COLORADO
Department of Public Health & Environment

Dedicated to protecting and improving the health and environment of the people of Colorado

To: Members of the State Board of Health

From: Jennifer Opila, Program Manager
James Jarvis, Regulatory Lead
Hazardous Materials and Waste Management Division

Through: Gary Baughman, Division Director GWB

Date: September 20, 2017

Subject: **Rulemaking Hearing**
Proposed Amendments to 6 CCR 1007-1, Part 1, General Provisions, and Part 17, Transportation of Radioactive Material, for the rulemaking hearing to occur in September of 2017

The Division is proposing to make technical amendments to the Part 17 radiation regulations, titled *Transportation of Radioactive Material* and an associated change to the Part 1 radiation regulations, titled *General Provisions*. The Part 1 rule contains formal definitions that are used throughout other regulatory parts. The Part 17 contains the basic requirements for transportation of radioactive materials and is used in conjunction with other federal regulations governing transportation of radioactive materials including those of the U.S. Nuclear Regulatory Commission (NRC) and the U.S. Department of Transportation (DOT).

In 2014 and 2015 the NRC and DOT made regulatory changes to better align and harmonize U.S. transportation regulations with those of the international community and the standards of the International Atomic Energy Agency (IAEA). The changes being proposed for Parts 1 and 17 are to align Colorado regulations with those of the federal government and ultimately international regulations. The changes are needed for compatibility with the federal regulations and to maintain Colorado's status as an agreement state, and allow Colorado to work within the global and national framework for regulation of transportation of radioactive materials.

Further details of the proposed rule are listed in a Statement of Basis and Purpose and Specific Statutory Authority for the proposed rule, which, along with a Regulatory Analysis and supporting information, is available at: https://www.colorado.gov/cdphe/radregs
During early stakeholder engagement outreach efforts in February 2017, approximately 600+ stakeholders were notified of the opportunity to provide comments on the rule changes under consideration. No comments were received during the comment period. Additionally, a stakeholder meeting was scheduled and offered during the comment period, but no stakeholders were in attendance.

For efficiency purposes, the Part 1 rulemaking effort is being amended concurrent with rulemaking activities for Part 17 since the changes are directly related.

At the September 2017 rulemaking hearing, the Radiation Program requests that the Board adopt the proposed changes.

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STATEMENT OF BASIS AND PURPOSE
AND SPECIFIC STATUTORY AUTHORITY
for Amendments to
6 CCR 1007-1, Part 1, General Provisions
6 CCR 1007-1, Part 17, Transportation of Radioactive Material

Basis and Purpose.

The proposed amendments make technical changes to the Part 1 and Part 17 rules.

The proposed changes to Part 1 and Part 17 will ensure Colorado regulations involving transportation of radioactive materials are consistent with the 2014 and 2015 changes to federal rules that are now in effect. The Colorado rule changes will also harmonize transportation requirements with the international rules of the International Atomic Energy Agency (IAEA).

Consistent with current federal and international rules, the proposed changes to Part 1 and Part 17 will: add or modify definitions for *criticality safety index*, *low specific activity*, and *uranium-natural, depleted, enriched,* and *special form* applicable to transportation; expand exemptions for transportation of certain low-level radioactive materials deemed to be of low risk; clarify that Colorado is responsible for review of certain package-related quality assurance programs for use of Type B packages under a general license; change the rule language to defer to federal rule requirements for package quality assurance rather than provide select requirements in Colorado rule; expand some recordkeeping requirements for irradiated fissile material shipments; add package and conveyance equations used for calculating limits for mixtures or unknown quantities of radioactive materials; adjust or add package limits for certain isotopes requiring updates or that were not previously identified; update contact and related information pertaining to notifications for shipments of nuclear waste due to NRC website and organizational changes; and various technical, editorial and typographical corrections of a minor nature.

Specific Statutory Authority.

These rules are promulgated pursuant to the following statutes:
25-1.5-101(1)(k), 25-1.5-101(1)(l), 25-11-103, 25-11-104, and 25-1-108, C.R.S.

Is this rulemaking due to a change in state statute?

_____ Yes, the bill number is _____. Rules are ___ authorized ___ required.
___X__ No

Is this rulemaking due to a federal statutory or regulatory change?

__X__ Yes
_____ No

Does this rule incorporate materials by reference?

_____ Yes
__X___ No

If "Yes," the rule needs to provide the URL of where the material is available on the internet (CDPHE website recommended) or the Division needs to provide one print or electronic copy of the incorporated material to the State Publications Library. § 24-4-103(12.5)(c), C.R.S.

Does this rule create or modify fines or fees?

_____ Yes
__X___ No

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REGULATORY ANALYSIS
for Amendments to
6 CCR 1007-1, Part 1, General Provisions
6 CCR 1007-1, Part 17, Transportation of Radioactive Material

1. A description of the classes of persons who will be affected by the proposed rule, including classes that will bear the costs of the proposed rule and classes that will benefit from the proposed rule.

   The proposed rule changes in Part 1 and Part 17 are expected to impact only a limited number of licensees due to the nature of the proposed changes. Licensees impacted by the proposed changes include: entities who transport or offer for transport low level materials who are excepted by the provisions in 17.4.2; licensees who utilize type B packages for transport of materials but excluding industrial radiography licensees per the exception in section 17.10.2; and licensees shipping nuclear waste**. (Note, there are no Colorado licensees who ship nuclear waste).

   It is expected that all users of the rule will generally benefit from the proposed requirements as it will ensure that transportation requirements are consistent between states and across international boundaries.

   The proposed rule will not impact those entities using only radiation producing (x-ray) machines for any purpose.

2. To the extent practicable, a description of the probable quantitative and qualitative impact of the proposed rule, economic or otherwise, upon affected classes of persons.

   The proposed changes are expected to have a minimal quantitative and qualitative impact. The requirements for submission of quality assurance program documents under the general license of 17.7 will require the licensee to submit documents to the Department rather than NRC as currently written. This change is expected to have a minimal impact on affected persons (licensees).

3. The probable costs to the agency and to any other agency of the implementation and enforcement of the proposed rule and any anticipated effect on state revenues.

   The proposed requirement for the Department (radiation program) to review the quality assurance program for entities operating under the general license described in section 17.7 of the proposed rule is the only provision expected to have a slight impact on the Department. The proposed requirement applies to the reviews of quality assurance programs for those using (NRC) approved packages. The most common types of packages requiring NRC approval (and an NRC certificate of compliance) used by Colorado licensees are known as “Type B” packages. Such Type B packages are typically used for shipment of higher risk radioactive materials. With the exception of industrial radiography licensees, the use of Type B packages by Colorado licensees occurs infrequently – typically every 2-4 years or so – at the time of source exchange. (Note that the Part 17 rule currently provides an exception from the quality assurance review process for industrial radiography licensees using Type B packages in 17.10 so there is no impact to these industrial radiography licensees or the Department as a result of the proposed update to the quality assurance program review provision).

   The use of Type B packages by Colorado licensees is secondary to the other activities of the licensee during such large activity shipments. Excluding industrial radiography shipments, most activities which involve the use of Type B packages will already involve

additional oversight by the Department so the review of any quality assurance documents or program elements are not expected to have a significant impact on the Department.

The rule requirements are enforced only by the Department. No other agency will encounter costs as a result of the proposed changes.

The costs to the Department, due to the review of additional program elements, is not expected to be significant.

4. A comparison of the probable costs and benefits of the proposed rule to the probable costs and benefits of inaction.

The benefits of amending the Part 1 and Part 17 rules will be to ensure that Colorado regulations involving transportation of radioactive materials will be consistent with the national and international framework for regulating radioactive materials transport. Colorado licensees shipping or receiving radioactive materials to or through states under the jurisdiction of NRC or who ship internationally are currently required to follow federal transportation regulations.

