

1 **DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT**

2 **Hazardous Materials and Waste Management Division**

3 **RADIATION CONTROL - TRANSPORTATION OF RADIOACTIVE MATERIALS**

4 **6 CCR 1007-1 Part 17**

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

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7 **Adopted by the Board of Health July 19, 2017, effective date September 14, 2017.**

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10 **PART 17: TRANSPORTATION OF RADIOACTIVE MATERIALS**

11 **GENERAL PROVISIONS**

12 **17.1 Purpose and Scope.**

13 17.1.1 Authority.

14 Rules and regulations set forth herein are adopted pursuant to the provisions of sections 25-1-
15 108, 25-1.5-101(1)(l), and 25-11-104, CRS.

16 17.1.2 Basis and Purpose.

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

19 17.1.3 Scope.

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

22 17.1.4 Applicability.

23 17.1.4.1 This part applies to any person who transports radioactive material or delivers
24 radioactive material to a carrier for transport.

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

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

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

34 (b) Quality assurance requirements of 17.10; and

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

Comment [jsj1]:

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 RULE DURING THE DRAFT REVIEW PROCESS.

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

EDITORIAL NOTE 2: COMPATIBILITY WITH FEDERAL U.S. NUCLEAR REGULATORY COMMISSION (NRC) REGULATIONS IS REQUIRED BY COLORADO STATUTE AND TO MAINTAIN AGREEMENT STATE STATUS WITH NRC. THE PROPOSED CHANGES TO PART 17 ARE BASED ON CHANGES IN 10 CFR 71. INFORMATION ON NRC COMPATIBILITY CATEGORIES MAY BE FOUND AT:

<https://scp.nrc.gov/resources.html>

EDITORIAL NOTE 3: THE CONFERENCE OF RADIATION CONTROL PROGRAM DIRECTORS (CRCPD), INC., DEVELOPS SUGGESTED STATE REGULATIONS FOR CONTROL OF RADIATION (KNOWN AS SSRCR'S). UNLESS OTHERWISE DETERMINED BY THE BOARD OF HEALTH, COLORADO'S RULES ARE TO BE CONSISTENT WITH NRC REGULATIONS AND THE SSRCR REGULATIONS. THE SSRCRS MAY BE FOUND ONLINE AT:

<http://www.crcpd.org/ssrcrs/default.aspx>

THE EQUIVALENT REGULATORY PART TO PART 17 IS SSRCR PART "T". PART T WAS LAST UPDATED IN 2014 BUT IS NOT CONSISTENT WITH THE MOST RECENT (2015) CHANGES TO 10 CFR PART 71.

EDITORIAL NOTE 4: INFORMATION ON THE NRC REGULATORY ACTION TRACKING SYSTEM (RATS) MAY BE FOUND AT:

https://scp.nrc.gov/rss_regamendents.html

EDITORIAL NOTE 5: THE PRIMARY PURPOSE OF THE PROPOSED CHANGES TO PART 17 IS TO MAKE THE RULE CONSISTENT WITH 10 CFR PART 71 (NRC) AND 49 CFR (U.S. DOT) BOTH OF WHICH WERE AMENDED TO BRING U.S. REQUIREMENTS IN ALIGNMENT WITH INTERNATIONAL TRANSPORTATION REQUIREMENTS OF THE IAEA.

EDITORIAL NOTE 6: WHERE APPLICABLE SOME UNAFFECTED SECTIONS OF THE RULE HAVE BEEN OMITTED FROM THE DRAFT FOR BREVITY. SUCH SECTIONS ARE DELINEATED BY

" * * * "

Comment [jsj2]: This reflects the date of anticipated adoption by the Colorado Board of Health (the Board). The effective date is approximately 60 days beyond the adopted date, based on the Colorado Secretary of State's publication calendar and pending final adoption by the Board.

- 36 (3) No provision of this part authorizes possession of licensed material.
- 37 (4) Exemptions from the requirement in 17.3 for a license are specified in 17.4.
- 38 (5) The general license under 17.7 requires that a NRC ~~e~~Certificate of eCompliance
39 or other package approval be issued for the package to be used under the
40 general license.
- 41 (6) General licenses for which no package approval is required are issued in 17.8
42 and 17.9.
- 43 (7) These rules apply to any person required to obtain a eCertificate of eCompliance
44 or an approved compliance plan from the NRC pursuant to 10 CFR 71 if the
45 person delivers radioactive material to a common or contract carrier for transport
46 or transports the material outside the confines of the person's plant or other
47 authorized place of use.
- 48 17.1.4.2 The packaging and transport of radioactive material are also subject to other
49 parts of these regulations and to the regulations of other agencies (such as the DOT, the
50 United States Postal Service and the NRC) having jurisdiction over means of transport.
- 51 17.1.4.3 The requirements of this part are in addition to, and not in substitution for, other
52 requirements.
- 53 17.1.5 Published Material Incorporated by Reference.
- 54 Published material incorporated in Part 17 by reference is available in accord with Part 1, Section
55 1.4.
- 56 **17.2 Definitions.**
- 57 17.2.1 Definitions of general applicability to these regulations are in Part 1, Section 1.2.2.
- 58 17.2.2 Terms used in Part 17 have the definitions set forth as follows.
- 59 "Carrier" means a person engaged in the transportation of passengers or property by land or
60 water as a common, contract, or private carrier, or by civil aircraft.
- 61 "Certificate holder" means a person who has been issued a eCertificate of eCompliance or other
62 package approval by the NRC.
- 63 "Certificate of Compliance" (COC) means the certificate issued by the NRC under subpart D of 10
64 CFR 71 (~~January 1, 2014~~) which approves the design of a package for the transportation of
65 radioactive material
- 66 "Closed transport vehicle" means a transport vehicle equipped with a securely attached exterior
67 enclosure that during normal transportation restricts the access of unauthorized persons to the
68 cargo space containing the radioactive material. The enclosure may be either temporary or
69 permanent but shall limit access from top, sides, and ends. In the case of packaged materials, it
70 may be of the "see-through" type.
- 71 "Consignment" means each shipment of a package or groups of packages or load of radioactive
72 material offered by a shipper for transport.

Comment [jsj3]: Here, and throughout the rule, Certificate of Compliance is capitalized for consistency with the formal definition in 17.2.2.

Comment [jsj4]: The original date is eliminated. Retaining the original date (or incorporating an updated date) may negate or cause confusion for those certificates that have been issued in the past and/or prior to a specified date.

The NRC certificates - are issued under the regulations in place at the time of issuance and have their own expiration date.

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

75 **"Contamination" means the presence of a radioactive substance on a surface in quantities**
76 **in excess of 0.4 Bq/cm² (1x10⁻⁵ µCi/cm²) for beta and gamma emitters and low toxicity**
77 **alpha emitters, or 0.04 Bq/cm² (1x10⁻⁶ µCi/cm²) for all other alpha emitters.**

78 **(1) Fixed contamination means contamination that cannot be removed from a**
79 **surface during normal conditions of transport.**

80 **(2) Non-fixed contamination means contamination that can be removed from a**
81 **surface during normal conditions of transport.**

82 "Conveyance" means:

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

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

87 (3) For transport by any aircraft.

88 "Criticality Safety Index (CSI)" means the dimensionless number (rounded up to the next tenth)
89 assigned to and placed on the label of a fissile material package, to designate the degree of
90 control of accumulation of packages containing fissile material during transportation.

91 Determination of the criticality safety index is described in 10 CFR 71.22, 71.23, and 71.59. **The**
92 **criticality safety index for an overpack, freight container, consignment or conveyance**
93 **containing fissile material packages is the arithmetic sum of the criticality safety indices of**
94 **all the fissile material packages contained within the overpack, freight container,**
95 **consignment or conveyance.**

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

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

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

107 "Graphite" means, for the purposes of Part 17, graphite with a boron equivalent content less than
108 5 parts per million and density greater than 1.5 grams per cubic centimeter.

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

112 "Low specific activity material" (LSA material) means radioactive material with limited specific
113 activity which is nonfissile or is excepted under Part 17 and which satisfies the descriptions and

Comment [jsj5]: Definitions added, consistent with the definition added to 10 CFR 71.4.

This definition is based on the definition in International Atomic Energy Agency (IAEA) TS-R-1 regulations for international transportation of radioactive materials. The definition addresses those solid objects which are not themselves radioactive, but rather, are contaminated on their surfaces.

NRC Compatibility "B"
[NRC RATS 2015-3](#)
[80 FR 33987 \(June 12, 2015\)](#)

Comment [jsj6]: Language added, consistent with definition in 10 CFR 71.4.

The current definition is amended based on a similar definition in IAEA TS-R-1 regulations for international transportation of radioactive materials.

NRC Compatibility "B"
[NRC RATS 2015-3](#)
[80 FR 33987 \(June 12, 2015\)](#)

Comment [jsj7]: Consistent with federal rule in 10 CFR Part 71.4, "tribe" is modified to "Tribe" here and elsewhere throughout rule as applicable.

NRC Compatibility "B"
[NRC RATS 2015-3](#)
[80 FR 74974 \(December 1, 2015\)](#)

Comment [jsj8]: Language added, consistent with an equivalent definition in 10 CFR 71.4.

This definition is modified based on a similar definition in IAEA TS-R-1 regulations for international transportation of radioactive materials.

NRC Compatibility "B"
[NRC RATS 2015-3](#)
[80 FR 33987 \(June 12, 2015\)](#)

114 | limits set forth ~~below~~ **in the following section**. Shielding materials surrounding the LSA material
115 | may not be considered in determining the estimated average specific activity of the package
116 | contents. **The** LSA material must be in one of three groups:

117 | (1) LSA-I.

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

121 | (b) ~~Solid ~~unirradiated~~ ~~n~~ Natural uranium, ~~or~~ depleted uranium, ~~or~~ natural~~
122 | ~~thorium or their ~~solid~~ ~~or~~ ~~liquid~~ compounds or mixtures, **provided they**~~
123 | ~~**are unirradiated and in solid or liquid form;**~~

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

126 | (d) Other radioactive material in which the activity is distributed throughout
127 | and the estimated average specific activity does not exceed 30 times the
128 | value for exempt material activity concentration determined in
129 | accordance with Appendix 17A.

130 | (2) LSA-II.

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

132 | (b) Other radioactive material in which the activity is distributed throughout,
133 | and the **estimated** average specific activity does not exceed $10^{-4} \times A_2/g$
134 | for solids and gases, and $10^{-5} \times A_2/g$ for liquids.

135 | (3) LSA-III. Solids **(e.g., consolidated wastes, activated materials), excluding**
136 | **powders, that satisfy the requirements of 10 CFR 71.77, in ~~and for~~ which:**

137 | (a) The radioactive material is distributed throughout a solid or a collection of
138 | solid objects, or is essentially uniformly distributed in a solid compact
139 | binding agent (such as concrete, bitumen, ~~or~~ ceramic, **etc.**); **and**

140 | (b) The radioactive material is relatively insoluble, or it is intrinsically
141 | contained in a relatively insoluble material, so that, even under loss of
142 | packaging, the loss of radioactive material per package by leaching,
143 | when placed in water for 7 days, ~~will~~ ~~would~~ not exceed $0.1 \times A_2$; **and**

144 | (c) The estimated average specific activity of the solid, **excluding any**
145 | **shielding material**, does not exceed $2 \times 10^{-3} A_2/g$; and

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

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

Comment [jsj9]: In a prior amendment to 10 CFR 71, NRC incorrectly incorporated the modifier "not" (as in "...not intended to be processed..."). This was later determined to be in conflict with U.S. DOT requirements in effect at the time. Therefore, NRC has corrected the definition for LSA-I in 10 CFR 71. The proposed change similarly corrects this same error in Part 17.

Comment [jsj10]: The requirements pertaining to testing (for LSA-III materials) have not been eliminated but rather, are removed from Part 17 since they are addressed in 10 CFR 71.77 which is referenced as part of the LSA-III definition above.

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

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

159 (iv) ~~The total activity of the free volume of water must be measured~~
160 ~~following the 7-day immersion test and must not exceed 0.1x A₂;~~

161 "Low toxicity alpha emitters" means natural uranium, depleted uranium, natural thorium; uranium-
162 235, uranium-238, thorium-232, thorium-228 or thorium-230 when contained in ores or physical or
163 chemical concentrates or tailings; or alpha emitters with a half-life of less than 10 days.

164 "Nuclear waste" means, for the purposes of Part 17, a quantity of source, byproduct or special
165 nuclear material required to be in NRC-approved specification packaging while transported to,
166 through or across a state boundary to a disposal site, or to a collection point for transport to a
167 disposal site.

168 "Packaging" means the assembly of components necessary to ensure compliance with the
169 packaging requirements of 10 CFR 71. It may consist of one or more receptacles, absorbent
170 materials, spacing structures, thermal insulation, radiation shielding, and devices for cooling or
171 absorbing mechanical shocks. The vehicle, tie-down system, and auxiliary equipment may be
172 designated as part of the packaging.

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

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

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

181 "Regulations of the NRC" means the regulations in 10 CFR 71 (January 1, ~~2014~~2016) for
182 purposes of Part 17.

183 "Surface contaminated object" (SCO) means a solid object that is not itself classed as radioactive
184 material, but which has radioactive material distributed on any of its surfaces. The SCO must be
185 in one of two groups with surface activity not exceeding the following limits:

- 186 (1) SCO-I: a solid object on which:
- 187 (a) The non-fixed contamination on the accessible surface averaged over
188 300 cm² (or the area of the surface if less than 300 cm²) does not exceed
189 4 Bq/cm² (10⁻⁴ microcurie/cm²) for beta, gamma and low toxicity alpha
190 emitters, or 0.4 Bq/cm² (10⁻⁵ microcurie/cm²) for all other alpha emitters;
- 191 (b) The fixed contamination on the accessible surface averaged over 300
192 cm² (or the area of the surface if less than 300 cm²) does not exceed 4 x
193 10⁴ Bq/cm² (1.0 microcurie/cm²) for beta, gamma and low toxicity alpha

- 194 emitters, or 4×10^3 Bq/cm² (0.1 microcurie/cm²) for all other alpha
195 emitters; and
- 196 (c) The non-fixed contamination plus the fixed contamination on the
197 inaccessible surface averaged over 300 cm² (or the area of the surface if
198 less than 300 cm²) does not exceed 4×10^4 Bq/cm² (1 microcurie/cm²)
199 for beta, gamma and low toxicity alpha emitters, or 4×10^3 Bq/cm² (0.1
200 microcurie/cm²) for all other alpha emitters.
- 201 (2) SCO-II: a solid object on which the limits for SCO-I are exceeded and on which:
- 202 (a) The non-fixed contamination on the accessible surface averaged over
203 300 cm² (or the area of the surface if less than 300 cm²) does not exceed
204 400 Bq/cm² (10^{-2} microcurie/cm²) for beta, gamma and low toxicity alpha
205 emitters or 40 Bq/cm² (10^{-3} microcurie/cm²) for all other alpha emitters;
- 206 (b) The fixed contamination on the accessible surface averaged over 300
207 cm² (or the area of the surface if less than 300 cm²) does not exceed $8 \times$
208 10^5 Bq/cm² (20 microcuries/cm²) for beta, gamma and low toxicity alpha
209 emitters, or 8×10^4 Bq/cm² (2 microcuries/cm²) for all other alpha
210 emitters; and
- 211 (c) The non-fixed contamination plus the fixed contamination on the
212 inaccessible surface averaged over 300 cm² (or the area of the surface if
213 less than 300 cm²) does not exceed 8×10^5 Bq/cm² (20 microcuries/cm²)
214 for beta, gamma and low toxicity alpha emitters, or 8×10^4 Bq/cm² (2
215 microcuries/cm²) for all other alpha emitters.
- 216 "Transport index" (TI) means the dimensionless number, rounded up the next tenth, placed on the
217 label of a package to designate the degree of control to be exercised by the carrier during
218 transportation. The transport index is the number determined by multiplying the maximum
219 radiation level in millisievert (mSv) per hour at 1 meter (3.3 feet) from the external surface of the
220 package by 100 (equivalent to the maximum radiation level in millirem per hour at 1 meter).
- 221 "Tribal official" means the highest ranking individual that represents Tribal leadership, such as the
222 Chief, President, or Tribal Council leadership.
- 223 "Type A package" means a Type A packaging that, together with its radioactive contents limited
224 to A1 or A2 as appropriate, meets the requirements of 49 CFR 173.410 and 173.412 and is
225 designed to retain the integrity of containment and shielding required by Part 17 under normal
226 conditions of transport as demonstrated by the tests set forth in 49 CFR 173.465 or 173.466, as
227 appropriate.
- 228 "Type A packaging" means a packaging designed for a Type A package.
- 229 "Type AF package", "Type BF package", "Type B(U)F package", and "Type B(M)F package" each
230 means a fissile material packaging together with its fissile material contents.
- 231 "Type A quantity" means a quantity of radioactive material, the aggregate radioactivity of which
232 does not exceed A1 for special form radioactive material or A2 for normal form radioactive
233 material, where A1 and A2 are given in Appendix 17A or may be determined by procedures
234 described in Appendix 17A.
- 235 "Type B package" means a Type B packaging together with its radioactive contents.²
- 236 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)

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

244 "Type B packaging" means a packaging designed to retain the integrity of containment and
245 shielding when subjected to the normal conditions of transport and hypothetical accident test
246 conditions set forth 10 CFR Part 71.

