^{-3}
Sm-153	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Sn-113 (a)	Tin (50)	1.0×10^{3}	2.7×10^{-8}	1.0×10^{7}	2.7×10^{-4}
Sn-117m	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Sn-119m	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{7}	2.7×10^{-4}
Sn-121m (a)	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{7}	2.7×10^{-4}
Sn-123	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{6}	2.7×10^{-5}
Sn-125	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{5}	2.7×10^{-6}
Sn-126 (a)	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
Sr-82 (a)	Strontium (38)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
Sr-85	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Sr-85m	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{7}	2.7×10^{-4}

TABLE 17A2: EXEMPT MATERIAL ACTIVITY CONCENTRATIONS AND EXEMPT CONSIGNMENT ACTIVITY LIMITS FOR RADIONUCLIDES Part 4 of 4

Symbol of radionuclide	Element and atomic number	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
Sr-87m	Strontium (38)	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Sr-89	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{6}	2.7×10^{-5}
Sr-90 (a)	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{4}	2.7×10^{-7}
Sr-91 (a)	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
Sr-92 (a)	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
T(H-3)	Tritium (1)	1.0×10^{6}	2.7×10^{-5}	1.0×10^{9}	2.7×10^{-2}
Ta-178 (long-lived)	Tantalum (73)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Ta-179	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{7}	2.7×10^{-4}
Ta-182	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{4}	2.7×10^{-7}
Tb-157	Terbium (65)	1.0×10^{4}	2.7×10^{-7}	1.0×10^{7}	2.7×10^{-4}
Tb-158	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Tb-160	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Tc-95m (a)	Technetium (43)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Tc-96	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Tc-96m (a)	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{7}	2.7×10^{-4}
Tc-97	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{8}	2.7×10^{-3}
Tc-97m	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{7}	2.7×10^{-4}
Tc-98	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Tc-99	.	1.0×10^{4}	2.7×10^{-7}	1.0×10^{7}	2.7×10^{-4}
Tc-99m	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{7}	2.7×10^{-4}
Te-121	Tellurium (52)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Te-121m	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{5}	2.7×10^{-6}
Te-123m	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{7}	2.7×10^{-4}
Te-125m	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{7}	2.7×10^{-4}
Te-127	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{6}	2.7×10^{-5}
Te-127m (a)	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{7}	2.7×10^{-4}
Te-129	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Te-129m (a)	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{6}	2.7×10^{-5}
Te-131m (a)	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Te-132 (a)	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{7}	2.7×10^{-4}
Th-227	Thorium (90)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{4}	2.7×10^{-7}
Th-228 (a)	.	1.0	2.7×10^{-11}	1.0×10^{4}	2.7×10^{-7}

Th-229	.	1.0	2.7×10^{-11}	1.0×10^{3}	2.7×10^{-8}
Th-230	.	1.0	2.7×10^{-11}	1.0×10^{4}	2.7×10^{-7}
Th-231	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{7}	2.7×10^{-4}
Th-232	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{4}	2.7×10^{-7}
Th-234 (a)	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{5}	2.7×10^{-6}
Th (natural)	.	1.0	2.7×10^{-11}	1.0×10^{3}	2.7×10^{-8}
Ti-44 (a)	Titanium (22)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
Tl-200	Thallium (81)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Tl-201	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Tl-202	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Tl-204	.	1.0×10^{4}	2.7×10^{-7}	1.0×10^{4}	2.7×10^{-7}
Tm-167	Thulium (69)	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Tm-170	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{6}	2.7×10^{-5}
Tm-171	.	1.0×10^{4}	2.7×10^{-7}	1.0×10^{8}	2.7×10^{-3}
U-230 (fast lung absorption) (a),(~~b~~d)	Uranium (92)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
U-230 (medium lung absorption) (a),(~~c~~c)	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
U-230 (slow lung absorption) (a),(~~f~~d)	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
U-232 (fast lung absorption) (~~b~~d)	Uranium (92)	1.0	2.7×10^{-11}	1.0×10^{3}	2.7×10^{-8}
U-232 (medium lung absorption) (~~c~~c)	.	1.0	2.7×10^{-11}	1.0×10^{3}	2.7×10^{-8}
U-232 (slow lung absorption) (~~f~~d)	.	1.0	2.7×10^{-11}	1.0×10^{3}	2.7×10^{-8}
U-233 (fast lung absorption)	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{4}	2.7×10^{-7}

Comment [JJ27]: The footnote lettering of this series of tables is updated to correspond to the relocated footnotes following the table.