The rule amendments will also help ensure that Colorado's status as an agreement state is maintained.

Inaction on the proposed rule will result in potential conflict with federal requirements and may jeopardize Colorado's agreement state status. Inaction would also limit Colorado's consistency within the national and international regulatory framework for radioactive materials regulation.

5. A determination of whether there are less costly methods or less intrusive methods for achieving the purpose of the proposed rule.

The proposed changes involve numerous technical changes. There are no less costly or less intrusive methods for achieving the purpose of the proposed rule changes.

The agency cost to review quality assurance programs is expected to be minimal and implemented as a part of routine program activities.

6. Alternative Rules or Alternatives to Rulemaking Considered and Why Rejected.

The proposed changes are technical changes necessary for compatibility with federal rule.

There are no alternate rules or alternatives available rulemaking to address the changes.

7. To the extent practicable, a quantification of the data used in the analysis; the analysis must take into account both short-term and long-term consequences.

The proposed changes are technical in nature and are needed to harmonize Colorado rule with federal and international rules involving transportation of radioactive materials.

There are no easily quantifiable data associated with the proposed rule changes.

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STAKEHOLDER COMMENTS
for Amendments to
6 CCR 1007-1, Part 1, General Provisions
6 CCR 1007-1, Part 17, Transportation of Radioactive Material

State law requires agencies to establish a representative group of participants when considering to adopt or modify new and existing rules. This is commonly referred to as a stakeholder group.

Early Stakeholder Engagement:
The following individuals and/or entities were invited to provide input and included in the development of these proposed rules:

The Governor-appointed members of the Colorado Radiation Advisory Committee who represent the healing arts, industry and higher education reviewed the proposed rule changes and had no comments on the proposed changes. The Part 17 rule (and associated Part 1 changes) apply the regulatory requirements for transportation of radioactive materials, and therefore all 300+ active radioactive material licensees were notified of the rule changes being considered for amendment and were given the opportunity to provide input. Additionally, another 300+ stakeholders representing a diverse group of entities, including non-licensees, public interest groups and individuals, federal agencies and others were notified of the rule change being considered and were invited to provide input and comments. No comments were received during this early stakeholder engagement period.

As part of the agreement state requirements, the U.S. Nuclear Regulatory Commission (NRC) reviewed the draft rule changes for consistency and compatibility with federal rule. The NRC provided several comments on the proposed rule changes specific to Part 17 which have been incorporated and are reflected in the most recent draft rule.

Stakeholder Group Notification
The stakeholder group was provided notice of the rulemaking hearing and provided a copy of the proposed rules or the internet location where the rules may be viewed. Notice was provided prior to the date of the notice of the rulemaking was published in the Colorado Register (typically, the 10th of the month following the Request for Rulemaking).
___ Not applicable. This is a Request for Rulemaking Packet. Notification will occur if the Board of Health sets this matter for rulemaking.
_X_ Yes.

Summarize Major Factual and Policy Issues Encountered and the Stakeholder Feedback Received. If there is a lack of consensus regarding the proposed rule, please also identify the Department's efforts to address stakeholder feedback or why the Department was unable to accommodate the request.

There were no major factual or policy issues encountered during the stakeholder process. No stakeholders provided comments on the proposed rule change. No entities attended the scheduled stakeholder meeting.

Please identify health equity and environmental justice (HEEJ) impacts. Does this proposal impact Coloradoans equally or equitably? Does this proposal provide an opportunity to advance HEEJ? Are there other factors that influenced these rules?

The proposed rule change impacts Coloradoans equally. The proposed rule changes are technical changes that do not provide an opportunity to advance HEEJ. The content of the proposed rule change is driven by the need for consistency with federal rule and the national and international framework for regulating the transport of radioactive materials. All entities falling under these regulatory requirements are treated in an equal manner.

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DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT

Hazardous Materials and Waste Management Division

RADIATION CONTROL - GENERAL PROVISIONS

6 CCR 1007-1 Part 01

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

Adopted by the Board of Health on September 20, 2017, effective date November 14, 2017.

~~**Adopted by the Board of Health on December 16, 2015.**~~

PART 1: GENERAL PROVISIONS

1.1 Purpose and Scope.

[* * * = Indicates omission of unaffected rules/sections]

* * *

1.1.5.1 **In accordance with Section 24-4-103(12.5)(c), CRS, https://www.colorado.gov/cdphe/radregs identifies where incorporated material is available to the public on the internet at no cost. If the incorporated material is not available on the internet at no cost to the public, copies of the incorporated material has been provided to the State Publications Depository and Distribution Center, also known as the State Publications Library. The State Librarian at the State Publication Library retains a copy of the material and will make the copy available to the public.**~~Published material incorporated in Part 1 by reference is available in accord with Section 1.4~~.

* * *

1.2 Definitions.

* * *

"Special form radioactive material" means radioactive material that satisfies the following conditions:

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

(2) The piece or capsule has at least one dimension not less than 5 millimeters (0.2 inch); and

(3) **It satisfies the requirements of 10 CFR 71.75. A special form encapsulation designed in accordance with the requirements of:**

(a) 10 CFR 71.4 in effect on June 30, 1983 (see 10 CFR part 71, revised as of January 1, 1983), and constructed before July 1, 1985;

(b) A special form encapsulation designed in accordance with the requirements of 10 CFR 71.4 in effect on March 31, 1996 (see 10 CFR part 71, revised as of January 1, 1996), and constructed before April 1, 1998; and

Commented [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 AID THE READER IN UNDERSTANDING THE PROPOSED RULE DURING THE DRAFT REVIEW PROCESS.

THESE COMMENTS ARE **NOT** PART OF THE RULE AND WILL BE DELETED PRIOR TO FINAL SUBMISSION FOR PUBLICATION.

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 THE NUCLEAR REGULATORY COMMISSION (NRC). THE PROPOSED CHANGES TO PART 1 ARE BASED ON INFORMATION FROM THE NRC REGULATORY ACTION TRACKING SYSTEM (RATS) WHICH MAY BE FOUND AT: https://scp.nrc.gov/rss_regamendents.html

INFORMATION ON NRC COMPATIBILITY CATEGORIES MAY BE FOUND AT: https://scp.nrc.gov/regresources.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). CONSISTENT WITH STATE LAW AND 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 1 IS SSRCR PART "A". PART A WAS LAST UPDATED IN 2003 AND IS NO LONGER CONSISTENT WITH CHANGES TO 10 CFR PART 71.

EDITORIAL NOTE 4: UNAFFECTED SECTIONS OF THE RULE HAVE BEEN OMITTED FROM THE DRAFT FOR BREVITY. SUCH SECTIONS ARE DELINIATED BY " * * * ".

Commented [jsj2]: These dates reflect the anticipated adoption by the Colorado Board of Health. The effective date is approximately 60 days beyond the adopted date, based upon the Colorado Secretary of State's publication calendar/schedule.

Commented [jsj3]: Definition is updated, consistent with the equivalent definition in 10 CFR 71.4.

NRC Compatibility "B"
NRC RATS 2015-3

(c) Special form material that was successfully tested before September 10, 2015 in accordance with the requirements of 10 CFR 71.75(d) in effect before September 10, 2015 may continue to be used. Any other special form encapsulation must meet the specifications of this definition.

~~All test requirements specified by the NRC that are applicable and in effect at the time are met by the special form encapsulation design and/or construction.~~

* * *

1.4.3 The addresses of the Federal Agencies and Organizations originally issuing the referenced materials are available on the Division website at **https://www.colorado.gov/cdphe/radregs**~~http://www.cdphe.state.co.us/hm/index.htm~~.

* * *

Commented [jsj4]: Web site URL updated for consistency with other rule changes and web site updates.