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

248 **"Uranium – natural, depleted, enriched".**

249 (1) **"Natural uranium" means, for the purposes of Part 17, uranium (which may**
250 **be chemically separated) with the naturally occurring distribution of**
251 **uranium isotopes (approximately 0.711 weight percent uranium-235 and the**
252 **remainder by weight essentially uranium-238).**

253 (2) **"Depleted uranium" means, for the purposes of Part 17, uranium**
254 **containing less uranium-235 than the naturally occurring distribution of**
255 **uranium isotopes.**

256 (3) **"Enriched uranium" means, for the purposes of Part 17, uranium**
257 **containing more uranium 235 than the naturally occurring distribution of**
258 **uranium isotopes.**

259 LICENSE-RELATED REGULATORY REQUIREMENTS

260 17.3 Requirement for License.

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

264

265 17.4 Exemptions.

266 17.4.1 Common and contract carriers, freight forwarders, and warehouse workers which are subject to
267 the requirements of the DOT in 49 CFR 170 through 189, or the U.S. Postal Service in the Postal
268 Service Manual (Domestic Mail Manual), are exempt from the requirements of Part 17 to the
269 extent that they transport or store radioactive material in the regular course of their carriage for
270 others or storage incident thereto. Common and contract carriers who are not subject to the
271 requirements of the DOT or U.S. Postal Service are subject to 17.3 and other applicable
272 requirements of these regulations.

273 17.4.2 Any licensee is exempt from the requirements of Part 17 with respect to shipment or carriage of
274 the following low-level materials:

275 17.4.2.1 Natural material and ores containing naturally occurring radionuclides that are
276 **either in their natural state, not intended to be processed for**
277 **purposes other than for the extraction of the radionuclides, and which are not**
278 **intended to be processed for the use of these radionuclides, provided the activity**
279 **concentration of the material does not exceed 10 times the applicable radionuclide**

Comment [jsj11]: Definitions specific to transportation of radioactive materials are added, consistent with 10 CFR Part 71.4 definitions and so as to not conflict with other similar definitions for non-transportation purposes.

NRC Compatibility "B"
[NRC RATS 2015-3](#)

Comment [jsj12]: Language is updated, consistent with changes to 10 CFR 71.14(a)(1), 49 CFR, and IAEA transportation requirements (TS-R-1).

Consistent with federal rule, the added language clarifies the concept that processing ores and other naturally occurring materials - and the associated transport of such materials - may be needed for purposes other than for the materials radioactivity content.

NRC Compatibility "B"
[NRC RATS 2015-3](#)
[80 FR 33987 \(June 12, 2015\)](#)
49 CFR 173.401(b)

280 activity concentration values specified in Appendix 17A, Table 17A2, or Table 17A3 of
281 this part.

282 17.4.2.2 Materials for which the activity concentration is not greater than the activity
283 concentration values specified in Appendix 17A, Table 17A2, or Table 17A3 of this part,
284 or for which the consignment activity is not greater than the limit for an exempt
285 consignment found in Appendix 17A, Table 17A2 or Table 17A3 of this part.

286 17.4.2.3 Non-radioactive solid objects with radioactive substances present on any
287 surfaces in quantities not in excess of the levels cited in the definition of
288 contamination in 17.2.

289 17.4.3 Fissile materials meeting the requirements of one of the paragraphs (a) through (f) in 10 CFR
290 71.15 are exempt from classification as fissile material, and from the fissile material package
291 standards of 10 CFR 71.55 and 10 CFR 71.59, but are subject to all other requirements of 10
292 CFR 71, except as noted in paragraphs (a) through (f) in 10 CFR 71.15.

293 17.4.4 Any physician licensed by a state to dispense drugs in the practice of medicine is exempt from
294 17.5 with respect to transport by the physician of licensed material for use in the practice of
295 medicine. However, any physician operating under this exemption must be licensed under Part 7
296 or equivalent requirements of another Agreement State or NRC.

297 **17.5 Transportation of Licensed Material.**

298 17.5.1 Each licensee who transports licensed material outside the site of usage, as specified in the
299 Department license, or where transport is on public highways, or who delivers licensed material to
300 a carrier for transport, shall:

301 17.5.1.1 Comply with the applicable requirements, appropriate to the mode of transport, of
302 the regulations of the DOT, particularly the regulations of the DOT in the following areas:

- 303 (1) Packaging - 49 CFR Part 173: Subparts A and B and I.
- 304 (2) Marking and labeling - 49 CFR Part 172: Subpart D, § § 172.400 through
305 172.407, § § 172.436 through 172.441, and Subpart E.
- 306 (3) Placarding - 49 CFR Part 172: Subpart F, especially § § 172.500 through
307 172.519, 172.556, and Appendices B and C.
- 308 (4) Accident reporting - 49 CFR Part 171: § § 171.15 and 171.16.
- 309 (5) Shipping papers and emergency information - 49 CFR Part 172: Subparts C and
310 G.
- 311 (6) Hazardous material employee training - 49 CFR Part 172: Subpart H.
- 312 (7) Security plans - 49 CFR Part 172: Subpart I.
- 313 (8) Hazardous material shipper/carrier registration - 49 CFR Part 107: Subpart G.

314 17.5.1.2 The licensee shall also comply with applicable regulations of the DOT pertaining
315 to the following modes of transportation:

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

Comment [jsj13]: Language is updated, consistent with changes to 10 CFR 71.14(a)(2) and IAEA transportation requirements in TS-R-1.

NRC Compatibility "B"
[NRC RATS 2015-3](#)
[80 FR 33987 \(June 12, 2015\)](#)

Comment [jsj14]: A new provision is added, consistent with changes to 10 CFR 71.14(a)(3).

Consistent with U.S. DOT requirements and for transportation purposes only, some solid items may be exempt from (radioactive material) transportation requirements even if they have contamination on their surfaces, provided levels are below those specified in the newly added definition of "contamination" as found in Section 17.2.

NRC Compatibility "B"
[NRC RATS 2015-3](#)
[80 FR 33987 \(June 12, 2015\)](#)

- 317 (2) Air - 49 CFR Part 175.
- 318 (3) Vessel - 49 CFR Part 176: Subparts A through F, and M.
- 319 (4) Public highway - 49 CFR Part 177 and Parts 390 through 397.
- 320 17.5.1.3 Assure that any special instructions needed to safely open the package are sent
321 to or have been made available to the consignee in accordance with 4.32.5.2.
- 322 17.5.2 If, for any reason, the regulations of the DOT are not applicable to a shipment of licensed
323 material, the licensee shall conform to the standards and requirements of 49 CFR Parts 170
324 through 189 appropriate to the mode of transport to the same extent as if the shipment was
325 subject to these regulations.

326 **GENERAL LICENSES**

327 **17.6 General Licenses for Carriers.**

328 17.6.1 A general license is hereby issued to any common or contract carrier not exempt under 17.4 to
329 receive, possess, transport, and store radioactive material in the regular course of their carriage
330 for others or storage incident thereto, provided the transportation and storage is in accordance
331 with the applicable requirements, appropriate to the mode of transport, of the DOT insofar as
332 such requirements relate to the loading and storage of packages, placarding of the transporting
333 vehicle, and incident reporting.³

334 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
335 the notification made to the DOT or other agencies.

336 17.6.2 A general license is hereby issued to any private carrier to transport radioactive material,
337 provided the transportation is in accordance with the applicable requirements, appropriate to the
338 mode of transport, of the DOT insofar as such requirements relate to the loading and storage of
339 packages, placarding of the transporting vehicle, and incident reporting.³

340 17.6.3 Persons who transport radioactive material pursuant to the general licenses in 17.6.1 and 17.6.2
341 are exempt from the requirements of Parts 4 and 10 of these regulations to the extent that they
342 transport radioactive material.

343 **17.7 General License: NRC-Approved Packages.**

344 17.7.1 A general license is hereby issued to any licensee of the Department to transport, or to deliver to
345 a carrier for transport, licensed material in a package for which a license, eCertificate of
346 eCompliance, or other approval has been issued by the NRC.

347 17.7.2 This general license applies only to a licensee who:

348 17.7.2.1 Has a quality assurance program approved by NRC as satisfying **the provisions**
349 **of Subpart H (excluding 71.101(c)(2), (d), and (e) and 71.107 through 71.125) of 10**
350 **CFR 71-Subpart H.**

351 ~~17.7.2.2 Has a copy of the specific license, certificate of compliance, or other approval by~~
352 ~~the NRC of the package and has the drawings and other documents referenced in the~~
353 ~~approval relating to the use and maintenance of the packaging and to the action(s) to be~~
354 ~~taken prior to shipment;~~

355 **17.7.3 Each licensee issued a general license under Section 17.7.1 shall:**

Comment [jsj15]: Language updated consistent with phrasing in 10 CFR 71.17(b).

NRC Compatibility "B"
[NRC RATS 2015-3](#)
[80 FR 33987 \(June 12, 2015\)](#)

Comment [jsj16]: Provision 17.7.2.2 is deleted and replaced by the provisions of 17.7.3 for consistency with the language and formatting of 10 CFR 71.17.

356 ~~17.7.3.1~~ **Maintain a copy of the Certificate of Compliance, or other approval of the**
357 **package, and the drawings and other documents referenced in the approval**
358 **relating to the use and maintenance of the packaging and to the actions to be**
359 **taken before shipment;**

360 ~~17.7.2-33.2~~ **Comply**Complies with the terms and conditions of the license, certificate, or
361 other approval by the NRC, as applicable, and the applicable requirements of **Subparts**
362 **A (excluding 71.11), G (excluding 71.85(a)-(c), and 71.91(b)), and H (excluding**
363 **71.101(c)(2), (d), and (e) and 71.107 through 71.125) of 10 CFR 71 and Part 17;**

364 17.7.2-43.3 Prior to the licensee's first use of the package, ~~has submitted~~submit to the NRC
365 in writing in accordance with 10 CFR ~~74.4~~71.17(c)(3):

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

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

368 17.7.34 The general license in 17.7.1 applies only when the package approval authorizes use of the
369 package under this general license.

370 17.7.45 For a Type B or fissile material package, the design of which was approved by NRC before April
371 1, 1996, the general license in 17.7.1 is subject to additional restrictions of 10 CFR 71.19.

372 **17.8 General Licenses: Use of Foreign-Approved and Other Approved Packages**

373 ~~17.8.1~~ A general license is issued to any licensee of the Department to transport, or to deliver to a
374 carrier for transport, licensed material in a package the design of which has been approved in a
375 foreign national competent authority certificate, ~~and that has been~~ revalidated by the DOT as
376 meeting the applicable requirements of 49 CFR ~~474.42~~171.23.

377 ~~17.8.2~~ **Except as otherwise provided in this section, the general license applies only to a licensee**
378 **who has a quality assurance program approved by the NRC as satisfying the applicable**
379 **provisions of 10 CFR 71.101 through 71.137 (Subpart H of 10 CFR 71, excluding**
380 **71.101(c)(2), (d), and (e) and 71.107 through 71.125).**

381 ~~17.8.3~~ This general license applies only to **shipments made to or from locations outside the United**
382 **States.:**

383 ~~17.8.1.1~~ **Shipments made to or from locations outside the United States; and**

384 ~~17.8.1.2~~ **A licensee who:**

385 **17.8.4 Each licensee issued a general license under Section 17.8.1 shall:**

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

387 (2)(1) **Has**Maintain a copy of the applicable certificate, the revalidation, and the
388 drawings and other documents referenced in the certificate, relating to the use
389 and maintenance of the packaging and to the actions to be taken ~~prior to~~before
390 shipment; **and**

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

392 (4)(2) **Comply with the terms and conditions of the certificate and revalidation,**
393 **and**Complies with the applicable requirements of Part 17, sections 17.1 through

Comment [jsj17]: Language is updated, consistent with 10 CFR 71.17(c)(1).

The revised language is similar to that in prior section 17.7.2.2 and conveys similar requirements, with the exception that a copy of the specific license is not explicitly required.

NRC Compatibility "B"
Comment [jsj18]: Section renumbered and language is updated, consistent with formatting and language of 10 CFR 71.17(c)(2).

Due to differences in the format between Part 17 and 10 CFR 71, "has submitted"(past) is replaced with "submit" (active).

NRC Compatibility "B"

Comment [jsj19]: Language is updated, consistent with 10 CFR 71.21(a).

A prior USDOT rulemaking relocated the requirements in 49 CFR 171.12 to 171.23, so the cross-reference is updated here.

NRC Compatibility "B"
[NRC RATS 2015-3](#)
[80 FR 33987 \(June 12, 2015\)](#)

Comment [jsj20]: Language is added, consistent with 10 CFR 71.21(b).

Exceptions to the references in Subpart H of 10 CFR Part 21 are added since some provisions of Subpart H are under NRC only jurisdiction.

NRC Compatibility "B"
[NRC RATS 2015-3](#)
[80 FR 33987 \(June 12, 2015\)](#)

Comment [jsj21]: Language is updated, consistent with 10 CFR 71.21(c).

NRC Compatibility "B"
[NRC RATS 2015-3](#)
[80 FR 33987 \(June 12, 2015\)](#)

Comment [jsj22]: Language of 17.8.1.1 merged into 17.8.3, consistent with phrasing and format of 10 CFR 71.21(c).

Comment [jsj23]: Replaced by new 17.8.4., consistent with phrasing and format of 10 CFR 71.21(d).

Comment [jsj24]: Replaced by new 17.8.2., consistent with phrasing and format of 10 CFR 71.21.

Comment [jsj25]: Deleted due to replacement by 17.8.4(2), consistent with phrasing and format of 10 CFR 71.21.

394 17.5, 17.10 through 17.17, and **Subparts A (excluding 71.11), G (excluding**
395 **71.85(a)-(c), and 71.91(b)), and H (excluding 71.101(c)(2), (d), and (e) and**
396 **71.107 through 71.125) of 10 CFR 7140-CFR 71 Subparts A, G, and H. With**
397 **respect to the quality assurance provisions of 10 CFR 71 Subpart H, the licensee**
398 **is exempt from design, construction, and fabrication considerations.**

Comment [jsj26]: Last sentence deleted, consistent with changes to 10 CFR 71.21(d)(2), which also removed this provision.

399 **17.9 General Licenses: Fissile Material Transport**

400 17.9.1 A general license is hereby issued to any licensee to transport fissile material, or to deliver fissile
401 material to a carrier for transport, if the licensee meets the requirements of 10 CFR 71.22 and the
402 material is shipped in accordance with 10 CFR 71.22 and each applicable requirement of Part 17.

Exceptions to the references in Subparts A, G, and H of 10 CFR Part 21 are added since some provisions of Subpart H are under NRC only jurisdiction.

NRC Compatibility "B"
[NRC RATS 2015-3](#)
[80 FR 33987 \(June 12, 2015\)](#)

403 17.9.2 A general license is hereby issued to any licensee to transport fissile material in the form of
404 plutonium-beryllium (Pu-Be) special form sealed sources, or to deliver fissile material in the form
405 of plutonium-beryllium (Pu-Be) special form sealed sources to a carrier for transport, if the
406 licensee meets the requirements of 10 CFR 71.23 and the material is shipped in accordance with
407 10 CFR 71.23 and each applicable requirement of Part 17.

408 **QUALITY ASSURANCE**

409 **17.10 Quality Assurance Requirements.**

410 17.10.1 Quality assurance requirements apply to design, purchase, fabrication, handling, shipping,
411 storing, cleaning, assembly, inspection, testing, operation, maintenance, repair, and modification
412 of components of packaging that are important to safety.

413 17.10.1.1 The licensee, certificate holder, and applicant for a COC are responsible for
414 complying with the quality assurance requirements which apply to design, fabrication,
415 testing, and modification of packaging.

416 17.10.1.2 Each licensee is responsible for complying with each quality assurance provision
417 which applies to the licensee's use of a packaging for the shipment of licensed material
418 subject to the requirements of 10 CFR 71 and Part 17.

419 17.10.2 Each licensee, certificate holder, and applicant for a COC shall:

420 17.10.2.1 Be responsible to establish, maintain, and execute a quality assurance program
421 that, using a graded approach to an extent that is commensurate with each quality
422 assurance requirement's importance to safety, satisfies

423 (1) Each applicable criterion of 10 CFR 71.101 through 71.137, **excluding**
424 **71.101(c)(2), (d), and (e) and 71.107 through 71.125;** and

Comment [jsj27]: Exceptions to the references in Subpart H of 10 CFR Part 21 are added since some provisions of Subpart H are under NRC only jurisdiction.