(~~d~~b) U-233 (medium lung absorption)	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{4}	2.7×10^{-7}
(~~e~~c) U-233 (slow lung absorption)	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{4}	2.7×10^{-7}
(~~f~~d) U-234 (fast lung absorption)	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{4}	2.7×10^{-7}
(~~d~~b) U-234 (medium lung absorption)	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{4}	2.7×10^{-7}
(~~e~~c) U-234 (slow lung absorption)	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{4}	2.7×10^{-7}
(~~f~~d) U-235 (all lung absorption types)	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{4}	2.7×10^{-7}
(a),(~~d~~b),(~~e~~c),(~~f~~d) U-236 (fast lung absorption)	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{4}	2.7×10^{-7}
(~~d~~b) U-236 (medium lung absorption)	Uranium (92)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{4}	2.7×10^{-7}
(~~e~~c) U-236 (slow lung absorption)	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{4}	2.7×10^{-7}
(~~f~~d) U-238 (all lung absorption types)	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{4}	2.7×10^{-7}

(~~d~~b),(ce),(~~f~~d)					
U (natural)	.	1.0	2.7×10^{-11}	1.0×10^{3}	2.7×10^{-8}
U (enriched to 20% or less) (~~g~~e)	.	1.0	2.7×10^{-11}	1.0×10^{3}	2.7×10^{-8}
U (depleted)	.	1.0	2.7×10^{-11}	1.0×10^{3}	2.7×10^{-8}
V-48	Vanadium (23)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
V-49	.	1.0×10^{4}	2.7×10^{-7}	1.0×10^{7}	2.7×10^{-4}
W-178 (a)	Tungsten (74)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
W-181	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{7}	2.7×10^{-4}
W-185	.	1.0×10^{4}	2.7×10^{-7}	1.0×10^{7}	2.7×10^{-4}
W-187	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
W-188 (a)	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{5}	2.7×10^{-6}
Xe-122 (a)	Xenon (54)	1.0×10^{2}	2.7×10^{-9}	1.0×10^{9}	2.7×10^{-2}
Xe-123	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{9}	2.7×10^{-2}
Xe-127	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{5}	2.7×10^{-6}
Xe-131m	.	1.0×10^{4}	2.7×10^{-7}	1.0×10^{4}	2.7×10^{-7}
Xe-133	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{4}	2.7×10^{-7}
Xe-135	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{10}	2.7×10^{-1}
Y-87 (a)	Yttrium (39)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Y-88	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Y-90	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{5}	2.7×10^{-6}
Y-91	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{6}	2.7×10^{-5}
Y-91m	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Y-92	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{5}	2.7×10^{-6}
Y-93	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{5}	2.7×10^{-6}
Yb-169	Ytterbium (79)	1.0×10^{2}	2.7×10^{-9}	1.0×10^{7}	2.7×10^{-4}
Yb-175	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{7}	2.7×10^{-4}
Zn-65	Zinc (30)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Zn-69	.	1.0×10^{4}	2.7×10^{-7}	1.0×10^{6}	2.7×10^{-5}
Zn-69m (a)	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Zr-88	Zirconium (40)	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Zr-93	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{7}	2.7×10^{-4}
Zr-95 (a)	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Zr-97 (a)	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}

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

Sr-90 Y-90

Zr-93 Nb-93m

Comment [JJ28]: The footnotes here are relocated from the prior table (Table 17A1) as they pertain to Table 17A2.

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, Pb212, Bi-212, Tl208 0.36 , Po-212 0.64

Th-229 Ra-225, Ac-225, Fr-221, At-217, Bi-213, Po-213, Pb-209

Th-nat Ra-228, Ac-228, Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208 0.36 , Po-12 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,

U-240 Np-240m

Np-237 Pa-233

Am-242m Am-242

Am-243 Np-239

b 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.

c 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.

d These values apply to all compounds of uranium other than those specified in d and e, above.

e These values apply to unirradiated uranium only.

Comment [JJ29]: Footnotes c through e are added for consistency with equivalent tables of Appendix A of 10 CFR 71.

TABLE 17A3: GENERAL VALUES FOR A 1 AND A 2

Contents	A_1 (TBq)	A_1 (Ci)	A_2 (TBq)	A_2 (Ci)	Activity concen-tration for exempt material(Bq/g)	Activity concen-tration for exempt material(Ci/g)	Activity limits for exempt consig	Activity limits for exempt consig

							n-ments (Bq)	n-ments (Ci)
Only beta or gamma emitting radionuclides are known to be present	1 x 10^{-1}	2.7 x 10^{0}	2 x 10^{-2}	5.4 x 10^{-1}	1 x 10^{1}	2.7 x10^{-10}	1 x 10^{4}	2.7 x10^{-7}
Only alpha emitting radionuclides are known to be present	2 x 10^{-1}	5.4 x 10^{0}	9 x 10^{-5}	2.4 x 10^{-3}	1 x 10^{-1}	2.7 x10^{-12}	1 x 10^{3}	2.7 x10^{-8}
No relevant data are available	1 x 10^{-3}	2.7 x 10^{-2}	9 x 10^{-5}	2.4 x 10^{-3}	1 x 10^{-1}	2.7 x 10^{-12}	1 x 10^{3}	2.7 x 10^{-8}

TABLE 17A4: ACTIVITY-MASS RELATIONSHIPS FOR URANIUM

Uranium Enrichment (i) weight % U-235 present	**Specific Activity**	**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}

I The figures for uranium include representative values for the activity of the uranium-235 that is concentrated during the enrichment process.

EDITOR'S NOTES

6 CCR 1007-1 has been divided into smaller sections for ease of use. Versions prior to 4/1/07 and rule history are located in the first section, 6 CCR 1007-1. Prior versions can be accessed from the History link that appears above the text in 6 CCR 1007-1. To view versions effective on or after 4/1/07, Select the desired part of the rule, for example 6 CCR 1007-1 Part 1 or 6 CCR 1007-1 Parts 8 - 10.

History

[For history of this section, see Editor's Notes in the first section, 6 CCR 1007-1]