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DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT

Hazardous Materials and Waste Management Division

RADIATION CONTROL - TRANSPORTATION OF RADIOACTIVE MATERIALS

6 CCR 1007-1 Part 17

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

Adopted by the Board of Health September 20, 2017, effective date November 14, 2017.

PART 17: TRANSPORTATION OF RADIOACTIVE MATERIALS

GENERAL PROVISIONS

17.1 Purpose and Scope.

17.1.1 Authority.

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

17.1.2 Basis and Purpose.

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

17.1.3 Scope.

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

17.1.4 Applicability.

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

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

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

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

(b) Quality assurance requirements of ~~17.10~~**10 CFR 71**; and

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

Commented [jsj5]:
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/regresources.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 MAY HAVE BEEN OMITTED FROM THE DRAFT FOR BREVITY. SUCH SECTIONS ARE DELINIATED BY "* * *".

Commented [jsj6]: 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.

Commented [JJ7]: Reference to Section 17.10 is removed as the rule will defer to the quality assurance requirements of 10 CFR Part 71 rather than duplicate limited portions of them in Section 17.10.

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

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

(5) The general license under 17.7 requires that a NRC ~~c~~**C**ertificate of ~~c~~**C**ompliance or other package approval be issued for the package to be used under the general license.

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

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

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

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

17.1.5 Published Material Incorporated by Reference.

In accordance with Section 24-4-103(12.5)(c), CRS, https://www.colorado.gov/cdphe/radregs identifies where incorporated material is available to the public on the internet at no cost. If the incorporated material is not available on the internet at no cost to the public, copies of the incorporated material has been provided to the State Publications Depository and Distribution Center, also known as the State Publications Library. The State Librarian at the State Publication Library retains a copy of the material and will make the copy available to the public.~~Published material incorporated in Part 17 by reference is available in accord with Part 1, Section 1.4.~~

17.2 Definitions.

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

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

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

"Certificate holder" means a person who has been issued a ~~c~~**C**ertificate of ~~c~~**C**ompliance or other package approval by the NRC.

"Certificate of Compliance" (COC) means the certificate issued by the NRC under subpart D of 10 CFR 71 ~~(January 1, 2014)~~ which approves the design of a package for the transportation of radioactive material

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

Commented [jsj8]: Here, and throughout the rule, Certificate of Compliance is capitalized for consistency with the formal definition in 17.2.2.

Commented [jsj9]: New language is added to provide an online resource for documents referenced in the rule.

Commented [JJ10]: This definition is deleted as it is a repeat of an equivalent definition found in Part 1.

Commented [jsj11]: 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.

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

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

"Contamination" means the presence of a radioactive substance on a surface in quantities in excess of 0.4 Bq/cm^2 (1x10^{-5} µCi/cm^2) for beta and gamma emitters and low toxicity alpha emitters, or 0.04 Bq/cm^2 (1x10^{-6} µCi/cm^2) for all other alpha emitters.

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

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

"Conveyance" means:

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

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

(3) For transport by any aircraft.

"Criticality Safety Index (CSI)" means the dimensionless number (rounded up to the next tenth) assigned to and placed on the label of a fissile material package, to designate the degree of control of accumulation of packages**, overpacks, or freight containers** containing fissile material during transportation. Determination of the criticality safety index is described in 10 CFR 71.22, 71.23, and 71.59. **The criticality safety index for an overpack, freight container, consignment or conveyance containing fissile material packages is the arithmetic sum of the criticality safety indices of all the fissile material packages contained within the overpack, freight container, consignment or conveyance.**

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

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

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

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

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

Commented [jsj12]: 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)

Commented [JJ13]: Language amended and updated consistent with the existing and updated definition in 10 CFR 71.4.

The current definition in federal rules 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)
NRC Letter April 6, 2017

Commented [jsj14]: 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 2015-5
80 FR 74974 (December 1, 2015)

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

(1) LSA-I.

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

(b) ~~Solid unirradiated n~~**N**atural uranium**,** ~~or~~ depleted uranium**,** ~~or~~ natural thorium or their ~~solid or liquid~~ compounds or mixtures**, provided they are unirradiated and in solid or liquid form;**~~.~~

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

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

(2) LSA-II.

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

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

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

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

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

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

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

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

Commented [jsj15]: 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)

Commented [jsj16]: 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.

Commented [jsj17]: 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.

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

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

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

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

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

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

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

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

"Regulations of the DOT" means the regulations in 49 CFR Parts 100-189 and Parts 390-397 (October 1, ~~2006~~**2016**).

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

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

(1) SCO-I: a solid object on which:

(a) The non-fixed contamination on the accessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 4 Bq/cm^2 (10^{-4} microcurie/cm^2) for beta, gamma and low toxicity alpha emitters, or 0.4 Bq/cm^2 (10^{-5} microcurie/cm^2) for all other alpha emitters;

(b) The fixed contamination on the accessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 4 x 10^4 Bq/cm^2 (1.0 microcurie/cm^2) for beta, gamma and low toxicity alpha emitters, or 4 x 10^3 Bq/cm^2 (0.1 microcurie/cm^2) for all other alpha emitters; and

(c) The non-fixed contamination plus the fixed contamination on the inaccessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 4 x 10^4 Bq/cm^2 (1 microcurie/cm^2) for beta, gamma and low toxicity alpha emitters, or 4 x 10^3 Bq/cm^2 (0.1 microcurie/cm^2) for all other alpha emitters.

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

(a) The non-fixed contamination on the accessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 400 Bq/cm^2 (10^{-2} microcurie/cm^2) for beta, gamma and low toxicity alpha emitters or 40 Bq/cm^2 (10^{-3} microcurie/cm^2) for all other alpha emitters;

(b) The fixed contamination on the accessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 8 x 10^5 Bq/cm^2 (20 microcuries/cm^2) for beta, gamma and low toxicity alpha emitters, or 8 x 10^4 Bq/cm^2 (2 microcuries/cm^2) for all other alpha emitters; and

(c) The non-fixed contamination plus the fixed contamination on the inaccessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 8 x 10^5 Bq/cm^2 (20 microcuries/cm^2) for beta, gamma and low toxicity alpha emitters, or 8 x 10^4 Bq/cm^2 (2 microcuries/cm^2) for all other alpha emitters.

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

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

"Type A package" means a Type A packaging that, together with its radioactive contents limited to A1 or A2 as appropriate, meets the requirements of 49 CFR 173.410 and 173.412 and is designed to retain the integrity of containment and shielding required by Part 17 under normal conditions of transport as demonstrated by the tests set forth in 49 CFR 173.465 or 173.466, as appropriate.

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

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

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

"Type B package" means a Type B packaging together with its radioactive contents.~~2~~**1**

~~2~~**1** A Type B package design is designated as B(U) or B(M). On approval, a Type B package design is designated by NRC as B(U) unless the package has a maximum normal operating pressure of more than 700kPa (100 lb/in2) gauge or a pressure relief device that would allow the release of radioactive material to the environment under the tests specified in 10 CFR 71.73 (hypothetical accident conditions), in which case it will receive a designation B(M). B(U) refers to the need for unilateral approval of international shipments; B(M) refers to the need for multilateral approval of international shipments. No distinction is made in how packages with these designations may be used in domestic transportation. To determine their distinction for international transportation, refer to 49 CFR Part 173. A Type B package approved prior to September 6, 1983 was designated only as Type B; limitations on its use are

specified in 17.8.

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

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

"Uranium – natural, depleted, enriched".

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

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

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

LICENSE-RELATED REGULATORY REQUIREMENTS

17.3 Requirement for License.

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

17.4 Exemptions.

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

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

17.4.2.1 Natural material and ores containing naturally occurring radionuclides that are **either in their natural state,** ~~not intended to be~~**or have only been** processed for **purposes other than for the extraction of the radionuclides, and which are not intended to be processed for the** use of these radionuclides, provided the activity concentration of the material does not exceed 10 times the **applicable radionuclide activity concentration** values specified in Appendix 17A, Table 17A2**, or Table 17A3 of this part**.