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

427 17.10.2.2 Be subject to each requirement that is applicable, whether the term "licensee" is
428 or is not used in the requirement, for whatever design, fabrication, assembly, and testing
429 of the package is accomplished with respect to a package before the time a package
430 approval is issued.

431 17.10.3 Before the use of any package for the shipment of licensed material subject Part 17, each
432 licensee shall obtain NRC approval of its quality assurance program.

- 433 17.10.4 A program for transport container inspection and maintenance limited to radiographic exposure
434 devices, source changers, or packages transporting these devices and meeting the requirements
435 of 10 CFR 34.31(b), or equivalent Agreement State requirements, is deemed to satisfy the
436 requirements of 17.7 and 17.10.2.
- 437 17.10.5 The licensee, certificate holder, and applicant for a COC shall be responsible for the
438 establishment and execution of the quality assurance program.
- 439 17.10.5.1 The licensee, certificate holder, and applicant for a COC may delegate to others,
440 such as contractors, agents, or consultants, the work of establishing and executing the
441 quality assurance program, or any part of the quality assurance program, but shall retain
442 responsibility for the program.
- 443 17.10.5.2 The licensee shall clearly establish and delineate, in writing, the authority and
444 duties of persons and organizations performing activities affecting the safety-related
445 functions of structures, systems, and components, including performing the functions
446 associated with attaining quality objectives and the quality assurance functions.
- 447 17.10.6 The quality assurance functions are:
- 448 17.10.6.1 Assuring that an appropriate quality assurance program is established and
449 effectively executed; and
- 450 17.10.6.2 Verifying, by procedures such as checking, auditing, and inspection, that
451 activities affecting the safety-related functions have been performed correctly.
- 452 17.10.7 The persons and organizations performing quality assurance functions must have sufficient
453 authority and organizational freedom to:
- 454 17.10.7.1 Identify quality problems;
- 455 17.10.7.2 Initiate, recommend, or provide solutions; and
- 456 17.10.7.3 Verify implementation of solutions.
- 457 **17.11 Advance Notification of Shipment of Nuclear Waste.**
- 458 17.11.1 As specified in 17.11.3, 17.11.4, and 17.11.5, each licensee shall provide advance notification
459 to the governor of a state, or the governor's designee, of the shipment of licensed material (nuclear
460 waste), within or across the boundary of the state, before the transport, or delivery to a carrier, for
461 transport, of licensed material outside the confines of the licensee's plant or other place of use or
462 storage.
- 463 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
464 shall provide advance notification to the Tribal official of participating Tribes referenced in
465 17.11.4.3(3), or the official's designee, of the shipment of licensed material, within or across the
466 boundary of the Tribe's reservation, before the transport, or delivery to a carrier, for transport, of
467 licensed material outside the confines of the licensee's plant or other place of use or storage.
- 468 17.11.3 Advance notification is also required under this section for the shipment of licensed material,
469 other than irradiated fuel, meeting the following three conditions:
- 470 17.11.3.1 The licensed material is required by this part to be in Type B packaging for
471 transportation;

- 472 17.11.3.2 The licensed material is being transported to or across a state boundary en route
473 to a disposal facility or to a collection point for transport to a disposal facility; and
- 474 17.11.3.3 The quantity of licensed material in a single package exceeds the least of the
475 following:
- 476 (1) 3000 times the A₁ value of the radionuclides as specified in Appendix 17A, Table
477 A1 for special form radioactive material; or
- 478 (2) 3000 times the A₂ value of the radionuclides as specified in Appendix 17A, Table
479 A1 for normal form radioactive material; or
- 480 (3) 1000 TBq (27,000 Ci).
- 481 17.11.4 Procedures for submitting advance notification
- 482 17.11.4.1 The notification must be made in writing to:
- 483 (1) The office of each appropriate governor or governor's designee;
- 484 (2) The office of each appropriate Tribal official or Tribal official's designee;
- 485 (3) The Department.
- 486 17.11.4.2 A notification delivered by mail must be postmarked at least 7 days before the
487 beginning of the 7 day period during which departure of the shipment is estimated to
488 occur.
- 489 17.11.4.3 A notification delivered by any other means than mail must reach the office of the
490 governor or of the governor's designee or the Tribal official, or Tribal official's designee at
491 least 4 days before the beginning of the 7-day period during which departure of the
492 shipment is estimated to occur.
- 493 (1) A list of the names and mailing addresses of the governors' designees receiving
494 advance notification of transportation of nuclear waste was published in the
495 Federal Register on June 30, 1995 (60 FR 34306)
- 496 (2) ~~The list of governor's designees and Tribal official's designees of participating~~
497 ~~Tribes will be published annually in the Federal Register on or about June 30th to~~
498 ~~reflect any changes in information. Contact information for each State,~~
499 ~~including telephone and mailing addresses of governors and governors'~~
500 ~~designees, and participating Tribes, including telephone and mailing~~
501 ~~addresses of Tribal officials and Tribal official's designees, is available on~~
502 ~~the NRC Web site at: <https://scp.nrc.gov/special/designee.pdf>.~~
- 503 (3) A list of the names and mailing addresses of the governor's designees and Tribal
504 official's designees of participating Tribes is available on request from the
505 Director, Division of **Material Safety, State, Tribal, and Rulemaking Programs,**
506 **Office of Nuclear Material Safety and Safeguards, Intergovernmental Liaison**
507 **and Rulemaking, Office of Federal and State Materials and Environmental**
508 **Management Programs,** U.S. Nuclear Regulatory Commission, Washington, DC
509 20555-0001.
- 510 17.11.4.4 The licensee shall retain a copy of the notification as a record for 3 years.

Comment [jsj28]: Language is updated, consistent with NRC regulations in 10 CFR 71.97(c)(3)(ii) which was amended in 2015.

Rather than publishing in the federal register annually, the contact list will be maintained by NRC on NRC's web site.

NRC RATS 2015-5
NRC Compatibility "B"

Comment [jsj29]: Address corrected, consistent with NRC regulations in 10 CFR 71.97(c)(3)(ii).

The change is necessary due to a reorganization at NRC.

- 511 17.11.5 Information to be furnished in advance notification of shipment.
- 512 17.11.5.1 Each advance notification of nuclear waste shall contain the following
513 information:
- 514 (1) The name, address, and telephone number of the shipper, carrier, and receiver
515 of the nuclear waste shipment;
- 516 (2) A description of the nuclear waste contained in the shipment, as required by 49
517 CFR 172.202 and 172.203(d);
- 518 (3) The point of origin of the shipment and the 7-day period during which departure
519 of the shipment is estimated to occur;
- 520 (4) The 7-day period during which arrival of the shipment at state boundaries or
521 Tribal reservation boundaries is estimated to occur;
- 522 (5) The destination of the shipment, and the 7-day period during which arrival of the
523 shipment is estimated to occur; and
- 524 (6) A point of contact with a telephone number for current shipment information.
- 525 17.11.6 Revision notice
- 526 17.11.6.1 A licensee who finds that schedule information previously furnished to a governor
527 or governor's designee or a Tribal official or Tribal official's designee, in accordance with
528 this section, will not be met, shall:
- 529 (1) Telephone a responsible individual in the office of the governor of the state or of
530 the governor's designee or the Tribal official or Tribal official's designee an inform
531 that individual of the extent of the delay beyond the schedule originally reported;
532 and
- 533 (2) Maintain a record of the name of the individual contacted for 3 years.
- 534 17.11.7 Cancellation notice
- 535 17.11.7.1 Each licensee who cancels a nuclear waste shipment, for which advance
536 notification has been sent, shall:
- 537 (1) Send a cancellation notice to the governor of each state, or governor's designee
538 previously notified, each Tribal official or Tribal official's designee previously
539 notified and to the Department;
- 540 (2) State in the notice that it is a cancellation and identify the advance notification
541 that is being cancelled; and
- 542 (3) Retain a copy of the notice for 3 years.
- 543 **17.12 Air Transport of Plutonium.**
- 544 Notwithstanding the provisions of any general licenses and notwithstanding any exemptions stated
545 directly in this part or included indirectly by citation of the regulations of the DOT, as may be applicable,
546 the licensee shall assure that plutonium in any form is not transported by air, or delivered to a carrier for
547 air transport, unless:

- 548 17.12.1 The plutonium is contained in a medical device designed for individual human application; or
- 549 17.12.2 The plutonium is contained in a material in which the specific activity is less than or equal to the
550 activity concentration values for plutonium specified in Appendix 17A, Table 17A-1, and in which
551 the radioactivity is essentially uniformly distributed; or
- 552 17.12.3 The plutonium is shipped in a single package containing no more than an A2 quantity of
553 plutonium in any isotope or form and is shipped in accordance with 17.5; or
- 554 17.12.4 The plutonium is shipped in a package specifically authorized (in the eCertificate of eCompliance
555 issued by the NRC for that package) for the shipment of plutonium by air and the licensee
556 requires, through special arrangement with the carrier, compliance with 49 CFR 175.704, the
557 regulations of the DOT applicable to the air transport of plutonium.

558 **OPERATING CONTROLS AND PROCEDURES**

559 **17.13 Fissile Material: Assumptions as to Unknown Properties of Fissile Material.**

560 When the isotopic abundance, mass, concentration, degree of irradiation, degree of moderation, or other
561 pertinent property of fissile material in any package is not known, the licensee shall package the fissile
562 material as if the unknown properties had credible values that would cause the maximum neutron
563 multiplication.

564 **17.14 Preliminary Determinations.**

565 ~~Prior to Before~~ the first use of any packaging for the shipment of radioactive material **the licensee shall**
566 **ascertain that the determinations in paragraphs (a) through (c) of 10 CFR 71.85 have been made**
567 **by the certificate holder.:**

568 ~~17.14.1 The licensee shall ascertain that there are no defects which could significantly reduce the~~
569 ~~effectiveness of the packaging;~~

570 ~~17.14.2 Where the maximum normal operating pressure will exceed 35 kilopascal (5 pounds per square~~
571 ~~inch) gauge, the licensee shall test the containment systems at an internal pressure at least 50~~
572 ~~percent higher than the maximum normal operating pressure to verify the capability of that~~
573 ~~system to maintain its structural integrity at that pressure;~~

574 ~~17.14.3 The licensee shall determine that the packaging has been fabricated in accordance with the~~
575 ~~design approved by the NRC; and~~

576 ~~17.14.4 The licensee shall conspicuously and durably mark the packaging with its model number, serial~~
577 ~~number, gross weight, and a package identification number as assigned by the NRC.~~

578 **17.15 Routine Determinations.**

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

580 17.15.1 The package is proper for the contents to be shipped;

581 17.15.2 The package is in unimpaired physical condition except for superficial defects such as marks or
582 dents;

583 17.15.3 Each closure device of the packaging, including any required gasket, is properly installed and
584 secured and free of defects;

Comment [jsj30]: Language added consistent with 10 CFR 71.85(d).

The intent of the revised provision is to ensure that the (shipping package) certificate holders are responsible for certain actions and have made the required preliminary determinations.

NOTE: The phrase "by the certificate holder" is not included in 10 CFR 71, but is added for clarity.

NRC Compatibility "B"
[NRC RATS 2015-3](#)
[80 FR 33987 \(June 12, 2015\)](#)

Comment [jsj31]: The provisions in 17.14.1 through 17.14.4 are deleted, due to a 2015 change in NRC compatibility level "B" to compatibility "NRC" for these specific regulations. Due to this change in compatibility, the requirements are no longer under state jurisdiction. (The equivalent items remain in federal rule and can be found in 10 CFR 71.85(a) through 71.85(c)).

Provisions that are designated as "NRC" compatibility are elements that cannot be relinquished to Agreement States such as Colorado and therefore states should not adopt (or must remove) these regulatory provisions.

NRC Compatibility "NRC"
[NRC RATS 2015-3](#)
[80 FR 33987 \(June 12, 2015\)](#)

- 585 17.15.4 Any system for containing liquid is adequately sealed and has adequate space or other specified
586 provision for expansion of the liquid;
- 587 17.15.5 Any pressure relief device is operable and set in accordance with written procedures;
- 588 17.15.6 The package has been loaded and closed in accordance with written procedures;
- 589 17.15.7 Any structural part of the package which could be used to lift or tie down the package during
590 transport is rendered inoperable for the purpose unless it satisfies design requirements specified
591 in 10 CFR 71.45;
- 592 17.15.8 The level of non-fixed (removable) radioactive contamination on the external surfaces of each
593 package offered for shipment is as low as reasonably achievable and within the limits specified in
594 49 CFR 173.443.
- 595 17.15.8.1 Determination of the level of non-fixed (removable) contamination shall be based
596 upon wiping an area of 300 square centimeters of the surface concerned with an
597 absorbent material, using moderate pressure, and measuring the activity on the wiping
598 material.
- 599 (1) The number and location of measurements shall be sufficient to yield a
600 representative assessment of the removable contamination levels.
- 601 (2) Other methods of assessment of equal or greater detection efficiency may be
602 used.
- 603 17.15.8.2 In the case of packages transported as exclusive use shipments by rail or
604 highway only, the non-fixed (removable) radioactive contamination:
- 605 (1) At the beginning of transport shall not exceed the levels specified in 49 CFR
606 173.443; and
- 607 (2) At any time during transport shall not exceed 10 times the levels specified in 49
608 CFR 173.443.
- 609 17.15.9 External radiation levels around the package and around the vehicle, if applicable, shall not
610 exceed:
- 611 17.15.9.1 2 mSv/h (200 millirem per hour) at any point on the external surface of the
612 package at any time during transportation;
- 613 17.15.9.2 A transport index of 10.0.
- 614 17.15.10 For a package transported in exclusive use by rail, highway or water, radiation levels
615 external to the package may exceed the limits specified in 17.15.9 but shall not exceed any of the
616 following:
- 617 17.15.10.1 2 mSv/h (200 millirem per hour) on the accessible external surface of the
618 package unless the following conditions are met, in which case the limit is 10 mSv/h
619 (1000 millirem per hour);
- 620 (1) The shipment is made in a closed transport vehicle,
- 621 (2) Provisions are made to secure the package so that its position within the vehicle
622 remains fixed during transportation, and

- 623 (3) No loading or unloading operation occurs between the beginning and end of the
624 transportation.
- 625 17.15.10.2 2 mSv/h (200 millirem per hour) at any point on the outer surface of the vehicle,
626 including the upper and lower surfaces, or, in the case of a flat-bed style vehicle, with a
627 personnel barrier, at any point on the vertical planes projected from the outer edges of
628 the vehicle, on the upper surface of the load (or enclosure, if used), and on the lower
629 external surface of the vehicle;
- 630 (1) A flat bed style vehicle with a personnel barrier shall have radiation levels
631 determined at vertical planes.
- 632 (2) If no personnel barrier is in place, the package cannot exceed 2 mSv/h (200
633 millirem per hour) at any accessible surface.
- 634 17.15.10.3 0.1 mSv/h (10 millirem per hour) at any point 2 meters from the vertical planes
635 represented by the outer lateral surfaces of the vehicle, or, in the case of a flat-bed style
636 vehicle, at any point 2 meters from the vertical planes projected from the outer edges of
637 the vehicle; and
- 638 17.15.10.4 0.02 mSv/h (2 millirem per hour) in any normally occupied positions of the
639 vehicle, except that this provision does not apply to private motor carriers when persons
640 occupying these positions are provided with special health supervision, personnel
641 radiation exposure monitoring devices, and training in accordance with 10.3; and
- 642 17.15.11 For shipments made under the provisions of Section 17.15.10, the shipper shall provide
643 specific written instructions to the carrier for maintenance of the exclusive use shipment controls.
644 The instructions must be included with the shipping paper information.
- 645 17.15.12 The written instructions required for exclusive use shipments must be sufficient so that,
646 when followed, they will cause the carrier to avoid actions that will:
- 647 17.15.12.1 Unnecessarily delay delivery; or
- 648 17.15.12.2 Unnecessarily result in increased radiation levels or radiation exposures to
649 transport workers or members of the general public.
- 650 17.15.13 A package must be prepared for transport so that in still air at 100 degrees Fahrenheit
651 (38 degrees Celsius) and in the shade, no accessible surface of a package would have a
652 temperature exceeding 50 degrees Celsius (122 degrees Fahrenheit) in a nonexclusive use
653 shipment or 82 degrees Celsius (185 degrees Fahrenheit) in an exclusive use shipment.
654 Accessible package surface temperatures shall not exceed these limits at any time during
655 transportation.
- 656 17.15.14 A package may not incorporate a feature intended to allow continuous venting during
657 transport.
- 658 17.15.15 Before delivery of a package to a carrier for transport, the licensee shall ensure that any
659 special instructions needed to safely open the package have been sent to the consignee, or
660 otherwise made available to the consignee, for the consignee's use in accordance with 4.32.5.2.

661 **REPORTS AND RECORDS**

662 **17.16 Reports.**

- 663 The licensee shall report to the Department within 30 days:
- 664 17.16.1 Any instance in which there is significant reduction in the effectiveness of any packaging during
665 use; and
- 666 17.16.2 Details of any defects with safety significance in the packaging after first use, with the means
667 employed to repair the defects and prevent their recurrence; and
- 668 17.16.3 Instances in which the conditions of approval in the eCertificate of eCompliance were not
669 observed in making a shipment.
- 670 **17.17 Shipment Records.**
- 671 **17.17.1** Each licensee shall maintain, for a period of 3 years after shipment, a record of each shipment of
672 licensed material not exempt under 17.4 showing, where applicable:
- 673 17.17.1.1 Identification of the packaging by model number and serial number;
- 674 17.17.1.2 Verification that the packaging, as shipped, had no significant defect;
- 675 17.17.1.3 Volume and identification of coolant;
- 676 17.17.1.4 Type and quantity of licensed material in each package, and the total quantity of
677 each shipment;
- 678 **17.17.1.5 For each item of irradiated fissile material:**
- 679 (1) **Identification by model number and serial number;**
- 680 (2) **Irradiation and decay history to the extent appropriate to**
681 **demonstrate that its nuclear and thermal characteristics comply**
682 **with license conditions; and**
- 683 (3) **Any abnormal or unusual condition relevant to radiation safety;**
- 684 **17.17.1.6** Date of the shipment;
- 685 **17.17.1.67 For fissile packages and for Tybe B packages, any special controls**
686 **exercised;**
- 687 **17.17.1.8** Name and address of the transferee;
- 688 17.17.1.79 Address to which the shipment was made; and
- 689 17.17.1.810 Results of the determinations required by 17.15 and by the conditions of the
690 package approval.
- 691 **17.17.2 The licensee, certificate holder, and an applicant for a COC, shall make available to the**
692 **Department for inspection, upon reasonable notice, all records required by this part. Records are**
693 **only valid if stamped, initialed, or signed and dated by authorized personnel, or otherwise**
694 **authenticated.**
- 695 **17.17.3 The licensee, certificate holder, and an applicant for a COC shall maintain sufficient**
696 **written records to furnish evidence of the quality of packaging.**

Comment [jsj32]: Provision added, consistent with 10 CFR 71.91(a)(5).

NRC RATS 2015-3 changed the compatibility level for this provision from a lower level "D" (not required for compatibility) to a compatibility category "C", which is now required for compatibility. Therefore, a number of items previously excluded from the rule are now added into the draft rule.

NRC Compatibility "C"
[NRC RATS 2015-3](#)
[80 FR 33987 \(June 12, 2015\)](#)

Comment [jsj33]: Provision added, consistent with 10 CFR 71.91(a)(7).

NRC RATS 2015-3 changed the compatibility level for this provision from a lower level "D" (not required for compatibility) to a compatibility category "C", which is now required for compatibility.

NRC Compatibility "C"
[NRC RATS 2015-3](#)
[80 FR 33987 \(June 12, 2015\)](#)

Comment [jsj34]: Provision added, consistent with 10 CFR 71.91(c).

NRC RATS 2015-3 changed the compatibility level for this provision from a lower level "D" (not required for compatibility) to a compatibility category "C", which is now required for compatibility.

NRC Compatibility "C"
[NRC RATS 2015-3](#)
[80 FR 33987 \(June 12, 2015\)](#)

Comment [jsj35]: Provision added, consistent with 10 CFR 71.91(d).

NRC RATS 2015-3 changed the compatibility level for this provision from a lower level "D" (not required for compatibility) to a compatibility category "C", which is now required for compatibility.

NRC Compatibility "C"
NRC RATS 2015-3 [80 FR 33987 \(June 12, 2015\)](#)

- 697 **17.17.3.1** **The records to be maintained shall include:**
- 698 **(1) Results of the determinations required by 17.14;**
- 699 **(2) Design, fabrication, and assembly records;**
- 700 **(3) Results of reviews, inspections, tests, and audits; results of**
701 **monitoring work performance and materials analyses; and**
- 702 **(4) Results of maintenance, modification, and repair activities.**
- 703 **17.17.3.2** **Inspection, test, and audit records must identify:**
- 704 **(1) The inspector or data records,**
- 705 **(2) The type of observation,**
- 706 **(3) The results,**
- 707 **(4) The acceptability, and**
- 708 **(5) The action taken in connection with any deficiencies noted.**
- 709 **17.17.3.3** **The records required by 17.17.3. must be retained for 3 years after the life**
710 **of the packaging to which they apply.**
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725 **Appendix 17A - Determination of A₁ and A₂**

726 **17A1** Values of A₁ and A₂ for individual radionuclides, which are the bases for many activity limits
727 elsewhere in these regulations are given in Table 17A1. The curie (Ci) values specified are
728 obtained by converting from the Terabecquerel (TBq) value figure. The Terabecquerel values are
729 the regulatory standard. The curie values are for information only and are not intended to be the
730 regulatory standard. ~~The curie values are expressed to three significant figures to assure that the~~
731 ~~difference in the TBq and Ci quantities is one-tenth of one percent or less.~~ Where values of A₁ or
732 A₂ are unlimited, it is for radiation control purposes only. For nuclear criticality safety, some
733 materials are subject to controls placed on fissile material.

Comment [jsj36]: Page break inserted to ensure the appendix begins on a new page at time of final publication.

Comment [jsj37]: Language is updated, consistent with parallel provision in 10 CFR 71, Appendix A.

NRC Compatibility "B"
[NRC RATS 2015-3](#)
[80 FR 33987 \(June 12, 2015\)](#)

734 17A2 For individual radionuclides whose identities are known, but which are:

735 17A2.1 Not listed in Table 17A1:

- 736 (1) The A₁ and A₂ values Table 17A3 may be used.
- 737 (2) Otherwise, the licensee shall obtain prior NRC approval of the A₁ and A₂ values
738 for radionuclides not listed in Table 17A1, before shipping the material. The
739 licensee shall submit such request for prior approval to NRC in accordance with
740 10 CFR 71.1.

741 17A2.2 Not listed in Table 17A2:

- 742 (1) The exempt material activity concentration and exempt consignment activity
743 values contained in Table 17A3 may be used.
- 744 (2) Otherwise, the licensee shall obtain prior NRC approval of the exempt material
745 activity concentration and exempt consignment activity values for radionuclides
746 not listed in Table 17A2, before shipping the material. The licensee shall submit
747 such request for prior approval to NRC in accordance with 10 CFR 71.1.

748 17A3 In the calculations of A₁ and A₂ for a radionuclide not in Table 17A1, a single radioactive decay
749 chain, in which radionuclides are present in their naturally occurring proportions, and in which no
750 radioactive decay product nuclide has a half-life either longer than 10 days, or longer than that of
751 the parent nuclide, shall be considered as a single radionuclide, and the activity to be taken into
752 account, and the A₁ or A₂ value to be applied shall be those corresponding to the parent nuclide
753 of that chain. In the case of radioactive decay chains in which any radioactive decay product
754 nuclide has a half-life either longer than 10 days, or greater than that of the parent nuclide, the
755 parent and those radioactive decay product nuclides shall be considered as mixtures of different
756 nuclides.

757 17A4 For mixtures of radionuclides whose identities and respective activities are known, the following
758 conditions apply:

759 17A4.1 For special form radioactive material, the maximum quantity transported in a Type A
760 package is as follows:

761
$$\sum_i \frac{B(i)}{A_1(i)} \leq 1$$

762 where B(i) is the activity of radionuclide i **in special form**, and A₁(i) is the A₁ value for
 763 radionuclide i.

764 **17A4.2** For normal form radioactive material, the maximum quantity transported in a Type A
 765 package is as follows:

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

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

768 where B(i) is the activity of radionuclide i **in normal form**, and A₂(i) is the A₂ value for
 769 radionuclide i.

770 **17A4.3** If the package contains both special and normal form radioactive materials, the
 771 activity that may be transported in a type A package is as follows:

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

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

776 **17A4.34** Alternatively, ~~an~~ the A₁ value for mixtures of special form material may be
 777 determined as follows:

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

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

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

782 **17A4.45** Alternatively, the A₂ value for mixtures of normal form material may be
 783 determined as follows:

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

Comment [jsj38]: There is no change to the calculation formula in 17A4.2 – only the formula file type has changed.

The purpose of the change is to incorporate a graphics file format that allows for future editing.

Comment [jsj39]: This is a new provision and equation, added for consistency with 10 CFR 71, Appendix A, paragraph IV.c.

Comment [jsj40]: There is no change to the calculation formula in (renumbered) 17A4.4 – only the formula file type has changed.

The purpose of the change is to incorporate a graphics file format that allows for future editing.

Comment [jsj41]: There is no change to the calculation formula in (renumbered) 17A4.5 – only the formula file type has changed.

The purpose of the change is to incorporate a graphics file format that allows for future editing.

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

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

17A4.66 The exempt activity concentration for mixtures of nuclides may be determined as follows:

$$[A] = \frac{1}{\sum_i \frac{f(i)}{[A](i)}}$$

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

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

17A4.67 The activity limit for an exempt consignment for mixtures of radionuclides may be determined as follows:

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

$$\text{Exempt consignment activity limit for mixture} = \frac{1}{\sum_i \frac{f(i)}{A(i)}}$$

where $f(i)$ is the fraction of activity of radionuclide i in the mixture, and $A(i)$ 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.

17A6 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 $[A]$ (activity concentration for exempt materials) or A (activity limit for exempt consignment) 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 $[A]$ or A values for the alpha emitters and beta/gamma emitters, respectively.

Comment [jsj42]: Effectively, there is no change to the calculation formula in (renumbered) 17A4.6 – only the formula file type has changed as well as clarifying wording being added, consistent with 10 CFR 71, Appendix A.

The purpose of the change is to incorporate a graphics file format that allows for future editing.

Comment [jsj43]: Similar to other equation editing, the graphics file format in this equation is updated to allow for future editing.

Comment [jsj44]: This is a new provision added for consistency with a similar provision in Appendix A of 10 CFR 71.V.b.

The added provision incorporates language when shipments involve concentrations of exempt materials that are not addressed by 17A5.

NRC Compatibility "B"
[NRC RATS 2015-3](#)
[80 FR 33987 \(June 12, 2015\)](#)

813

TABLE 17A1: A₁ AND A₂ VALUES FOR RADIONUCLIDES

Symbol of radionuclide	Element and atomic number	A ₁ (TBq)	A ₁ (Ci)b	A ₂ (TBq)	A ₂ (Ci)	Specific activity	
						(TBq/g)	(Ci/g)
Ac-225 (a)	Actinium (89)	8.0X10 ⁻¹	2.2X10 ¹	6.0X10 ⁻³	1.6X10 ⁻¹	2.1X10 ³	5.8X10 ⁴
Ac-227 (a)	.	9.0X10 ⁻¹	2.4X10 ¹	9.0X10 ⁻⁵	2.4X10 ⁻³	2.7	7.2X10 ¹
Ac-228	.	6.0X10 ⁻¹	1.6X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	8.4X10 ⁴	2.2X10 ⁶
Ag-105	Silver (47)	2.0	5.4X10 ¹	2.0	5.4X10 ¹	1.1X10 ³	3.0X10 ⁴
Ag-108m (a)	.	7.0X10 ⁻¹	1.9X10 ¹	7.0X10 ⁻¹	1.9X10 ¹	9.7X10 ⁻¹	2.6X10 ¹
Ag-110m (a)	.	4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	1.8X10 ²	4.7X10 ³
Ag-111	.	2.0	5.4X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	5.8X10 ³	1.6X10 ⁵
Al-26	Aluminum (13)	1.0X10 ⁻¹	2.7	1.0X10 ⁻¹	2.7	7.0X10 ⁻⁴	1.9X10 ⁻²
Am-241	Americium (95)	1.0X10 ¹	2.7X10 ²	1.0X10 ⁻³	2.7X10 ⁻²	1.3X10 ⁻¹	3.4
Am-242m (a)	.	1.0X10 ¹	2.7X10 ²	1.0X10 ⁻³	2.7X10 ⁻²	3.6X10 ⁻¹	1.0X10 ¹
Am-243 (a)	.	5.0	1.4X10 ²	1.0X10 ⁻³	2.7X10 ⁻²	7.4X10 ⁻³	2.0X10 ⁻¹
Ar-37	Argon (18)	4.0X10 ¹	1.1X10 ³	4.0X10 ¹	1.1X10 ³	3.7X10 ³	9.9X10 ⁴
Ar-39	.	4.0X10 ¹	1.1X10 ³	2.0X10 ¹	5.4X10 ²	1.3	3.4X10 ¹
Ar-41	.	3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	1.5X10 ⁶	4.2X10 ⁷
As-72	Arsenic (33)	3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	6.2X10 ⁴	1.7X10 ⁶
As-73	.	4.0X10 ¹	1.1X10 ³	4.0X10 ¹	1.1X10 ³	8.2X10 ²	2.2X10 ⁴
As-74	.	1.0	2.7X10 ¹	9.0X10 ⁻¹	2.4X10 ¹	3.7X10 ³	9.9X10 ⁴
As-76	.	3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	5.8X10 ⁴	1.6X10 ⁶
As-77	.	2.0X10 ¹	5.4X10 ²	7.0X10 ⁻¹	1.9X10 ¹	3.9X10 ⁴	1.0X10 ⁶
At-211 (a)	Astatine (85)	2.0X10 ¹	5.4X10 ²	5.0X10 ⁻¹	1.4X10 ¹	7.6X10 ⁴	2.1X10 ⁶
Au-193	Gold (79)	7.0	1.9X10 ²	2.0	5.4X10 ¹	3.4X10 ⁴	9.2X10 ⁵
Au-194	.	1.0	2.7X10 ¹	1.0	2.7X10 ¹	1.5X10 ⁴	4.1X10 ⁵
Au-195	.	1.0X10 ¹	2.7X10 ²	6.0	1.6X10 ²	1.4X10 ²	3.7X10 ³
Au-198	.	1.0	2.7X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	9.0X10 ³	2.4X10 ⁵
Au-199	.	1.0X10 ¹	2.7X10 ²	6.0X10 ⁻¹	1.6X10 ¹	7.7X10 ³	2.1X10 ⁵
Ba-131 (a)	Barium (56)	2.0	5.4X10 ¹	2.0	5.4X10 ¹	3.1X10 ³	8.4X10 ⁴
Ba-133	.	3.0	8.1X10 ¹	3.0	8.1X10 ¹	9.4	2.6X10 ²
Ba-133m	.	2.0X10 ¹	5.4X10 ²	6.0X10 ⁻¹	1.6X10 ¹	2.2X10 ⁴	6.1X10 ⁵
Ba-140 (a)	.	5.0X10 ⁻¹	1.4X10 ¹	3.0X10 ⁻¹	8.1	2.7X10 ³	7.3X10 ⁴
Be-7	Beryllium (4)	2.0X10 ¹	5.4X10 ²	2.0X10 ¹	5.4X10 ²	1.3X10 ⁴	3.5X10 ⁵
Be-10	.	4.0X10 ¹	1.1X10 ³	6.0X10 ⁻¹	1.6X10 ¹	8.3X10 ⁻⁴	2.2X10 ⁻²
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