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

Commented [jsj18]: 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.

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Commented [jsj19]: 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.

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NRC RATS 2015-3
80 FR 33987 (June 12, 2015)
49 CFR 173.401(b)

Commented [jsj20]: Language is updated, consistent with changes to 10 CFR 71.14(a)(2) and IAEA transportation requirements in TS-R-1.

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

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

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

17.5 Transportation of Licensed Material.

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

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

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

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

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

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

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

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

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

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

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

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

(2) Air - 49 CFR Part 175.

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

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

17.5.1.3 Assure that any special instructions needed to safely open the package are sent to or have been made available to the consignee in accordance with 4.32.5.2.

Commented [jsj21]: 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.

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17.5.2 If, for any reason, the regulations of the DOT are not applicable to a shipment of licensed material, the licensee shall conform to the standards and requirements of 49 CFR Parts 170 through 189 appropriate to the mode of transport to the same extent as if the shipment was subject to these regulations.

GENERAL LICENSES

17.6 General Licenses for Carriers.

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

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

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

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

17.7 General License: NRC-Approved Packages.

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

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

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

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

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

17.7.3.1 Maintain a copy of the NRC issued Certificate of Compliance, or other approval of the package, and the drawings and other documents referenced in the approval relating to the use and maintenance of the packaging and to the actions to be taken before shipment;

17.7.~~2.3~~**3.2 Comply**~~Complies~~ with the terms and conditions of the license, **NRC issued** ~~e~~**C**ertificate **of Compliance**, or other approval by the ~~NRC~~**Department**, as applicable, and the applicable requirements of **Subparts A (excluding 71.11), G (excluding 71.85(a)-(c), and 71.91(b)), and H (excluding 71.101(c)(2), (d), and (e) and 71.107 through 71.125) of 10 CFR 71** ~~Part 17~~;

Commented [JJ22]: Language updated based on a request from NRC.
Agreement States such as Colorado do not have jurisdiction for issuing a Certificate of Compliance, so the language is clarified here.

NRC Compatibility "B"
NRC Letter April 6, 2017

Commented [JJ23]: As requested by NRC in correspondence dated April 6, 2017, the responsibility for review of a licensee quality assurance program within Colorado is the Colorado radiation program.

NRC Compatibility "B"
NRC Letter April 6, 2017

Formatted: par1

Commented [jsj24]: Language updated to exclude those provisions which are limited to NRC jurisdiction in subpart H of 10 CFR 71.

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Commented [jsj25]: 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.

Commented [jsj26]:
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"

Commented [jsj27]: 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"

Commented [JJ28]:
To avoid confusion and partial duplication of regulatory requirements, the reference to Part 17 is deleted, thereby deferring to 10 CFR Part 71.

17.7.~~2.4~~**3.3** Prior to the licensee's first use of the package, ~~has submitted~~**submit** to the **Department**~~NRC~~ in writing ~~in accordance with 10 CFR 71.1~~**71.17(c)(3)**~~)~~:

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

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

17.7.~~3~~**4** The general license in 17.7.1 applies only when the package approval authorizes use of the package under this general license.

17.7.~~4~~**5** For a Type B or fissile material package, the design of which was approved by NRC before April 1, 1996, the general license in 17.7.1 is subject to additional restrictions of 10 CFR 71.19.

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

17.8.1 A general license is issued to any licensee of the Department to transport, or to deliver to a carrier for transport, licensed material in a package the design of which has been approved in a foreign national competent authority certificate**,** ~~and~~**that has been** revalidated by the DOT as meeting the applicable requirements of 49 CFR ~~171.12~~**171.23**.

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

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

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

~~17.8.1.2 A licensee who:~~

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

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

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

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

~~(4)~~**(2) Comply with the terms and conditions of the certificate and revalidation, and**~~Complies~~ with the applicable requirements of Part 17, sections 17.1 through 17.5, 17.10 through 17.17, and **Subparts A (excluding 71.11), G (excluding 71.85(a)-(c), and 71.91(b)), and H (excluding 71.101(c)(2), (d), and (e) and 71.107 through 71.125) of 10 CFR 71**~~10 CFR 71 Subparts A, G, and H. With respect to the quality assurance provisions of 10 CFR 71 Subpart H, the licensee is exempt from design, construction, and fabrication considerations~~.

17.9 General Licenses: Fissile Material Transport

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

Commented [jsj29]: 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.

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Commented [jsj30]: 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.

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Commented [jsj31]: Language is updated, consistent with 10 CFR 71.21(c).

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Commented [jsj32]: Language of 17.8.1.1 merged into 17.8.3, consistent with phrasing and format of 10 CFR 71.21(c).

Commented [jsj33]: Replaced by new 17.8.4., consistent with phrasing and format of 10 CFR 71.21(d).

Commented [jsj34]: Replaced by new 17.8.2., consistent with phrasing and format of 10 CFR 71.21.

Commented [jsj35]: Deleted due to replacement by 17.8.4(2), consistent with phrasing and format of 10 CFR 71.21.

Commented [jsj36]: Last sentence deleted, consistent with changes to 10 CFR 71.21(d)(2), which also removed this provision.

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.

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

QUALITY ASSURANCE

17.10 Quality Assurance Requirements.

17.10.1 Subpart H of 10 CFR 71 describes quality assurance requirements applying to design, purchase, fabrication, handling, shipping, storing, cleaning, assembly, inspection, testing, operation, maintenance, repair, and modification of components of packaging that are important to safety. As used in Subpart H of 10 CFR 71, "quality assurance" comprises all those planned and systematic actions necessary to provide adequate confidence that a system or component will perform satisfactorily in service. Quality assurance includes quality control, which comprises those quality assurance actions related to control of the physical characteristics and quality of the material or component to predetermined requirements.

Each licensee is responsible for satisfying the quality assurance requirements that apply to its use of a packaging for the shipment of licensed material subject to the applicable requirements of Subpart H of 10 CFR 71 (excluding 71.101(c)(2), (d), and (e) and 71.107 through 71.125).

17.10.2 Radiography containers.

A program for transport container inspection and maintenance limited to radiographic exposure devices, source changers, or packages transporting these devices and meeting the requirements of Part 5, sections 5.12(4) through 5.12(6) or equivalent Agreement State or NRC requirement, is deemed to satisfy the requirements of 17.7.2 and 10 CFR 71.101(b).

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

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

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

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

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

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

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

~~17.10.2.2 Be subject to each requirement that is applicable, whether the term "licensee" is or is not used in the requirement, for whatever design, fabrication, assembly, and testing~~

Commented [JJ37]: Due to the potential overlap in provisions of Part 17 and 10 CFR Part 71 as discussed in correspondence from NRC to Colorado, most original provisions in this section are removed in order to defer to the 10 CFR Part 71 requirements that are within Colorado's jurisdiction.

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~~of the package is accomplished with respect to a package before the time a package approval is issued.~~

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

~~17.10.4 A program for transport container inspection and maintenance limited to radiographic exposure devices, source changers, or packages transporting these devices and meeting the requirements of 10 CFR 34.31(b), or equivalent Agreement State requirements, is deemed to satisfy the requirements of 17.7 and 17.10.2.~~

Commented [JJ38]: The requirements of 17.10.4 have been updated and incorporated into 17.10.2 (above).

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

~~17.10.5.1 The licensee, certificate holder, and applicant for a COC may delegate to others, such as contractors, agents, or consultants, the work of establishing and executing the quality assurance program, or any part of the quality assurance program, but shall retain responsibility for the program.~~

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

~~17.10.6 The quality assurance functions are:~~

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

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

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

~~17.10.7.1 Identify quality problems;~~

~~17.10.7.2 Initiate, recommend, or provide solutions; and~~

~~17.10.7.3 Verify implementation of solutions.~~

17.11 Advance Notification of Shipment of Nuclear Waste.

17.11.1 As specified in 17.11.3, 17.11.4, and 17.11.5, each licensee shall provide advance notification to the governor of a state, or the governor's designee, of the shipment of licensed material (nuclear waste), within or across the boundary of the state, before the transport, or delivery to a carrier, for transport, of licensed material outside the confines of the licensee's plant or other place of use or storage.