TABLE 17A1: A ₁ AND A ₂ VALUES FOR RADIONUCLIDES							
Symbol of radionuclide	Element and atomic number	A ₁ (TBq)	A ₁ (Ci)b	A ₂ (TBq)	A ₂ (Ci).	Specific activity	
						(TBq/g)	(Ci/g)
Bk-249 (a)	.	4.0X10 ⁻¹	1.1X10 ⁻³	3.0X10 ⁻¹	8.1	6.1X10 ⁻¹	1.6X10 ⁻³
Br-76	Bromine (35)	4.0X10 ⁻¹	1.1X10 ⁻¹	4.0X10 ⁻¹	1.1X10 ⁻¹	9.4X10 ⁻⁴	2.5X10 ⁻⁶
Br-77	.	3.0	8.1X10 ⁻¹	3.0	8.1X10 ⁻¹	2.6X10 ⁻⁴	7.1X10 ⁻⁵
Br-82	.	4.0X10 ⁻¹	1.1X10 ⁻¹	4.0X10 ⁻¹	1.1X10 ⁻¹	4.0X10 ⁻⁴	1.1X10 ⁻⁶
C-11	Carbon (6)	1.0	2.7X10 ⁻¹	6.0X10 ⁻¹	1.6X10 ⁻¹	3.1X10 ⁻⁷	8.4X10 ⁻⁸
C-14	.	4.0X10 ⁻¹	1.1X10 ⁻³	3.0	8.1X10 ⁻¹	1.6X10 ⁻¹	4.5
Ca-41	Calcium (20)	Unlimited	Unlimited	Unlimited	Unlimited	3.1X10 ⁻³	8.5X10 ⁻²
Ca-45	.	4.0X10 ⁻¹	1.1X10 ⁻³	1.0	2.7X10 ⁻¹	6.6X10 ⁻²	1.8X10 ⁻⁴
Ca-47 (a)	.	3.0	8.1X10 ⁻¹	3.0X10 ⁻¹	8.1	2.3X10 ⁻⁴	6.1X10 ⁻⁵
Cd-109	Cadmium (48)	3.0X10 ⁻¹	8.1X10 ⁻²	2.0	5.4X10 ⁻¹	9.6X10 ⁻¹	2.6X10 ⁻³
Cd-113m	.	4.0X10 ⁻¹	1.1X10 ⁻³	5.0X10 ⁻¹	1.4X10 ⁻¹	8.3	2.2X10 ⁻²
Cd-115 (a)	.	3.0	8.1X10 ⁻¹	4.0X10 ⁻¹	1.1X10 ⁻¹	1.9X10 ⁻⁴	5.1X10 ⁻⁵
Cd-115m	.	5.0X10 ⁻¹	1.4X10 ⁻¹	5.0X10 ⁻¹	1.4X10 ⁻¹	9.4X10 ⁻²	2.5X10 ⁻⁴
Ce-139	Cerium (58)	7.0	1.9X10 ⁻²	2.0	5.4X10 ⁻¹	2.5X10 ⁻²	6.8X10 ⁻³
Ce-141	.	2.0X10 ⁻¹	5.4X10 ⁻²	6.0X10 ⁻¹	1.6X10 ⁻¹	1.1X10 ⁻³	2.8X10 ⁻⁴
Ce-143	.	9.0X10 ⁻¹	2.4X10 ⁻¹	6.0X10 ⁻¹	1.6X10 ⁻¹	2.5X10 ⁻⁴	6.6X10 ⁻⁵
Ce-144 (a)	.	2.0X10 ⁻¹	5.4	2.0X10 ⁻¹	5.4	1.2X10 ⁻²	3.2X10 ⁻³
Cf-248	Californium (98)	4.0X10 ⁻¹	1.1X10 ⁻³	6.0X10 ⁻³	1.6X10 ⁻¹	5.8X10 ⁻¹	1.6X10 ⁻³
Cf-249	.	3.0	8.1X10 ⁻¹	8.0X10 ⁻⁴	2.2X10 ⁻²	1.5X10 ⁻¹	4.1
Cf-250	.	2.0X10 ⁻¹	5.4X10 ⁻²	2.0X10 ⁻³	5.4X10 ⁻²	4.0	1.1X10 ⁻²
Cf-251	.	7.0	1.9X10 ⁻²	7.0X10 ⁻⁴	1.9X10 ⁻²	5.9X10 ⁻²	1.6
Cf-252 (B)	.	51.0X10⁻²¹	1.42.7	3.0X10 ⁻³	8.1X10 ⁻²	2.0X10 ⁻¹	5.4X10 ⁻²
Cf-253 (a)	.	4.0X10 ⁻¹	1.1X10 ⁻³	4.0X10 ⁻²	1.1	1.1X10 ⁻³	2.9X10 ⁻⁴
Cf-254	.	1.0X10 ⁻³	2.7X10 ⁻²	1.0X10 ⁻³	2.7X10 ⁻²	3.1X10 ⁻²	8.5X10 ⁻³
Cl-36	Chlorine (17)	1.0X10 ⁻¹	2.7X10 ⁻²	6.0X10 ⁻¹	1.6X10 ⁻¹	1.2X10 ⁻³	3.3X10 ⁻²
Cl-38	.	2.0X10 ⁻¹	5.4	2.0X10 ⁻¹	5.4	4.9X10 ⁻⁶	1.3X10 ⁻⁸
Cm-240	Curium (96)	4.0X10 ⁻¹	1.1X10 ⁻³	2.0X10 ⁻²	5.4X10 ⁻¹	7.5X10 ⁻²	2.0X10 ⁻⁴
Cm-241	.	2.0	5.4X10 ⁻¹	1.0	2.7X10 ⁻¹	6.1X10 ⁻²	1.7X10 ⁻⁴
Cm-242	.	4.0X10 ⁻¹	1.1X10 ⁻³	1.0X10 ⁻²	2.7X10 ⁻¹	1.2X10 ⁻²	3.3X10 ⁻³
Cm-243	.	9.0	2.4X10 ⁻²	1.0X10 ⁻³	2.7X10 ⁻²	1.9X10 ⁻³	5.2X10 ⁻¹
Cm-244	.	2.0X10 ⁻¹	5.4X10 ⁻²	2.0X10 ⁻³	5.4X10 ⁻²	3.0	8.1X10 ⁻¹
Cm-245	.	9.0	2.4X10 ⁻²	9.0X10 ⁻⁴	2.4X10 ⁻²	6.4X10 ⁻³	1.7X10 ⁻¹
Cm-246	.	9.0	2.4X10 ⁻²	9.0X10 ⁻⁴	2.4X10 ⁻²	1.1X10 ⁻²	3.1X10 ⁻¹
Cm-247 (a)	.	3.0	8.1X10 ⁻¹	1.0X10 ⁻³	2.7X10 ⁻²	3.4X10 ⁻⁶	9.3X10 ⁻⁵
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

Comment [jsj45]: A1 values are increased (made less restrictive) for Cf252, consistent with 2015 changes to 10 CFR 71, Table A-1.

Amended values are consistent with U.S. Department of Transportation (DOT) requirements, and International Atomic Energy Agency (IAEA) transportation regulations in [TS-R-1](#) (2009).

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TABLE 17A1: A ₁ AND A ₂ VALUES FOR RADIONUCLIDES							
Symbol of radionuclide	Element and atomic number	A ₁ (TBq)	A ₁ (Ci)b	A ₂ (TBq)	A ₂ (Ci).	Specific activity	
						(TBq/g)	(Ci/g)
Co-60	.	4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	4.2X10 ¹	1.1X10 ³
Cr-51	Chromium (24)	3.0X10 ¹	8.1X10 ²	3.0X10 ¹	8.1X10 ²	3.4X10 ³	9.2X10 ⁴
Cs-129	Cesium (55)	4.0	1.1X10 ²	4.0	1.1X10 ²	2.8X10 ⁴	7.6X10 ⁵
Cs-131	.	3.0X10 ¹	8.1X10 ²	3.0X10 ¹	8.1X10 ²	3.8X10 ³	1.0X10 ⁵
Cs-132	.	1.0	2.7X10 ¹	1.0	2.7X10 ¹	5.7X10 ³	1.5X10 ⁵
Cs-134	.	7.0X10 ⁻¹	1.9X10 ¹	7.0X10 ⁻¹	1.9X10 ¹	4.8X10 ¹	1.3X10 ³
Cs-134m	.	4.0X10 ¹	1.1X10 ³	6.0X10 ⁻¹	1.6X10 ¹	3.0X10 ⁵	8.0X10 ⁶
Cs-135	.	4.0X10 ¹	1.1X10 ³	1.0	2.7X10 ¹	4.3X10 ⁻⁵	1.2X10 ⁻³
Cs-136	.	5.0X10 ⁻¹	1.4X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	2.7X10 ³	7.3X10 ⁴
Cs-137 (a)	.	2.0	5.4X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	3.2	8.7X10 ¹
Cu-64	Copper (29)	6.0	1.6X10 ²	1.0	2.7X10 ¹	1.4X10 ⁵	3.9X10 ⁶
Cu-67	.	1.0X10 ¹	2.7X10 ²	7.0X10 ⁻¹	1.9X10 ¹	2.8X10 ⁴	7.6X10 ⁵
Dy-159	Dysprosium (66)	2.0X10 ¹	5.4X10 ²	2.0X10 ¹	5.4X10 ²	2.1X10 ²	5.7X10 ³
Dy-165	.	9.0X10 ⁻¹	2.4X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	3.0X10 ⁵	8.2X10 ⁶
Dy-166 (a)	.	9.0X10 ⁻¹	2.4X10 ¹	3.0X10 ⁻¹	8.1	8.6X10 ³	2.3X10 ⁵
Er-169	Erbium (68)	4.0X10 ¹	1.1X10 ³	1.0	2.7X10 ¹	3.1X10 ³	8.3X10 ⁴
Er-171	.	8.0X10 ⁻¹	2.2X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	9.0X10 ⁴	2.4X10 ⁶
Eu-147	Europium (63)	2.0	5.4X10 ¹	2.0	5.4X10 ¹	1.4X10 ³	3.7X10 ⁴
Eu-148	.	5.0X10 ⁻¹	1.4X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	6.0X10 ²	1.6X10 ⁴
Eu-149	.	2.0X10 ¹	5.4X10 ²	2.0X10 ¹	5.4X10 ²	3.5X10 ²	9.4X10 ³
Eu-150. (short.lived)	.	2.0	5.4X10 ¹	7.0X10 ⁻¹	1.9X10 ¹	6.1X10 ⁴	1.6X10 ⁶
Eu-150. (long.lived)	.	7.0X10 ⁻¹	1.9X10 ¹	7.0X10 ⁻¹	1.9X10 ¹	6.1X10 ⁴	1.6X10 ⁶
Eu-152	.	1.0	2.7X10 ¹	1.0	2.7X10 ¹	6.5	1.8X10 ²
Eu-152m	.	8.0X10 ⁻¹	2.2X10 ¹	8.0X10 ⁻¹	2.2X10 ¹	8.2X10 ⁴	2.2X10 ⁶
Eu-154	.	9.0X10 ⁻¹	2.4X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	9.8	2.6X10 ²
Eu-155	.	2.0X10 ¹	5.4X10 ²	3.0	8.1X10 ¹	1.8X10 ¹	4.9X10 ²
Eu-156	.	7.0X10 ⁻¹	1.9X10 ¹	7.0X10 ⁻¹	1.9X10 ¹	2.0X10 ³	5.5X10 ⁴
F-18	Fluorine.(9)	1.0	2.7X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	3.5X10 ⁶	9.5X10 ⁷
Fe-52.(a)	Iron.(26)	3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	2.7X10 ⁵	7.3X10 ⁶
Fe-55	.	4.0X10 ¹	1.1X10 ³	4.0X10 ¹	1.1X10 ³	8.8X10 ¹	2.4X10 ³
Fe-59	.	9.0X10 ⁻¹	2.4X10 ¹	9.0X10 ⁻¹	2.4X10 ¹	1.8X10 ³	5.0X10 ⁴
Fe-60 (a)	.	4.0X10 ¹	1.1X10 ³	2.0X10 ⁻¹	5.4	7.4X10 ⁻⁴	2.0X10 ⁻²
Ga-67	Gallium (31)	7.0	1.9X10 ²	3.0	8.1X10 ¹	2.2X10 ⁴	6.0X10 ⁵
Ga-68	.	5.0X10 ⁻¹	1.4X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	1.5X10 ⁶	4.1X10 ⁷
Ga-72	.	4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	1.1X10 ⁵	3.1X10 ⁶
Gd-146.(a)	Gadolinium(64)	5.0X10 ⁻¹	1.4X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	6.9X10 ²	1.9X10 ⁴
Gd-148	.	2.0X10 ¹	5.4X10 ²	2.0X10 ⁻³	5.4X10 ⁻²	1.2	3.2X10 ¹
Gd-153	.	1.0X10 ¹	2.7X10 ²	9.0	2.4X10 ²	1.3X10 ²	3.5X10 ³
Gd-159	.	3.0	8.1X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	3.9X10 ⁴	1.1X10 ⁶

TABLE 17A1: A₁ AND A₂ VALUES FOR RADIONUCLIDES

Symbol of radionuclide	Element and atomic number	A ₁ (TBq)	A ₁ (Ci)b	A ₂ (TBq)	A ₂ (Ci).	Specific activity	
						(TBq/g)	(Ci/g)
Ge-68.(a)	Germanium(32)	5.0X10 ⁻¹	1.4X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	2.6X10 ²	7.1X10 ³
Ge-71	.	4.0X10 ¹	1.1X10 ³	4.0X10 ¹	1.1X10 ³	5.8X10 ³	1.6X10 ⁵
Ge-77	.	3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	1.3X10 ⁵	3.6X10 ⁶
Hf-172 (a)	Hafnium (72)	6.0X10 ⁻¹	1.6X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	4.1X10 ¹	1.1X10 ³
Hf-175	.	3.0	8.1X10 ¹	3.0	8.1X10 ¹	3.9X10 ²	1.1X10 ⁴
Hf-181	.	2.0	5.4X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	6.3X10 ²	1.7X10 ⁴
Hf-182	.	Unlimited	Unlimited	Unlimited	Unlimited	8.1X10 ⁻⁶	2.2X10 ⁻⁴
Hg-194 (a)	Mercury (80)	1.0	2.7X10 ¹	1.0	2.7X10 ¹	1.3X10 ⁻¹	3.5
Hg-195m (a)	.	3.0	8.1X10 ¹	7.0X10 ⁻¹	1.9X10 ¹	1.5X10 ⁴	4.0X10 ⁵
Hg-197	.	2.0X10 ¹	5.4X10 ²	1.0X10 ¹	2.7X10 ²	9.2X10 ³	2.5X10 ⁵
Hg-197m	.	1.0X10 ¹	2.7X10 ²	4.0X10 ⁻¹	1.1X10 ¹	2.5X10 ⁴	6.7X10 ⁵
Hg-203	.	5.0	1.4X10 ²	1.0	2.7X10 ¹	5.1X10 ²	1.4X10 ⁴
Ho-166	Holmium (67)	4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	2.6X10 ⁴	7.0X10 ⁵
Ho-166m	.	6.0X10 ⁻¹	1.6X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	6.6X10 ⁻²	1.8
I-123	Iodine (53)	6.0	1.6X10 ²	3.0	8.1X10 ¹	7.1X10 ⁴	1.9X10 ⁶
I-124	.	1.0	2.7X10 ¹	1.0	2.7X10 ¹	9.3X10 ³	2.5X10 ⁵
I-125	.	2.0X10 ¹	5.4X10 ²	3.0	8.1X10 ¹	6.4X10 ²	1.7X10 ⁴
I-126	.	2.0	5.4X10 ¹	1.0	2.7X10 ¹	2.9X10 ³	8.0X10 ⁴
I-129	.	Unlimited	Unlimited	Unlimited	Unlimited	6.5X10 ⁻⁶	1.8X10 ⁻⁴
I-131	.	3.0	8.1X10 ¹	7.0X10 ⁻¹	1.9X10 ¹	4.6X10 ³	1.2X10 ⁵
I-132	.	4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	3.8X10 ⁵	1.0X10 ⁷
I-133	.	7.0X10 ⁻¹	1.9X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	4.2X10 ⁴	1.1X10 ⁶
I-134	.	3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	9.9X10 ⁵	2.7X10 ⁷
I-135.(a)	.	6.0X10 ⁻¹	1.6X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	1.3X10 ⁵	3.5X10 ⁶
In-111	Indium (49)	3.0	8.1X10 ¹	3.0	8.1X10 ¹	1.5X10 ⁴	4.2X10 ⁵
In-113m	.	4.0	1.1X10 ²	2.0	5.4X10 ¹	6.2X10 ⁵	1.7X10 ⁷
In-114m.(a)	.	1.0X10 ¹	2.7X10 ²	5.0X10 ⁻¹	1.4X10 ¹	8.6X10 ²	2.3X10 ⁴
In-115m	.	7.0	1.9X10 ²	1.0	2.7X10 ¹	2.2X10 ⁵	6.1X10 ⁶
Ir-189.(a)	Iridium (77)	1.0X10 ¹	2.7X10 ²	1.0X10 ¹	2.7X10 ²	1.9X10 ³	5.2X10 ⁴
Ir-190	.	7.0X10 ⁻¹	1.9X10 ¹	7.0X10 ⁻¹	1.9X10 ¹	2.3X10 ³	6.2X10 ⁴
Ir-192.(e)	.	(c) 1.0	(c) 2.7X10¹	6.0X10 ⁻¹	1.6X10 ¹	3.4X10 ²	9.2X10 ³
Ir-194	.	3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	3.1X10 ⁴	8.4X10 ⁵
K-40	Potassium (19)	9.0X10 ⁻¹	2.4X10 ¹	9.0X10 ⁻¹	2.4X10 ¹	2.4X10 ⁻⁷	6.4X10 ⁻⁶
K-42	.	2.0X10 ⁻¹	5.4	2.0X10 ⁻¹	5.4	2.2X10 ⁵	6.0X10 ⁶
K-43	.	7.0X10 ⁻¹	1.9X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	1.2X10 ⁵	3.3X10 ⁶
Kr-79	Krypton (36)	4.0	1.1X10²	2.0	5.4X10¹	4.2X10⁴	1.1X10⁶
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

Comment [jsj46]: Footnote for Ir192 updated, consistent with 2015 changes to 10 CFR 71, Table A-1.

Footnote "c" is relocated to clarify that it only applies to the A1 value and only to the special form (~sealed sources) of the isotope.

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Comment [jsj47]: Values for Kr-79 added, consistent with 2015 changes to 10 CFR 71, Table A-1.