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

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

17.11.3.1 The licensed material is required by this part to be in Type B packaging for transportation;

17.11.3.2 The licensed material is being transported to or across a state boundary en route to a disposal facility or to a collection point for transport to a disposal facility; and

17.11.3.3 The quantity of licensed material in a single package exceeds the least of the following:

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

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

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

17.11.4 Procedures for submitting advance notification

17.11.4.1 The notification must be made in writing to:

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

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

(3) The Department.

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

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

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

(2) ~~The list of governor's designees and Tribal official's designees of participating Tribes will be published annually in the Federal Register on or about June 30th to reflect any changes in information.~~**Contact information for each State, including telephone and mailing addresses of governors and governors' designees, and participating Tribes, including telephone and mailing addresses of Tribal officials and Tribal official's designees, is available on the NRC Web site at: https://scp.nrc.gov/special/designee.pdf.**

(3) A list of the names and mailing addresses of the governor's designees and Tribal official's designees of participating Tribes is available on request from the Director, Division of **Material Safety, State, Tribal, and Rulemaking Programs, Office of Nuclear Material Safety and Safeguards,**~~Intergovernmental Liaison and Rulemaking, Office of Federal and State Materials and Environmental Management Programs,~~ U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001.

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

Commented [jsj39]: 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"

Commented [jsj40]: Address corrected, consistent with NRC regulations in 10 CFR 71.97(c)(3)(ii).

The change is necessary due to a reorganization at NRC.

17.11.5 Information to be furnished in advance notification of shipment.

17.11.5.1 Each advance notification of nuclear waste shall contain the following information:

(1) The name, address, and telephone number of the shipper, carrier, and receiver of the nuclear waste shipment;

(2) A description of the nuclear waste contained in the shipment, as required by 49 CFR 172.202 and 172.203(d);

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

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

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

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

17.11.6 Revision notice

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

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

(2) Maintain a record of the name of the individual contacted for 3 years.

17.11.7 Cancellation notice

17.11.7.1 Each licensee who cancels a nuclear waste shipment, for which advance notification has been sent, shall:

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

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

(3) Retain a copy of the notice for 3 years.

17.12 Air Transport of Plutonium.

Notwithstanding the provisions of any general licenses and notwithstanding any exemptions stated directly in this part or included indirectly by citation of the regulations of the DOT, as may be applicable, the licensee shall assure that plutonium in any form is not transported by air, or delivered to a carrier for air transport, unless:

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

17.12.2 The plutonium is contained in a material in which the specific activity is less than or equal to the activity concentration values for plutonium specified in Appendix 17A, Table 17A-1, and in which the radioactivity is essentially uniformly distributed; or

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

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

OPERATING CONTROLS AND PROCEDURES

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

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

17.14 Preliminary Determinations.

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

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

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

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

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

17.15 Routine Determinations.

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

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

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

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

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

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

Commented [jsj41]: 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)

Commented [jsj42]: 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)

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

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

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

17.15.8.1 Determination of the level of non-fixed (removable) contamination shall be based upon wiping an area of 300 square centimeters of the surface concerned with an absorbent material, using moderate pressure, and measuring the activity on the wiping material.

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

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

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

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

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

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

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

17.15.9.2 A transport index of 10.0.

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

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

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

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

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

17.15.10.2 2 mSv/h (200 millirem per hour) at any point on the outer surface of the vehicle, including the upper and lower surfaces, or, in the case of a flat-bed style vehicle, with a personnel barrier, at any point on the vertical planes projected from the outer edges of

the vehicle, on the upper surface of the load (or enclosure, if used), and on the lower external surface of the vehicle;

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

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

17.15.10.3 0.1 mSv/h (10 millirem per hour) at any point 2 meters from the vertical planes represented by the outer lateral surfaces of the vehicle, or, in the case of a flat-bed style vehicle, at any point 2 meters from the vertical planes projected from the outer edges of the vehicle; and

17.15.10.4 0.02 mSv/h (2 millirem per hour) in any normally occupied positions of the vehicle, except that this provision does not apply to private motor carriers when persons occupying these positions are provided with special health supervision, personnel radiation exposure monitoring devices, and training in accordance with 10.3; and

17.15.11 For shipments made under the provisions of Section 17.15.10, the shipper shall provide specific written instructions to the carrier for maintenance of the exclusive use shipment controls. The instructions must be included with the shipping paper information.

17.15.12 The written instructions required for exclusive use shipments must be sufficient so that, when followed, they will cause the carrier to avoid actions that will:

17.15.12.1 Unnecessarily delay delivery; or

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

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

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

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

REPORTS AND RECORDS

17.16 Reports.

The licensee shall report to the Department within 30 days:

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

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

17.16.3 Instances in which the conditions of approval in the ~~c~~**C**ertificate of ~~c~~**C**ompliance were not observed in making a shipment.

17.17 Shipment Records.

17.17.1 Each licensee shall maintain, for a period of 3 years after shipment, a record of each shipment of licensed material not exempt under 17.4 showing, where applicable:

17.17.1.**1** Identification of the packaging by model number and serial number;

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

17.17.1.3 Volume and identification of coolant;

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

17.17.1.5 **For each item of irradiated fissile material:**

(1) Identification by model number and serial number;

(2) Irradiation and decay history to the extent appropriate to demonstrate that its nuclear and thermal characteristics comply with license conditions; and

(3) Any abnormal or unusual condition relevant to radiation safety;

17.17.1.6 Date of the shipment;

17.17.1.~~6~~7 **For fissile packages and for Type B packages, any special controls exercised;**

17.17.1.8 Name and address of the transferee;

17.17.1.~~7~~**9** Address to which the shipment was made; and

17.17.1.~~8~~**10** Results of the determinations required by 17.15 and by the conditions of the package approval.

17.17.2 The licensee shall make available to the Department for inspection, upon reasonable notice, all records required by this part. Records are only valid if stamped, initialed, or signed and dated by authorized personnel, or otherwise authenticated.

17.17.3 The licensee shall maintain sufficient written records to furnish evidence of the quality of packaging.

17.17.3.1 The records to be maintained shall include:

(1) Results of the determinations required by 10 CFR 71.85(a) through (c);

(2) Design, fabrication, and assembly records;

(3) Results of reviews, inspections, tests, and audits; results of monitoring work performance and materials analyses; and

(4) Results of maintenance, modification, and repair activities.

17.17.3.2 Inspection, test, and audit records must identify:

Commented [jsj43]: 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)

Commented [jsj44]: 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)

Commented [jsj45]: 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)

Commented [jsj46]: 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)

Commented [JJ47]: As a result of the change in compatibility category of 17.14 to "NRC" (only) jurisdiction and the subsequent removal of most provisions in 17.14, the reference for recordkeeping is modified to refer to 10 CFR 71.

NRC Compatibility "C"
RATS 2015-3
10 CFR 71.91(c)-(d)

(1) The inspector or data records,

(2) The type of observation,

(3) The results,

(4) The acceptability, and

(5) The action taken in connection with any deficiencies noted.

17.17.3.3 The records required by 17.17.3. must be retained for 3 years after the life of the packaging to which they apply.