Previously, the more generic values of Table 17A3 were used since there was no value specific to Kr-79. The IAEA added values for Kr-79 to better reflect the radiological hazard of this radionuclide. In turn, the NRC adopted the same values in 10 CFR 71.

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TABLE 17A1: A₁ AND A₂ VALUES FOR RADIONUCLIDES

Symbol of radionuclide	Element and atomic number	A ₁ (TBq)	A ₁ (Ci)b	A ₂ (TBq)	A ₂ (Ci).	Specific activity	
						(TBq/g)	(Ci/g)
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) (ih)	.	1.0	2.7X10 ⁻¹	6.0X10 ⁻¹	1.6X10 ⁻¹	1.8X10 ⁻⁴	4.8X10 ⁻⁵
N-13	Nitrogen (7)	9.0X10 ⁻¹	2.4X10 ⁻¹	6.0X10 ⁻¹	1.6X10 ⁻¹	5.4X10 ⁻⁷	1.5X10 ⁻⁹
Na-22	Sodium (11)	5.0X10 ⁻¹	1.4X10 ⁻¹	5.0X10 ⁻¹	1.4X10 ⁻¹	2.3X10 ⁻²	6.3X10 ⁻³
Na-24	.	2.0X10 ⁻¹	5.4	2.0X10 ⁻¹	5.4	3.2X10 ⁻⁵	8.7X10 ⁻⁶
Nb-93m	Niobium (41)	4.0X10 ⁻¹	1.1X10 ⁻³	3.0X10 ⁻¹	8.1X10 ⁻²	8.8	2.4X10 ⁻²
Nb-94	.	7.0X10 ⁻¹	1.9X10 ⁻¹	7.0X10 ⁻¹	1.9X10 ⁻¹	6.9X10 ⁻³	1.9X10 ⁻¹
Nb-95	.	1.0	2.7X10 ⁻¹	1.0	2.7X10 ⁻¹	1.5X10 ⁻³	3.9X10 ⁻⁴
Nb-97	.	9.0X10 ⁻¹	2.4X10 ⁻¹	6.0X10 ⁻¹	1.6X10 ⁻¹	9.9X10 ⁻⁵	2.7X10 ⁻⁷
Nd-147	Neodymium (60)	6.0	1.6X10 ⁻²	6.0X10 ⁻¹	1.6X10 ⁻¹	3.0X10 ⁻³	8.1X10 ⁻⁴
Nd-149	.	6.0X10 ⁻¹	1.6X10 ⁻¹	5.0X10 ⁻¹	1.4X10 ⁻¹	4.5X10 ⁻⁵	1.2X10 ⁻⁷
Ni-59	Nickel (28)	Unlimited	Unlimited	Unlimited	Unlimited	3.0X10 ⁻³	8.0X10 ⁻²
Ni-63	.	4.0X10 ⁻¹	1.1X10 ⁻³	3.0X10 ⁻¹	8.1X10 ⁻²	2.1	5.7X10 ⁻¹
Ni-65	.	4.0X10 ⁻¹	1.1X10 ⁻¹	4.0X10 ⁻¹	1.1X10 ⁻¹	7.1X10 ⁻⁵	1.9X10 ⁻⁷
Np-235	Neptunium (93)	4.0X10 ⁻¹	1.1X10 ⁻³	4.0X10 ⁻¹	1.1X10 ⁻³	5.2X10 ⁻¹	1.4X10 ⁻³
Np-236 (short-lived)	.	2.0X10 ⁻¹	5.4X10 ⁻²	2.0	5.4X10 ⁻¹	4.7X10 ⁻⁴	1.3X10 ⁻²
Np-236 (long-lived)	.	9.0X10 ⁰	2.4X10 ⁻²	2.0X10 ⁻²	5.4X10 ⁻¹	4.7X10 ⁻⁴	1.3X10 ⁻²
Np-237	.	2.0X10 ⁻¹	5.4X10 ⁻²	2.0X10 ⁻³	5.4X10 ⁻²	2.6X10 ⁻⁵	7.1X10 ⁻⁴
Np-239	.	7.0	1.9X10 ⁻²	4.0X10 ⁻¹	1.1X10 ⁻¹	8.6X10 ⁻³	2.3X10 ⁻⁵
Os-185	Osmium (76)	1.0	2.7X10 ⁻¹	1.0	2.7X10 ⁻¹	2.8X10 ⁻²	7.5X10 ⁻³
Os-191	.	1.0X10 ⁻¹	2.7X10 ⁻²	2.0	5.4X10 ⁻¹	1.6X10 ⁻³	4.4X10 ⁻⁴
Os-191m	.	4.0X10 ⁻¹	1.1X10 ⁻³	3.0X10 ⁻¹	8.1X10 ⁻²	4.6X10 ⁻⁴	1.3X10 ⁻⁶
Os-193	.	2.0	5.4X10 ⁻¹	6.0X10 ⁻¹	1.6X10 ⁻¹	2.0X10 ⁻⁴	5.3X10 ⁻⁵
Os-194 (a)	.	3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	1.1X10 ⁻¹	3.1X10 ⁻²
P-32	Phosphorus. (15)	5.0X10 ⁻¹	1.4X10 ⁻¹	5.0X10 ⁻¹	1.4X10 ⁻¹	1.1X10 ⁻⁴	2.9X10 ⁻⁵

Comment [jsj48]: Footnote for Mo99 updated, consistent with 2015 changes to 10 CFR 71, Table A-1.

With reference to (new) footnote "h", the change restores the A₂ value (20 Ci) for Mo99 for domestic shipments. The original footnote "i" was inadvertently removed from the rule sometime in the past. This original footnote "i" indicated that the domestic value for Mo99 was 20 Ci, so there is no change to the A₂ value.

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TABLE 17A1: A ₁ AND A ₂ VALUES FOR RADIONUCLIDES							
Symbol of radionuclide	Element and atomic number	A ₁ (TBq)	A ₁ (Ci)b	A ₂ (TBq)	A ₂ (Ci).	Specific activity	
						(TBq/g)	(Ci/g)
P-33	.	4.0X10 ¹	1.1X10 ³	1.0	2.7X10 ¹	5.8X10 ³	1.6X10 ⁵
Pa-230. (a)	Protactinium. (91)	2.0	5.4X10 ¹	7.0X10 ⁻²	1.9	1.2X10 ³	3.3X10 ⁴
Pa-231	.	4.0	1.1X10 ²	4.0X10 ⁻⁴	1.1X10 ⁻²	1.7X10 ⁻³	4.7X10 ⁻²
Pa-233	.	5.0	1.4X10 ²	7.0X10 ⁻¹	1.9X10 ¹	7.7X10 ²	2.1X10 ⁴
Pb-201	Lead. (82)	1.0	2.7X10 ¹	1.0	2.7X10 ¹	6.2X10 ⁴	1.7X10 ⁶
Pb-202	.	4.0X10 ¹	1.1X10 ³	2.0X10 ¹	5.4X10 ²	1.2X10 ⁻⁴	3.4X10 ⁻³
Pb-203	.	4.0	1.1X10 ²	3.0	8.1X10 ¹	1.1X10 ⁴	3.0X10 ⁵
Pb-205	.	Unlimited	Unlimited	Unlimited	Unlimited	4.5X10 ⁻⁶	1.2X10 ⁻⁴
Pb-210. (a)	.	1.0	2.7X10 ¹	5.0X10 ⁻²	1.4	2.8	7.6X10 ¹
Pb-212. (a)	.	7.0X10 ⁻¹	1.9X10 ¹	2.0X10 ⁻¹	5.4	5.1X10 ⁴	1.4X10 ⁶
Pd-103. (a)	Palladium. (46)	4.0X10 ¹	1.1X10 ³	4.0X10 ¹	1.1X10 ³	2.8X10 ³	7.5X10 ⁴
Pd-107	.	Unlimited	Unlimited	Unlimited	Unlimited	1.9X10 ⁻⁵	5.1X10 ⁻⁴
Pd-109	.	2.0	5.4X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	7.9X10 ⁴	2.1X10 ⁶
Pm-143	Promethium. (61)	3.0	8.1X10 ¹	3.0	8.1X10 ¹	1.3X10 ²	3.4X10 ³
Pm-144	.	7.0X10 ⁻¹	1.9X10 ¹	7.0X10 ⁻¹	1.9X10 ¹	9.2X10 ¹	2.5X10 ³
Pm-145	.	3.0X10 ¹	8.1X10 ²	1.0X10 ¹	2.7X10 ²	5.2	1.4X10 ²
Pm-147	.	4.0X10 ¹	1.1X10 ³	2.0	5.4X10 ¹	3.4X10 ¹	9.3X10 ²
Pm-148m. (a)	.	8.0X10 ⁻¹	2.2X10 ¹	7.0X10 ⁻¹	1.9X10 ¹	7.9X10 ²	2.1X10 ⁴
Pm-149	.	2.0	5.4X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	1.5X10 ⁴	4.0X10 ⁵
Pm-151	.	2.0	5.4X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	2.7X10 ⁴	7.3X10 ⁵
Po-210	Polonium. (84)	4.0X10 ¹	1.1X10 ³	2.0X10 ⁻²	5.4X10 ⁻¹	1.7X10 ²	4.5X10 ³
Pr-142	Praseodymium. (59)	4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	4.3X10 ⁴	1.2X10 ⁶
Pr-143	.	3.0	8.1X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	2.5X10 ³	6.7X10 ⁴
Pt-188. (a)	Platinum. (78)	1.0	2.7X10 ¹	8.0X10 ⁻¹	2.2X10 ¹	2.5X10 ³	6.8X10 ⁴
Pt-191	.	4.0	1.1X10 ²	3.0	8.1X10 ¹	8.7X10 ³	2.4X10 ⁵
Pt-193	.	4.0X10 ¹	1.1X10 ³	4.0X10 ¹	1.1X10 ³	1.4	3.7X10 ¹
Pt-193m	.	4.0X10 ¹	1.1X10 ³	5.0X10 ⁻¹	1.4X10 ¹	5.8X10 ³	1.6X10 ⁵
Pt-195m	.	1.0X10 ¹	2.7X10 ²	5.0X10 ⁻¹	1.4X10 ¹	6.2X10 ³	1.7X10 ⁵
Pt-197	.	2.0X10 ¹	5.4X10 ²	6.0X10 ⁻¹	1.6X10 ¹	3.2X10 ⁴	8.7X10 ⁵
Pt-197m	.	1.0X10 ¹	2.7X10 ²	6.0X10 ⁻¹	1.6X10 ¹	3.7X10 ⁵	1.0X10 ⁷
Pu-236	Plutonium. (94)	3.0X10 ¹	8.1X10 ²	3.0X10 ⁻³	8.1X10 ⁻²	2.0X10 ¹	5.3X10 ²
Pu-237	.	2.0X10 ¹	5.4X10 ²	2.0X10 ¹	5.4X10 ²	4.5X10 ²	1.2X10 ⁴
Pu-238	.	1.0X10 ¹	2.7X10 ²	1.0X10 ⁻³	2.7X10 ⁻²	6.3X10 ⁻¹	1.7X10 ¹
Pu-239	.	1.0X10 ¹	2.7X10 ²	1.0X10 ⁻³	2.7X10 ⁻²	2.3X10 ⁻³	6.2X10 ⁻²
Pu-240	.	1.0X10 ¹	2.7X10 ²	1.0X10 ⁻³	2.7X10 ⁻²	8.4X10 ⁻³	2.3X10 ⁻¹
Pu-241. (a)	.	4.0X10 ¹	1.1X10 ³	6.0X10 ⁻²	1.6	3.8	1.0X10 ²
Pu-242	.	1.0X10 ¹	2.7X10 ²	1.0X10 ⁻³	2.7X10 ⁻²	1.5X10 ⁻⁴	3.9X10 ⁻³
Pu-244. (a)	.	4.0X10 ⁻¹	1.1X10 ¹	1.0X10 ⁻³	2.7X10 ⁻²	6.7X10 ⁻⁷	1.8X10 ⁻⁵

TABLE 17A1: A ₁ AND A ₂ VALUES FOR RADIONUCLIDES							
Symbol of radionuclide	Element and atomic number	A ₁ (TBq)	A ₁ (Ci)b	A ₂ (TBq)	A ₂ (Ci)	Specific activity	
						(TBq/g)	(Ci/g)
Ra-223. (a)	Radium. (88)	4.0X10 ⁻¹	1.1X10 ¹	7.0X10 ⁻³	1.9X10 ⁻¹	1.9X10 ³	5.1X10 ⁴
Ra-224. (a)	.	4.0X10 ⁻¹	1.1X10 ¹	2.0X10 ⁻²	5.4X10 ⁻¹	5.9X10 ³	1.6X10 ⁵
Ra-225 (a)	.	2.0X10 ⁻¹	5.4	4.0X10 ⁻³	1.1X10 ⁻¹	1.5X10 ³	3.9X10 ⁴
Ra-226. (a)	.	2.0X10 ⁻¹	5.4	3.0X10 ⁻³	8.1X10 ⁻²	3.7X10 ⁻²	1.0
Ra-228. (a)	.	6.0X10 ⁻¹	1.6X10 ¹	2.0X10 ⁻²	5.4X10 ⁻¹	1.0X10 ¹	2.7X10 ²
Rb-81	Rubidium (37)	2.0	5.4X10 ¹	8.0X10 ⁻¹	2.2X10 ¹	3.1X10 ⁵	8.4X10 ⁶
Rb-83. (a)	.	2.0	5.4X10 ¹	2.0	5.4X10 ¹	6.8X10 ²	1.8X10 ⁴
Rb-84	.	1.0	2.7X10 ¹	1.0	2.7X10 ¹	1.8X10 ³	4.7X10 ⁴
Rb-86	.	5.0X10 ⁻¹	1.4X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	3.0X10 ³	8.1X10 ⁴
Rb-87	.	Unlimited	Unlimited	Unlimited	Unlimited	3.2X10 ⁻⁹	8.6X10 ⁻⁸
Rb(nat)	.	Unlimited	Unlimited	Unlimited	Unlimited	6.7X10 ⁶	1.8X10 ⁸
Re-184	Rhenium (75)	1.0	2.7X10 ¹	1.0	2.7X10 ¹	6.9X10 ²	1.9X10 ⁴
Re-184m	.	3.0	8.1X10 ¹	1.0	2.7X10 ¹	1.6X10 ²	4.3X10 ³
Re-186	.	2.0	5.4X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	6.9X10 ³	1.9X10 ⁵
Re-187	.	Unlimited	Unlimited	Unlimited	Unlimited	1.4X10 ⁻⁹	3.8X10 ⁻⁸
Re-188	.	4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	3.6X10 ⁴	9.8X10 ⁵
Re-189. (a)	.	3.0	8.1X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	2.5X10 ⁴	6.8X10 ⁵
Re(nat)	.	Unlimited	Unlimited	Unlimited	Unlimited	0.0	2.4X10 ⁻⁸
Rh-99	Rhodium (45)	2.0	5.4X10 ¹	2.0	5.4X10 ¹	3.0X10 ³	8.2X10 ⁴
Rh-101	.	4.0	1.1X10 ²	3.0	8.1X10 ¹	4.1X10 ¹	1.1X10 ³
Rh-102	.	5.0X10 ⁻¹	1.4X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	4.5X10 ¹	1.2X10 ³
Rh-102m	.	2.0	5.4X10 ¹	2.0	5.4X10 ¹	2.3X10 ²	6.2X10 ³
Rh-103m	.	4.0X10 ¹	1.1X10 ³	4.0X10 ¹	1.1X10 ³	1.2X10 ⁶	3.3X10 ⁷
Rh-105	.	1.0X10 ¹	2.7X10 ²	8.0X10 ⁻¹	2.2X10 ¹	3.1X10 ⁴	8.4X10 ⁵
Rn-222. (a)	Radon (86)	3.0X10 ⁻¹	8.1	4.0X10 ⁻³	1.1X10 ⁻¹	5.7X10 ³	1.5X10 ⁵
Ru-97	Ruthenium (44)	5.0	1.4X10 ²	5.0	1.4X10 ²	1.7X10 ⁴	4.6X10 ⁵
Ru-103. (a)	.	2.0	5.4X10 ¹	2.0	5.4X10 ¹	1.2X10 ³	3.2X10 ⁴
Ru-105	.	1.0	2.7X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	2.5X10 ⁵	6.7X10 ⁶
Ru-106. (a)	.	2.0X10 ⁻¹	5.4	2.0X10 ⁻¹	5.4	1.2X10 ²	3.3X10 ³
S-35	Sulphur (16)	4.0X10 ¹	1.1X10 ³	3.0	8.1X10 ¹	1.6X10 ³	4.3X10 ⁴
Sb-122	Antimony (51)	4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	1.5X10 ⁴	4.0X10 ⁵
Sb-124	.	6.0X10 ⁻¹	1.6X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	6.5X10 ²	1.7X10 ⁴
Sb-125	.	2.0	5.4X10 ¹	1.0	2.7X10 ¹	3.9X10 ¹	1.0X10 ³
Sb-126	.	4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	3.1X10 ³	8.4X10 ⁴
Sc-44	Scandium (21)	5.0X10 ⁻¹	1.4X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	6.7X10 ⁵	1.8X10 ⁷
Sc-46	.	5.0X10 ⁻¹	1.4X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	1.3X10 ³	3.4X10 ⁴
Sc-47	.	1.0X10 ¹	2.7X10 ²	7.0X10 ⁻¹	1.9X10 ¹	3.1X10 ⁴	8.3X10 ⁵
Sc-48	.	3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	5.5X10 ⁴	1.5X10 ⁶
Se-75	Selenium (34)	3.0	8.1X10 ¹	3.0	8.1X10 ¹	5.4X10 ²	1.5X10 ⁴
Se-79	.	4.0X10 ¹	1.1X10 ³	2.0	5.4X10 ¹	2.6X10 ⁻³	7.0X10 ⁻²

TABLE 17A1: A ₁ AND A ₂ VALUES FOR RADIONUCLIDES							
Symbol of radionuclide	Element and atomic number	A ₁ (TBq)	A ₁ (Ci) ^b	A ₂ (TBq)	A ₂ (Ci)	Specific activity	
						(TBq/g)	(Ci/g)
Si-31	Silicon (14)	6.0X10 ⁻¹	1.6X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	1.4X10 ⁶	3.9X10 ⁷
Si-32	.	4.0X10 ¹	1.1X10 ³	5.0X10 ⁻¹	1.4X10 ¹	3.9	1.1X10 ²
Sm-145	Samarium (62)	1.0X10 ¹	2.7X10 ²	1.0X10 ¹	2.7X10 ²	9.8X10 ¹	2.6X10 ³
Sm-147	.	Unlimited	Unlimited	Unlimited	Unlimited	8.5X10 ⁻¹	2.3X10 ⁻⁸
Sm-151	.	4.0X10 ¹	1.1X10 ³	1.0X10 ¹	2.7X10 ²	9.7X10 ⁻¹	2.6X10 ¹
Sm-153	.	9.0	2.4X10 ²	6.0X10 ⁻¹	1.6X10 ¹	1.6X10 ⁴	4.4X10 ⁵
Sn-113. (a)	Tin (50)	4.0	1.1X10 ²	2.0	5.4X10 ¹	3.7X10 ²	1.0X10 ⁴
Sn-117m	.	7.0	1.9X10 ²	4.0X10 ⁻¹	1.1X10 ¹	3.0X10 ³	8.2X10 ⁴
Sn-119m	.	4.0X10 ¹	1.1X10 ³	3.0X10 ¹	8.1X10 ²	1.4X10 ²	3.7X10 ³
Sn-121m. (a)	.	4.0X10 ¹	1.1X10 ³	9.0X10 ⁻¹	2.4X10 ¹	2.0	5.4X10 ¹
Sn-123	.	8.0X10 ⁻¹	2.2X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	3.0X10 ²	8.2X10 ³
Sn-125	.	4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	4.0X10 ³	1.1X10 ⁵
Sn-126. (a)	.	6.0X10 ⁻¹	1.6X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	1.0X10 ⁻³	2.8X10 ⁻²
Sr-82. (a)	Strontium (38)	2.0X10 ⁻¹	5.4	2.0X10 ⁻¹	5.4	2.3X10 ³	6.2X10 ⁴
Sr-85	.	2.0	5.4X10 ¹	2.0	5.4X10 ¹	8.8X10 ²	2.4X10 ⁴
Sr-85m	.	5.0	1.4X10 ²	5.0	1.4X10 ²	1.2X10 ⁶	3.3X10 ⁷
Sr-87m	.	3.0	8.1X10 ¹	3.0	8.1X10 ¹	4.8X10 ⁵	1.3X10 ⁷
Sr-89	.	6.0X10 ⁻¹	1.6X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	1.1X10 ³	2.9X10 ⁴
Sr-90. (a)	.	3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	5.1	1.4X10 ²
Sr-91. (a)	.	3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	1.3X10 ⁵	3.6X10 ⁶
Sr-92. (a)	.	1.0	2.7X10 ¹	3.0X10 ⁻¹	8.1	4.7X10 ⁵	1.3X10 ⁷
T(H-3)	Tritium. (1)	4.0X10 ¹	1.1X10 ³	4.0X10 ¹	1.1X10 ³	3.6X10 ²	9.7X10 ³
Ta-178. (long)	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

TABLE 17A1: A₁ AND A₂ VALUES FOR RADIONUCLIDES

Symbol of radionuclide	Element and atomic number	A ₁ (TBq)	A ₁ (Ci)b	A ₂ (TBq)	A ₂ (Ci).	Specific activity	
						(TBq/g)	(Ci/g)
Te-121	Tellurium. (52)	2.0	5.4X10 ¹	2.0	5.4X10 ¹	2.4X10 ³	6.4X10 ⁴
Te-121m	.	5.0	1.4X10 ²	3.0	8.1X10 ¹	2.6X10 ²	7.0X10 ³
Te-123m	.	8.0	2.2X10 ²	1.0	2.7X10 ¹	3.3X10 ²	8.9X10 ³
Te-125m	.	2.0X10 ¹	5.4X10 ²	9.0X10 ⁻¹	2.4X10 ¹	6.7X10 ²	1.8X10 ⁴
Te-127	.	2.0X10 ¹	5.4X10 ²	7.0X10 ⁻¹	1.9X10 ¹	9.8X10 ⁴	2.6X10 ⁶
Te-127m. (a)	.	2.0X10 ¹	5.4X10 ²	5.0X10 ⁻¹	1.4X10 ¹	3.5X10 ²	9.4X10 ³
Te-129	.	7.0X10 ⁻¹	1.9X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	7.7X10 ⁵	2.1X10 ⁷
Te-129m. (a)	.	8.0X10 ⁻¹	2.2X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	1.1X10 ³	3.0X10 ⁴
Te-131m. (a)	.	7.0X10 ⁻¹	1.9X10 ¹	5.0X10 ⁻¹	1.4X10 ¹	3.0X10 ⁴	8.0X10 ⁵
Te-132. (a)	.	5.0X10 ⁻¹	1.4X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	1.1X10 ⁴	3.0X10 ⁵
Th-227	Thorium. (90)	1.0X10 ¹	2.7X10 ²	5.0X10 ⁻³	1.4X10 ⁻¹	1.1X10 ³	3.1X10 ⁴
Th-228. (a)	.	5.0X10 ⁻¹	1.4X10 ¹	1.0X10 ⁻³	2.7X10 ⁻²	3.0X10 ¹	8.2X10 ²
Th-229	.	5.0	1.4X10 ²	5.0X10 ⁻⁴	1.4X10 ⁻²	7.9X10 ⁻³	2.1X10 ⁻¹
Th-230	.	1.0X10 ¹	2.7X10 ²	1.0X10 ⁻³	2.7X10 ⁻²	7.6X10 ⁻⁴	2.1X10 ⁻²
Th-231	.	4.0X10 ¹	1.1X10 ³	2.0X10 ⁻²	5.4X10 ⁻¹	2.0X10 ⁴	5.3X10 ⁵
Th-232	.	Unlimited	Unlimited	Unlimited	Unlimited	4.0X10 ⁻⁹	1.1X10 ⁻⁷
Th-234. (a)	.	3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	8.6X10 ²	2.3X10 ⁴
Th(nat)	.	Unlimited	Unlimited	Unlimited	Unlimited	8.1X10 ⁻⁹	2.2X10 ⁻⁷
Ti-44. (a)	Titanium. (22)	5.0X10 ⁻¹	1.4X10 ¹	4.0X10 ⁻¹	1.1X10 ¹	6.4	1.7X10 ²
Tl-200	Thallium. (81)	9.0X10 ⁻¹	2.4X10 ¹	9.0X10 ⁻¹	2.4X10 ¹	2.2X10 ⁴	6.0X10 ⁵
Tl-201	.	1.0X10 ¹	2.7X10 ²	4.0	1.1X10 ²	7.9X10 ³	2.1X10 ⁵
Tl-202	.	2.0	5.4X10 ¹	2.0	5.4X10 ¹	2.0X10 ³	5.3X10 ⁴
Tl-204	.	1.0X10 ¹	2.7X10 ²	7.0X10 ⁻¹	1.9X10 ¹	1.7X10 ¹	4.6X10 ²
Tm-167	Thulium. (69)	7.0	1.9X10 ²	8.0X10 ⁻¹	2.2X10 ¹	3.1X10 ³	8.5X10 ⁴
Tm-170	.	3.0	8.1X10 ¹	6.0X10 ⁻¹	1.6X10 ¹	2.2X10 ²	6.0X10 ³
Tm-171	.	4.0X10 ¹	1.1X10 ³	4.0X10 ¹	1.1X10 ³	4.0X10 ¹	1.1X10 ³
U-230. (fast. lung. absorption). (a)(d)	Uranium. (92)	4.0X10 ¹	1.1X10 ³	1.0X10 ⁻¹	2.7	1.0X10 ³	2.7X10 ⁴
U-230. (medium. lung. absorption). (a)(e)	.	4.0X10 ¹	1.1X10 ³	4.0X10 ⁻³	1.1X10 ⁻¹	1.0X10 ³	2.7X10 ⁴
U-230 (slow lung absorption) (a)(f)	.	3.0X10 ¹	8.1X10 ²	3.0X10 ⁻³	8.1X10 ⁻²	1.0X10 ³	2.7X10 ⁴

TABLE 17A1: A ₁ AND A ₂ VALUES FOR RADIONUCLIDES							
Symbol of radionuclide	Element and atomic number	A ₁ (TBq)	A ₁ (Ci)b	A ₂ (TBq)	A ₂ (Ci).	Specific activity	
						(TBq/g)	(Ci/g)
U-232. (fast. lung. absorption). (d)	.	4.0X10 ¹	1.1X10 ³	1.0X10 ⁻²	2.7X10 ⁻¹	8.3X10 ⁻¹	2.2X10 ¹
U-232. (medium. lung. absorption). (e)	.	4.0X10 ¹	1.1X10 ³	7.0X10 ⁻³	1.9X10 ⁻¹	8.3X10 ⁻¹	2.2X10 ¹
U-232. (slow. lung. absorption). (f)	.	1.0X10 ¹	2.7X10 ²	1.0X10 ⁻³	2.7X10 ⁻²	8.3X10 ⁻¹	2.2X10 ¹
U-233. (fast. lung. absorption). (d)	.	4.0X10 ¹	1.1X10 ³	9.0X10 ⁻²	2.4	3.6X10 ⁻⁴	9.7X10 ⁻³
U-233. (medium. lung. absorption). (e)	.	4.0X10 ¹	1.1X10 ³	2.0X10 ⁻²	5.4X10 ⁻¹	3.6X10 ⁻⁴	9.7X10 ⁻³
U-233. (slow. lung. absorption). (f)	.	4.0X10 ¹	1.1X10 ³	6.0X10 ⁻³	1.6X10 ⁻¹	3.6X10 ⁻⁴	9.7X10 ⁻³
U-234. (fast. lung. absorption)(d)	.	4.0X10 ¹	1.1X10 ³	9.0X10 ⁻²	2.4	2.3X10 ⁻⁴	6.2X10 ⁻³
U-234 (medium lung absorption) (e)	.	4.0X10 ¹	1.1X10 ³	2.0X10 ⁻²	5.4X10 ⁻¹	2.3X10 ⁻⁴	6.2X10 ⁻³
U-234 (slow lung absorption) (f)	.	4.0X10 ¹	1.1X10 ³	6.0X10 ⁻³	1.6X10 ⁻¹	2.3X10 ⁻⁴	6.2X10 ⁻³
U-235. (all. lung. absorption. types). (a),(d),(e),(f)	.	Unlimited	Unlimited	Unlimited	Unlimited	8.0X10 ⁻⁸	2.2X10 ⁻⁶
U-236. (fast. lung. absorption). (d)	.	Unlimited	Unlimited	Unlimited	Unlimited	2.4X10 ⁻⁶	6.5X10 ⁻⁵
U-236. (medium. lung. absorption). (e)	.	4.0X10 ¹	1.1X10 ³	2.0X10 ⁻²	5.4X10 ⁻¹	2.4X10 ⁻⁶	6.5X10 ⁻⁵

TABLE 17A1: A ₁ AND A ₂ VALUES FOR RADIONUCLIDES							
Symbol of radionuclide	Element and atomic number	A ₁ (TBq)	A ₁ (Ci) ^b	A ₂ (TBq)	A ₂ (Ci)	Specific activity	
						(TBq/g)	(Ci/g)
U-236 (slow lung absorption) (f)	.	4.0X10 ⁻¹	1.1X10 ⁻³	6.0X10 ⁻³	1.6X10 ⁻¹	2.4X10 ⁻⁶	6.5X10 ⁻⁵
U-238 (all lung absorption types) (d),(e),(f)	.	Unlimited	Unlimited	Unlimited	Unlimited	1.2X10 ⁻⁸	3.4X10 ⁻⁷
U. (nat)	.	Unlimited	Unlimited	Unlimited	Unlimited	2.6X10 ⁻⁸	7.1X10 ⁻⁷
U. (enriched. to. 20%. or. less). (g)	.	Unlimited	Unlimited	Unlimited	Unlimited	See. Table. 17A4	See. Table. 17A4
U. (dep)	.	Unlimited	Unlimited	Unlimited	Unlimited	See. Table. 17A4	(See. Table. 17A3)
V-48	Vanadium. (23)	4.0X10 ⁻¹	1.1X10 ⁻¹	4.0X10 ⁻¹	1.1X10 ⁻¹	6.3X10 ⁻³	1.7X10 ⁻⁵
V-49	.	4.0X10 ⁻¹	1.1X10 ⁻³	4.0X10 ⁻¹	1.1X10 ⁻³	3.0X10 ⁻²	8.1X10 ⁻³
W-178. (a)	Tungsten. (74)	9.0	2.4X10 ⁻²	5.0	1.4X10 ⁻²	1.3X10 ⁻³	3.4X10 ⁻⁴
W-181	.	3.0X10 ⁻¹	8.1X10 ⁻²	3.0X10 ⁻¹	8.1X10 ⁻²	2.2X10 ⁻²	6.0X10 ⁻³
W-185	.	4.0X10 ⁻¹	1.1X10 ⁻³	8.0X10 ⁻¹	2.2X10 ⁻¹	3.5X10 ⁻²	9.4X10 ⁻³
W-187	.	2.0	5.4X10 ⁻¹	6.0X10 ⁻¹	1.6X10 ⁻¹	2.6X10 ⁻⁴	7.0X10 ⁻⁵
W-188. (a)	.	4.0X10 ⁻¹	1.1X10 ⁻¹	3.0X10 ⁻¹	8.1	3.7X10 ⁻²	1.0X10 ⁻⁴
Xe-122. (a)	Xenon. (54)	4.0X10 ⁻¹	1.1X10 ⁻¹	4.0X10 ⁻¹	1.1X10 ⁻¹	4.8X10 ⁻⁴	1.3X10 ⁻⁶
Xe-123	.	2.0	5.4X10 ⁻¹	7.0X10 ⁻¹	1.9X10 ⁻¹	4.4X10 ⁻⁵	1.2X10 ⁻⁷
Xe-127	.	4.0	1.1X10 ⁻²	2.0	5.4X10 ⁻¹	1.0X10 ⁻³	2.8X10 ⁻⁴
Xe-131m	.	4.0X10 ⁻¹	1.1X10 ⁻³	4.0X10 ⁻¹	1.1X10 ⁻³	3.1X10 ⁻³	8.4X10 ⁻⁴
Xe-133	.	2.0X10 ⁻¹	5.4X10 ⁻²	1.0X10 ⁻¹	2.7X10 ⁻²	6.9X10 ⁻³	1.9X10 ⁻⁵
Xe-135	.	3.0	8.1X10 ⁻¹	2.0	5.4X10 ⁻¹	9.5X10 ⁻⁴	2.6X10 ⁻⁶
Y-87. (a)	Yttrium. (39)	1.0	2.7X10 ⁻¹	1.0	2.7X10 ⁻¹	1.7X10 ⁻⁴	4.5X10 ⁻⁵
Y-88	.	4.0X10 ⁻¹	1.1X10 ⁻¹	4.0X10 ⁻¹	1.1X10 ⁻¹	5.2X10 ⁻²	1.4X10 ⁻⁴
Y-90	.	3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	2.0X10 ⁻⁴	5.4X10 ⁻⁵
Y-91	.	6.0X10 ⁻¹	1.6X10 ⁻¹	6.0X10 ⁻¹	1.6X10 ⁻¹	9.1X10 ⁻²	2.5X10 ⁻⁴
Y-91m	.	2.0	5.4X10 ⁻¹	2.0	5.4X10 ⁻¹	1.5X10 ⁻⁶	4.2X10 ⁻⁷
Y-92	.	2.0X10 ⁻¹	5.4	2.0X10 ⁻¹	5.4	3.6X10 ⁻⁵	9.6X10 ⁻⁶
Y-93	.	3.0X10 ⁻¹	8.1	3.0X10 ⁻¹	8.1	1.2X10 ⁻⁵	3.3X10 ⁻⁶
Yb-169	Ytterbium. (70)	4.0	1.1X10 ⁻²	1.0	2.7X10 ⁻¹	8.9X10 ⁻²	2.4X10 ⁻⁴
Yb-175	.	3.0X10 ⁻¹	8.1X10 ⁻²	9.0X10 ⁻¹	2.4X10 ⁻¹	6.6X10 ⁻³	1.8X10 ⁻⁵