Appendix 17A - Determination of A_1 and A_2

17A1 Values of A_1 and A_2 for individual radionuclides, which are the bases for many activity limits elsewhere in these regulations are given in Table 17A1. The curie (Ci) values specified are obtained by converting from the Terabecquerel (TBq) **value**~~figure~~. The Terabecquerel values are the regulatory standard. The curie values are for information only and are not intended to be the regulatory standard. ~~The curie values are expressed to three significant figures to assure that the difference in the TBq and Ci quantities is one tenth of one percent or less.~~ Where values of A_1 or A_2 are unlimited, it is for radiation control purposes only. For nuclear criticality safety, some materials are subject to controls placed on fissile material.

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

17A2.1 Not listed in Table 17A1:

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

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

17A2.2 Not listed in Table 17A2:

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

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

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

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

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

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

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

Commented [jsj48]: Page break inserted to ensure the appendix begins on a new page at time of final publication.

Commented [jsj49]: Language is updated, consistent with parallel provision in 10 CFR 71, Appendix A.

NRC Compatibility "B"
NRC RATS 2015-3
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17A4.2 For normal form radioactive material, the maximum quantity transported in a Type A package is as follows:

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

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

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

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

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

Where B(i) is the activity of radionuclide i as special form radioactive material, A_1(i) is the A_1 value for radionuclide i, C(j) is the activity of radionuclide j as normal form radioactive material, and A_2(j) is the A_2 value for radionuclide j.

17A4.~~3~~4 Alternatively, ~~an~~**the** A_1 value for mixtures of special form material may be determined as follows:

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

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

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

17A4.~~4~~5 Alternatively, the A_2 value for mixtures of normal form material may be determined as follows:

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

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

Commented [jsj50]: 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.

Commented [jsj51]: This is a new provision and equation, added for consistency with 10 CFR 71, Appendix A, paragraph IV.c.

Commented [jsj52]: 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.

Commented [jsj53]: 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.

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

17A4.~~5~~6 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.~~6~~7 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.

Commented [jsj54]: 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.

Commented [jsj55]: Similar to other equation editing, the graphics file format in this equation is updated to allow for future editing.

Commented [jsj56]: 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.

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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)
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
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}

Commented [JJ57]: Page break inserted at first page of table to ensure the table begins on a new page at time of final publication.

Font size of exponent superscript number adjusted as needed throughout table for consistency.

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)
Br-82	.	4.0X10 -1	1.1X10 1	4.0X10 -1	1.1X10 1	4.0X10 4	1.1X10 6
C-11	Carbon (6)	1.0	2.7X10 1	6.0X10 -1	1.6X10 1	3.1X10 7	8.4X10 8
C-14	.	4.0X10 1	1.1X10 3	3.0	8.1X10 1	1.6X10 -1	4.5
Ca-41	Calcium (20)	Unlimited	Unlimited	Unlimited	Unlimited	3.1X10 -3	8.5X10 -2
Ca-45	.	4.0X10 1	1.1X10 3	1.0	2.7X10 1	6.6X10 2	1.8X10 4
Ca-47 (a)	.	3.0	8.1X10 1	3.0X10 -1	8.1	2.3X10 4	6.1X10 5
Cd-109	Cadmium (48)	3.0X10 1	8.1X10 2	2.0	5.4X10 1	9.6X10 1	2.6X10 3
Cd-113m	.	4.0X10 1	1.1X10 3	5.0X10 -1	1.4X10 1	8.3	2.2X10 2
Cd-115 (a)	.	3.0	8.1X10 1	4.0X10 -1	1.1X10 1	1.9X10 4	5.1X10 5
Cd-115m	.	5.0X10 -1	1.4X10 1	5.0X10 -1	1.4X10 1	9.4X10 2	2.5X10 4
Ce-139	Cerium (58)	7.0	1.9X10 2	2.0	5.4X10 1	2.5X10 2	6.8X10 3
Ce-141	.	2.0X10 1	5.4X10 2	6.0X10 -1	1.6X10 1	1.1X10 3	2.8X10 4
Ce-143	.	9.0X10 -1	2.4X10 1	6.0X10 -1	1.6X10 1	2.5X10 4	6.6X10 5
Ce-144 (a)	.	2.0X10 -1	5.4	2.0X10 -1	5.4	1.2X10 2	3.2X10 3
Cf-248	Californium (98)	4.0X10 1	1.1X10 3	6.0X10 -3	1.6X10 -1	5.8X10 1	1.6X10 3
Cf-249	.	3.0	8.1X10 1	8.0X10 -4	2.2X10 -2	1.5X10 -1	4.1
Cf-250	.	2.0X10 1	5.4X10 2	2.0X10 -3	5.4X10 -2	4.0	1.1X10 2
Cf-251	.	7.0	1.9X10 2	7.0X10 -4	1.9X10 -2	5.9X10 -2	1.6
Cf-252 ~~(h)~~	.	~~5~~1.0X10 ~~-2~~1	~~1.4~~2.7	3.0X10 -3	8.1X10 -2	2.0X10 1	5.4X10 2
Cf-253 (a)	.	4.0X10 1	1.1X10 3	4.0X10 -2	1.1	1.1X10 3	2.9X10 4
Cf-254	.	1.0X10 -3	2.7X10 -2	1.0X10 -3	2.7X10 -2	3.1X10 2	8.5X10 3
Cl-36	Chlorine (17)	1.0X10 1	2.7X10 2	6.0X10 -1	1.6X10 1	1.2X10 -3	3.3X10 -2
Cl-38	.	2.0X10 -1	5.4	2.0X10 -1	5.4	4.9X10 6	1.3X10 8
Cm-240	Curium (96)	4.0X10 1	1.1X10 3	2.0X10 -2	5.4X10 -1	7.5X10 2	2.0X10 4
Cm-241	.	2.0	5.4X10 1	1.0	2.7X10 1	6.1X10 2	1.7X10 4
Cm-242	.	4.0X10 1	1.1X10 3	1.0X10 -2	2.7X10 -1	1.2X10 2	3.3X10 3
Cm-243	.	9.0	2.4X10 2	1.0X10 -3	2.7X10 -2	1.9X10 -3	5.2X10 1
Cm-244	.	2.0X10 1	5.4X10 2	2.0X10 -3	5.4X10 -2	3.0	8.1X10 1
Cm-245	.	9.0	2.4X10 2	9.0X10 -4	2.4X10 -2	6.4X10 -3	1.7X10 -1
Cm-246	.	9.0	2.4X10 2	9.0X10 -4	2.4X10 -2	1.1X10 -2	3.1X10 -1
Cm-247 (a)	.	3.0	8.1X10 1	1.0X10 -3	2.7X10 -2	3.4X10 -6	9.3X10 -5
Cm-248	.	2.0X10 -2	5.4X10 -1	3.0X10 -4	8.1X10 -3	1.6X10 -4	4.2X10 -3
Co-55	Cobalt (27)	5.0X10 -1	1.4X10 1	5.0X10 -1	1.4X10 1	1.1X10 5	3.1X10 6
Co-56	.	3.0X10 -1	8.1	3.0X10 -1	8.1	1.1X10 3	3.0X10 4
Co-57	.	1.0X10 1	2.7X10 2	1.0X10 1	2.7X10 2	3.1X10 2	8.4X10 3
Co-58	.	1.0	2.7X10 1	1.0	2.7X10 1	1.2X10 3	3.2X10 4
Co-58m	.	4.0X10 1	1.1X10 3	4.0X10 1	1.1X10 3	2.2X10 5	5.9X10 6
Co-60	.	4.0X10 -1	1.1X10 1	4.0X10 -1	1.1X10 1	4.2X10 1	1.1X10 3
Cr-51	Chromium (24)	3.0X10 1	8.1X10 2	3.0X10 1	8.1X10 2	3.4X10 3	9.2X10 4
Cs-129	Cesium (55)	4.0	1.1X10 2	4.0	1.1X10 2	2.8X10 4	7.6X10 5
Cs-131	.	3.0X10 1	8.1X10 2	3.0X10 1	8.1X10 2	3.8X10 3	1.0X10 5
Cs-132	.	1.0	2.7X10 1	1.0	2.7X10 1	5.7X10 3	1.5X10 5

Commented [jsj58]: 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).