Symbol of radionuclide	Element and atomic number	A ₁ (TBq)	A ₁ (Ci) ^b	A ₂ (TBq)	A ₂ (Ci)	Specific activity	
						(TBq/g)	(Ci/g)
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

814 Notes:

- 815 ^a A₁ and/or A₂ values include contributions from daughter nuclides with half-lives less than 10 days, as listed in the
- 816 following:-
- 817 Mg-28 Al-28
 - 818 Ca-47 Sc-47
 - 819 Ti-44 Sc-44
 - 820 Fe-52 Mn-52m
 - 821 Fe-60 Co-60m
 - 822 Zn-69m Zn-69
 - 823 Ge-68 Ga-68
 - 824 Rb-83 Kr-83m
 - 825 Sr-82 Rb-82
 - 826 Sr-90 Y-90
 - 827 Sr-91 Y-91m
 - 828 Sr-92 Y-92
 - 829 Y-87 Sr-87m
 - 830 Zr-95 Nb-95m
 - 831 Zr-97 Nb-97m, Nb-97
 - 832 Mo-99 Tc-99m
 - 833 Tc-95m Tc-95
 - 834 Tc-96m Tc-96
 - 835 Ru-103 Rh-103m
 - 836 Ru-106 Rh-106
 - 837 Pd-103 Rh-103m
 - 838 Ag-108m Ag-108
 - 839 Ag-110m Ag-110
 - 840 Cd-115 In-115m
 - 841 In-114m In-114
 - 842 Sn-113 In-113m
 - 843 Sn-121m Sn-121
 - 844 Sn-126 Sb-126m
 - 845 Te-127m Te-127
 - 846 Te-129m Te-129
 - 847 Te-131m Te-131
 - 848 Te-132 I-132
 - 849 I-135 Xe-135m
 - 850 Xe-122 I-122
 - 851 Cs-137 Ba-137m
 - 852 Ba-131 Cs-131
 - 853 Ba-140 La-140
 - 854 Ce-144 Pr-144m, Pr-144
 - 855 Pm-148m Pm-148
 - 856 Gd-146 Eu-146
 - 857 Dy-166 Ho-166
 - 858 Hf-172 Lu-172
 - 859 W-178 Ta-178
 - 860 W-188 Re-188
 - 861 Re-189 Os-189m
 - 862 Os-194 Ir-194
 - 863 Ir-189 Os-189m

Comment [jsj49]: Footnote updated, consistent with 2015 changes to 10 CFR 71, Table A1.

864	Pt-188	Ir-188
865	Hg-194	Au-194
866	Hg-195m	Hg-195
867	Pb-210	Bi-210
868	Pb-212	Bi-212, Tl-208, Po-212
869	Bi-210m	Tl-206
870	Bi-212	Tl-208, Po-212
871	At-211	Po-211
872	Rn-222	Po-218, Pb-214, At-218, Bi-214, Po-214
873	Ra-223	Rn-219, Po-215, Pb-211, Bi-211, Po-211, Tl-207
874	Ra-224	Rn-220, Po-216, Pb-212, Bi-212, Tl-208, Po-212
875	Ra-225	Ac-225, Fr-221, At-217, Bi-213, Tl-209, Po-213, Pb-209
876	Ra-226	Rn-222, Po-218, Pb-214, At-218, Bi-214, Po-214
877	Ra-228	Ac-228
878	Ac-225	Fr-221, At-217, Bi-213, Tl-209, Po-213, Pb-209
879	Ac-227	Fr-223
880	Th-228	Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208, Po-212
881	Th-234	Pa-234m, Pa-234
882	Pa-230	Ac-226, Th-226, Fr-222, Ra-222, Rn-218, Po-214
883	U-230	Th-226, Ra-222, Rn-218, Po-214
884	U-235	Th-231
885	Pu-241	U-237
886	Pu-244	U-240, Np-240m
887	Am-242m	Am-242, Np-238
888	Am-243	Np-239
889	Cm-247	Pu-243
890	Bk-249	Am-245
891	Cf-253	Cm-249
892		

893 b The values of A₁ and A₂ in Curies (Ci) are approximate and for information only; the regulatory standard units are
 894 Terabecquerels (TBq) (see Appendix 17A – Determination of A₁ and A₂, Section 17A1)

895 ~~c~~ The quantity/activity of Ir-192 in special form may be determined from a measurement of the rate of decay or a
 896 measurement of the radiation level at a prescribed distance from the source.

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

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

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

902 g These values apply to unirradiated uranium only.

903 h A₂ = 0.74 TBq (20 Ci) for Mo-99 for domestic use. These values apply to domestic transport only. For international
 904 transport, use the values in the table below.

Comment [jsj50]: Footnote updated, consistent with 2015 changes to 10 CFR 71, Table A1.

As discussed in an earlier note, footnote "c" applies only to the special form of Ir-192.

NRC Compatibility "B"
[NRC RATS 2015-3](#)
[80 FR 33987 \(June 12, 2015\)](#)

Comment [jsj51]: Footnote revised, consistent with changes to 10 CFR 71, Table A1.

A domestic value limit for Mo-99 shipment is retained and updated, while the A1 values are harmonized into a single set of values.

NRC Compatibility "B"
[NRC RATS 2015-3](#)
[80 FR 33987 \(June 12, 2015\)](#)

Comment [jsj52]: Supplemental table 17A1 is deleted as the values for international shipments of Cf-252 and Mo-99 have been harmonized and now appear in the main Table 17A1 (above).

TABLE 17A1 (SUPPLEMENT): A1 AND A2 VALUES FOR RADIONUCLIDES FOR INTERNATIONAL SHIPMENTS

Symbol of radionuclide	Element and atomic number	A ₁ (TBq)	A ₁ (Ci)	A ₂ (TBq)	A ₂ (Ci)	Specific activity (TBq/g)	Specific activity (Ci/g)
Cf-252	Californium (98)	5.0x10 ⁻²⁵	1.4	3.0x10 ⁻²⁵	8.1x10 ⁻²⁵	2.0x10 ⁻⁴	5.4x10 ⁻³
Mo-99 ^c	Molybdenum (42)	1.0	2.7x10 ⁻¹	6.0x10 ⁻¹	1.6x10 ⁻¹	1.8x10 ⁻⁴	4.8x10 ⁻⁵

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TABLE 17A2: EXEMPT MATERIAL ACTIVITY CONCENTRATIONS AND EXEMPT CONSIGNMENT ACTIVITY LIMITS FOR RADIONUCLIDES					
Symbol of radionuclide	Element and atomic number	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
Ac-225 (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 (83)	1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Bi-206	.	1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
Bi-207	.	1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Bi-210	.	1.0×10^3	2.7×10^{-8}	1.0×10^6	2.7×10^{-5}
Bi-210m (a)	.	1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}

Comment [jsj53]: Here and subsequently in Table 17A2, references to footnote "(a)", are removed or added for consistency with equivalent footnote of Table A-2 of 10 CFR 71.

The equivalent footnotes in 10 CFR 71 did not change, but rather, the changes are to address differences between the Table 17A2 and the Part 71 table for certain radionuclides.

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

Symbol of radionuclide	Element and atomic number	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
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 ^a	.	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}

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

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

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

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

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

Symbol of radionuclide	Element and atomic number	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
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-79	Krypton (36)	1.0×10^3	2.7×10^{-8}	1.0×10^5	2.7×10^{-6}
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 (25)	1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
Mn-53	.	1.0×10^4	2.7×10^{-7}	1.0×10^9	2.7×10^{-2}
Mn-54	.	1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Mn-56	.	1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
Mo-93	Molybdenum (42)	1.0×10^3	2.7×10^{-8}	1.0×10^8	2.7×10^{-3}
Mo-99 (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}

Comment [jsj54]: Values for Kr-79 added, consistent with 2015 changes to 10 CFR 71, Table A-2.

Previously, specific values for Kr-79 were not available and the generic values of Table 17A3 were applicable. The IAEA derived values for Kr-79 and are now included in this table.

NRC Compatibility "B"
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TABLE 17A2: EXEMPT MATERIAL ACTIVITY CONCENTRATIONS AND EXEMPT CONSIGNMENT ACTIVITY LIMITS FOR RADIONUCLIDES

Symbol of radionuclide	Element and atomic number	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
Np-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 (a)	.	1.0	2.7×10^{-11}	1.0×10^3	2.7×10^{-8}
Np-239	.	1.0×10^2	2.7×10^{-9}	1.0×10^7	2.7×10^{-4}
Os-185	Osmium (76)	1.0×10^1	2.7×10^{-10}	1.0×10^6	2.7×10^{-5}
Os-191	.	1.0×10^2	2.7×10^{-9}	1.0×10^7	2.7×10^{-4}
Os-191m	.	1.0×10^3	2.7×10^{-8}	1.0×10^7	2.7×10^{-4}
Os-193	.	1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
Os-194 (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}

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

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

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

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

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

Symbol of radionuclide	Element and atomic number	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
Sr-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^{56}	2.7×10^{-65}
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 (a)	.	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) (a)	.	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}

Comment [jsj55]: Select values for Te-121m are revised, consistent with 10 CFR 71, Table A-2.

The IAEA revised its values for Te-121m based on new analyses and information.

This is a relatively uncommon isotope. As such, the proposed change is not expected to have an impact on licensees.

NRC Compatibility "B"
[NRC RATS 2015-3](#)
[80 FR 33987 \(June 12, 2015\)](#)

TABLE 17A2: EXEMPT MATERIAL ACTIVITY CONCENTRATIONS AND EXEMPT CONSIGNMENT ACTIVITY LIMITS FOR RADIONUCLIDES					
Symbol of radionuclide	Element and atomic number	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
TI-202	.	1.0×10^2	2.7×10^{-9}	1.0×10^6	2.7×10^{-5}
TI-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)	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)	.	1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
U-230 (slow lung absorption) (a),(d)	.	1.0×10^1	2.7×10^{-10}	1.0×10^5	2.7×10^{-6}
U-232 (fast lung absorption) (a),(b)	Uranium (92)	1.0	2.7×10^{-11}	1.0×10^3	2.7×10^{-8}
U-232 (medium lung absorption) (c)	.	1.0	2.7×10^{-11}	1.0×10^3	2.7×10^{-8}
U-232 (slow lung absorption) (d)	.	1.0	2.7×10^{-11}	1.0×10^3	2.7×10^{-8}
U-233 (fast lung absorption) (b)	.	1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-7}
U-233 (medium lung absorption) (c)	.	1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-7}
U-233 (slow lung absorption) (d)	.	1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-7}
U-234 (fast lung absorption) (b)	.	1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-7}
U-234 (medium lung absorption) (c)	.	1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-7}
U-234 (slow lung absorption) (d)	.	1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-7}
U-235 (all lung absorption types) (a),(b),(c),(d)	.	1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-7}
U-236 (fast lung absorption) (b)	.	1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-7}
U-236 (medium lung absorption)	Uranium (92)	1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-7}

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

Symbol of radionuclide	Element and atomic number	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
(c)					
U-236 (slow lung absorption) (d)	.	1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-7}
U-238 (all lung absorption types) (a),(b),(c),(d)	.	1.0×10^1	2.7×10^{-10}	1.0×10^4	2.7×10^{-7}
U (natural) (a)	.	1.0	2.7×10^{-11}	1.0×10^3	2.7×10^{-8}
U (enriched to 20% or less) (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 (a)	.	1.0×10^3	2.7×10^{-8}	1.0×10^7	2.7×10^{-4}

TABLE 17A2: EXEMPT MATERIAL ACTIVITY CONCENTRATIONS AND EXEMPT CONSIGNMENT ACTIVITY LIMITS FOR RADIONUCLIDES					
Symbol of radionuclide	Element and atomic number	Activity concentration for exempt material (Bq/g)	Activity concentration for exempt material (Ci/g)	Activity limit for exempt consignment (Bq)	Activity limit for exempt consignment (Ci)
Zr-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}

909 a) Parent nuclides and their progeny included in secular equilibrium are listed in the following:

- 910 Sr-90 Y-90
- 911 Zr-93 Nb-93m
- 912 Zr-97 Nb-97
- 913 Ru-106 Rh-106
- 914 **Ag-108m Ag-108**
- 915 Cs-137 Ba-137m
- 916 ~~Ce-134 La-134~~
- 917 Ce-144 Pr-144
- 918 Ba-140 La-140
- 919 Bi-212 Tl-208 (0.36), Po-212 (0.64)
- 920 Pb-210 Bi-210, Po-210
- 921 Pb-212 Bi-212, Tl-208 (0.36), Po-212 (0.64)
- 922 ~~Rn-220 Po-216~~
- 923 Rn-222 Po-218, Pb-214, Bi-214, Po-214
- 924 Ra-223 Rn-219, Po-215, Pb-211, Bi-211, Tl-207
- 925 Ra-224 Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212 (0.64)
- 926 Ra-226 Rn-222, Po-218, Pb-214, Bi-214, Po-214, Pb-210, Bi-210, Po-210
- 927 Ra-228 Ac-228
- 928 ~~Th-226 Ra-222, Rn-218, Po-214~~
- 929 Th-228 Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212 (0.64)
- 930 Th-229 Ra-225, Ac-225, Fr-221, At-217, Bi-213, Po-213, Pb-209
- 931 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)
- 932 Th-234 Pa-234m
- 933 U-230 Th-226, Ra-222, Rn-218, Po-214
- 934 U-232 Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212 (0.64)
- 935 U-235 Th-231
- 936 U-238 Th-234, Pa-234m
- 937 U-nat Th-234, Pa-234m, U-234, Th-230, Ra-226, Rn-222, Po-218, Pb-214, Bi-214, Po-214, **Pb-210, Bi-210, Po-210**
- 938 ~~U-240 Np-240m~~
- 939 Np-237 Pa-233
- 940 Am-242m Am-242
- 941 Am-243 Np-239

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

944 c These values apply only to compounds of uranium that take the chemical form of UO₃, UF₄, UCl₄, and hexavalent compounds in

Comment [jsj56]: Tab spacing is added for formatting purposes only.

Consistent with 10 CFR 71 (and IAEA regulation), Ag-108m is added, and certain parent and progeny values are removed from this footnote.

- 945 both normal and accident conditions of transport.
- 946 d These values apply to all compounds of uranium other than those specified in d and e, above.
- 947 e These values apply to unirradiated uranium only.
- 948

949 **TABLE 17A3: GENERAL VALUES FOR A1 AND A2**

Comment [jsj57]: SEE NEXT COMMENT.

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

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

Comment [jsj58]: Changes are made to Table 17A3 and footnote, consistent with existing provisions and recent updates to 10 CFR 71, Table A-3.

951 **TABLE 17A4: ACTIVITY-MASS RELATIONSHIPS FOR URANIUM**

Uranium Enrichment (i) weight % U-235 present	Specific Activity	
	TBq/g	Ci/g
0.45	1.8x10 ⁻⁸	5.0x10 ⁻⁷
0.72	2.6x10 ⁻⁸	7.1x10 ⁻⁷
1.0	2.8x10 ⁻⁸	7.6x10 ⁻⁷
1.5	3.7x10 ⁻⁸	1.0x10 ⁻⁶
5.0	1.0x10 ⁻⁷	2.7x10 ⁻⁶
10.0	1.8x10 ⁻⁷	4.8x10 ⁻⁶
20.0	3.7x10 ⁻⁷	1.0x10 ⁻⁵
35.0	7.4x10 ⁻⁷	2.0x10 ⁻⁵
50.0	9.3x10 ⁻⁷	2.5x10 ⁻⁵
90.0	2.2x10 ⁻⁶	5.8x10 ⁻⁵
93.0	2.6x10 ⁻⁶	7.0x10 ⁻⁵
95.0	3.4x10 ⁻⁶	9.1x10 ⁻⁵

Due to the original wording, some users may have incorrectly applied the (original) third criteria of the table when they encountered an alpha emitter that also emitted beta particles or gamma rays when it was intended that they be assigned to the second row of the table. The updated language is intended to clarify the requirements and avoid such errors.

For neutron emitters that also emit alpha particles (including Cf-252, Cf-254, Cm-248), the third row of the table would apply.

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[80 FR 33987 \(June 12, 2015\)](#)

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