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

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)
Cs-134	.	7.0X10 -1	1.9X10 1	7.0X10 -1	1.9X10 1	4.8X10 1	1.3X10 3
Cs-134m	.	4.0X10 1	1.1X10 3	6.0X10 -1	1.6X10 1	3.0X10 5	8.0X10 6
Cs-135	.	4.0X10 1	1.1X10 3	1.0	2.7X10 1	4.3X10 -5	1.2X10 -3
Cs-136	.	5.0X10 -1	1.4X10 1	5.0X10 -1	1.4X10 1	2.7X10 3	7.3X10 4
Cs-137 (a)	.	2.0	5.4X10 1	6.0X10 -1	1.6X10 1	3.2	8.7X10 1
Cu-64	Copper (29)	6.0	1.6X10 2	1.0	2.7X10 1	1.4X10 5	3.9X10 6
Cu-67	.	1.0X10 1	2.7X10 2	7.0X10 -1	1.9X10 1	2.8X10 4	7.6X10 5
Dy-159	Dysprosium (66)	2.0X10 1	5.4X10 2	2.0X10 1	5.4X10 2	2.1X10 2	5.7X10 3
Dy-165	.	9.0X10 -1	2.4X10 1	6.0X10 -1	1.6X10 1	3.0X10 5	8.2X10 6
Dy-166 (a)	.	9.0X10 -1	2.4X10 1	3.0X10 -1	8.1	8.6X10 3	2.3X10 5
Er-169	Erbium (68)	4.0X10 1	1.1X10 3	1.0	2.7X10 1	3.1X10 3	8.3X10 4
Er-171	.	8.0X10 -1	2.2X10 1	5.0X10 -1	1.4X10 1	9.0X10 4	2.4X10 6
Eu-147	Europium (63)	2.0	5.4X10 1	2.0	5.4X10 1	1.4X10 3	3.7X10 4
Eu-148	.	5.0X10 -1	1.4X10 1	5.0X10 -1	1.4X10 1	6.0X10 2	1.6X10 4
Eu-149	.	2.0X10 1	5.4X10 2	2.0X10 1	5.4X10 2	3.5X10 2	9.4X10 3
Eu-150. (short.lived)	.	2.0	5.4X10 1	7.0X10 -1	1.9X10 1	6.1X10 4	1.6X10 6
Eu-150. (long.lived)	.	7.0X10 -1	1.9X10 1	7.0X10 -1	1.9X10 1	6.1X10 4	1.6X10 6
Eu-152	.	1.0	2.7X10 1	1.0	2.7X10 1	6.5	1.8X10 2
Eu-152m	.	8.0X10 -1	2.2X10 1	8.0X10 -1	2.2X10 1	8.2X10 4	2.2X10 6
Eu-154	.	9.0X10 -1	2.4X10 1	6.0X10 -1	1.6X10 1	9.8	2.6X10 2
Eu-155	.	2.0X10 1	5.4X10 2	3.0	8.1X10 1	1.8X10 1	4.9X10 2
Eu-156	.	7.0X10 -1	1.9X10 1	7.0X10 -1	1.9X10 1	2.0X10 3	5.5X10 4
F-18	Fluorine.(9)	1.0	2.7X10 1	6.0X10 -1	1.6X10 1	3.5X10 6	9.5X10 7
Fe-52.(a)	Iron.(26)	3.0X10 -1	8.1	3.0X10 -1	8.1	2.7X10 5	7.3X10 6
Fe-55	.	4.0X10 1	1.1X10 3	4.0X10 1	1.1X10 3	8.8X10 1	2.4X10 3
Fe-59	.	9.0X10 -1	2.4X10 1	9.0X10 -1	2.4X10 1	1.8X10 3	5.0X10 4
Fe-60 (a)	.	4.0X10 1	1.1X10 3	2.0X10 -1	5.4	7.4X10 -4	2.0X10 -2
Ga-67	Gallium (31)	7.0	1.9X10 2	3.0	8.1X10 1	2.2X10 4	6.0X10 5
Ga-68	.	5.0X10 -1	1.4X10 1	5.0X10 -1	1.4X10 1	1.5X10 6	4.1X10 7
Ga-72	.	4.0X10 -1	1.1X10 1	4.0X10 -1	1.1X10 1	1.1X10 5	3.1X10 6
Gd-146.(a)	Gadolinium(64)	5.0X10 -1	1.4X10 1	5.0X10 -1	1.4X10 1	6.9X10 2	1.9X10 4
Gd-148	.	2.0X10 1	5.4X10 2	2.0X10 -3	5.4X10 -2	1.2	3.2X10 1
Gd-153	.	1.0X10 1	2.7X10 2	9.0	2.4X10 2	1.3X10 2	3.5X10 3
Gd-159	.	3.0	8.1X10 1	6.0X10 -1	1.6X10 1	3.9X10 4	1.1X10 6
Ge-68.(a)	Germanium(32)	5.0X10 -1	1.4X10 1	5.0X10 -1	1.4X10 1	2.6X10 2	7.1X10 3
Ge-71	.	4.0X10 1	1.1X10 3	4.0X10 1	1.1X10 3	5.8X10 3	1.6X10 5
Ge-77	.	3.0X10 -1	8.1	3.0X10 -1	8.1	1.3X10 5	3.6X10 6
Hf-172 (a)	Hafnium (72)	6.0X10 -1	1.6X10 1	6.0X10 -1	1.6X10 1	4.1X10 1	1.1X10 3
Hf-175	.	3.0	8.1X10 1	3.0	8.1X10 1	3.9X10 2	1.1X10 4
Hf-181	.	2.0	5.4X10 1	5.0X10 -1	1.4X10 1	6.3X10 2	1.7X10 4

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)
Hf-182	.	Unlimited	Unlimited	Unlimited	Unlimited	8.1X10 $^{-6}$	2.2X10 $^{-4}$
Hg-194 (a)	Mercury (80)	1.0	2.7X10 ^{1}	1.0	2.7X10 ^{1}	1.3X10 $^{-1}$	3.5
Hg-195m (a)	.	3.0	8.1X10 ^{1}	7.0X10 $^{-1}$	1.9X10 ^{1}	1.5X10 ^{4}	4.0X10 ^{5}
Hg-197	.	2.0X10 ^{1}	5.4X10 ^{2}	1.0X10 ^{1}	2.7X10 ^{2}	9.2X10 ^{3}	2.5X10 ^{5}
Hg-197m	.	1.0X10 ^{1}	2.7X10 ^{2}	4.0X10 $^{-1}$	1.1X10 ^{1}	2.5X10 ^{4}	6.7X10 ^{5}
Hg-203	.	5.0	1.4X10 ^{2}	1.0	2.7X10 ^{1}	5.1X10 ^{2}	1.4X10 ^{4}
Ho-166	Holmium (67)	4.0X10 $^{-1}$	1.1X10 ^{1}	4.0X10 $^{-1}$	1.1X10 ^{1}	2.6X10 ^{4}	7.0X10 ^{5}
Ho-166m	.	6.0X10 $^{-1}$	1.6X10 ^{1}	5.0X10 $^{-1}$	1.4X10 ^{1}	6.6X10 $^{-2}$	1.8
I-123	Iodine (53)	6.0	1.6X10 ^{2}	3.0	8.1X10 ^{1}	7.1X10 ^{4}	1.9X10 ^{6}
I-124	.	1.0	2.7X10 ^{1}	1.0	2.7X10 ^{1}	9.3X10 ^{3}	2.5X10 ^{5}
I-125	.	2.0X10 ^{1}	5.4X10 ^{2}	3.0	8.1X10 ^{1}	6.4X10 ^{2}	1.7X10 ^{4}
I-126	.	2.0	5.4X10 1	1.0	2.7X10 1	2.9X10 3	8.0X10 ^{4}
I-129	.	Unlimited	Unlimited	Unlimited	Unlimited	6.5X10 $^{-6}$	1.8X10 $^{-4}$
I-131	.	3.0	8.1X10 ^{1}	7.0X10 $^{-1}$	1.9X10 ^{1}	4.6X10 ^{3}	1.2X10 ^{5}
I-132	.	4.0X10 $^{-1}$	1.1X10 ^{1}	4.0X10 $^{-1}$	1.1X10 ^{1}	3.8X10 ^{5}	1.0X10 ^{7}
I-133	.	7.0X10 $^{-1}$	1.9X10 ^{1}	6.0X10 $^{-1}$	1.6X10 ^{1}	4.2X10 ^{4}	1.1X10 ^{6}
I-134	.	3.0X10 $^{-1}$	8.1	3.0X10 $^{-1}$	8.1	9.9X10 ^{5}	2.7X10 ^{7}
I-135.(a)	.	6.0X10 $^{-1}$	1.6X10 ^{1}	6.0X10 $^{-1}$	1.6X10 ^{1}	1.3X10 ^{5}	3.5X10 ^{6}
In-111	Indium (49)	3.0	8.1X10 ^{1}	3.0	8.1X10 ^{1}	1.5X10 ^{4}	4.2X10 ^{5}
In-113m	.	4.0	1.1X10 ^{2}	2.0	5.4X10 ^{1}	6.2X10 ^{5}	1.7X10 ^{7}
In-114m.(a)	.	1.0X10 1	2.7X10 ^{2}	5.0X10 $^{-1}$	1.4X10 ^{1}	8.6X10 ^{2}	2.3X10 ^{4}
In-115m	.	7.0	1.9X10 ^{2}	1.0	2.7X10 ^{1}	2.2X10 ^{5}	6.1X10 ^{6}
Ir-189.(a)	Iridium (77)	1.0X10 ^{1}	2.7X10 ^{2}	1.0X10 ^{1}	2.7X10 ^{2}	1.9X10 ^{3}	5.2X10 ^{4}
Ir-190	.	7.0X10 $^{-1}$	1.9X10 ^{1}	7.0X10 $^{-1}$	1.9X10 ^{1}	2.3X10 ^{3}	6.2X10 ^{4}
Ir-192.~~(c)~~	.	[c] 1.0	[c] 2.7X10 ^{1}	6.0X10 $^{-1}$	1.6X10 ^{1}	3.4X10 ^{2}	9.2X10 ^{3}
Ir-194	.	3.0X10 $^{-1}$	8.1	3.0X10 $^{-1}$	8.1	3.1X10 ^{4}	8.4X10 ^{5}
K-40	Potassium (19)	9.0X10 $^{-1}$	2.4X10 ^{1}	9.0X10 $^{-1}$	2.4X10 ^{1}	2.4X10 $^{-7}$	6.4X10 $^{-6}$
K-42	.	2.0X10 $^{-1}$	5.4	2.0X10 $^{-1}$	5.4	2.2X10 ^{5}	6.0X10 ^{6}
K-43	.	7.0X10 $^{-1}$	1.9X10 ^{1}	6.0X10 $^{-1}$	1.6X10 ^{1}	1.2X10 ^{5}	3.3X10 ^{6}
Kr-79	**Krypton (36)**	**4.0**	**1.1X10 ^{2}**	**2.0**	**5.4X10 ^{1}**	**4.2X10 ^{4}**	**1.1X10 ^{6}**
Kr-81	~~Krypton (36)~~	4.0X10 ^{1}	1.1X10 ^{3}	4.0X10 ^{1}	1.1X10 ^{3}	7.8X10 $^{-4}$	2.1X10 $^{-2}$
Kr-85	.	1.0X10 ^{1}	2.7X10 ^{2}	1.0X10 ^{1}	2.7X10 ^{2}	1.5X10 ^{1}	3.9X10 ^{2}
Kr-85m	.	8.0	2.2X10 ^{2}	3.0	8.1X10 ^{1}	3.0X10 ^{5}	8.2X10 ^{6}
Kr-87	.	2.0X10 $^{-1}$	5.4	2.0X10 $^{-1}$	5.4	1.0X10 ^{6}	2.8X10 ^{7}
La-137	Lanthanum(57)	3.0X10 ^{1}	8.1X10 ^{2}	6.0	1.6X10 ^{2}	1.6X10 $^{-3}$	4.4X10 $^{-2}$
La-140	.	4.0X10 $^{-1}$	1.1X10 ^{1}	4.0X10 $^{-1}$	1.1X10 ^{1}	2.1X10 ^{4}	5.6X10 ^{5}
Lu-172	Lutetium (71)	6.0X10 $^{-1}$	1.6X10 ^{1}	6.0X10 $^{-1}$	1.6X10 ^{1}	4.2X10 ^{3}	1.1X10 ^{5}
Lu-173	.	8.0	2.2X10 ^{2}	8.0	2.2X10 ^{2}	5.6X10 ^{1}	1.5X10 ^{3}
Lu-174	.	9.0	2.4X10 ^{2}	9.0	2.4X10 ^{2}	2.3X10 ^{1}	6.2X10 ^{2}
Lu-174m	.	2.0X10 ^{1}	5.4X10 ^{2}	1.0X10 ^{1}	2.7X10 ^{2}	2.0X10 ^{2}	5.3X10 ^{3}
Lu-177	.	3.0X10 ^{1}	8.1X10 ^{2}	7.0X10 $^{-1}$	1.9X10 ^{1}	4.1X10 ^{3}	1.1X10 ^{5}
Mg-28.(a)	Magnesium(12)	3.0X10 $^{-1}$	8.1	3.0X10 $^{-1}$	8.1	2.0X10 ^{5}	5.4X10 ^{6}

Commented [jsj59]: 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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Commented [jsj60]: 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: 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)
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
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

Commented [jsj61]: 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 A_2 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 A_2 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)
Pb-212. (a)	.	$7.0X10^{-1}$	$1.9X10^{1}$	$2.0X10^{-1}$	5.4	$5.1X10^{4}$	$1.4X10^{6}$
Pd-103. (a)	Palladium. (46)	$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	$2.8X10^{3}$	$7.5X10^{4}$
Pd-107	.	Unlimited	Unlimited	Unlimited	Unlimited	$1.9X10^{-5}$	$5.1X10^{-4}$
Pd-109	.	2.0	$5.4X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$7.9X10^{4}$	$2.1X10^{6}$
Pm-143	Promethium. (61)	3.0	$8.1X10^{1}$	3.0	$8.1X10^{1}$	$1.3X10^{2}$	$3.4X10^{3}$
Pm-144	.	$7.0X10^{-1}$	$1.9X10^{1}$	$7.0X10^{-1}$	$1.9X10^{1}$	$9.2X10^{1}$	$2.5X10^{3}$
Pm-145	.	$3.0X10^{1}$	$8.1X10^{2}$	$1.0X10^{1}$	$2.7X10^{2}$	5.2	$1.4X10^{2}$
Pm-147	.	$4.0X10^{1}$	$1.1X10^{3}$	2.0	$5.4X10^{1}$	$3.4X10^{1}$	$9.3X10^{2}$
Pm-148m. (a)	.	$8.0X10^{-1}$	$2.2X10^{1}$	$7.0X10^{-1}$	$1.9X10^{1}$	$7.9X10^{2}$	$2.1X10^{4}$
Pm-149	.	2.0	$5.4X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$1.5X10^{4}$	$4.0X10^{5}$
Pm-151	.	2.0	$5.4X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$2.7X10^{4}$	$7.3X10^{5}$
Po-210	Polonium. (84)	$4.0X10^{1}$	$1.1X10^{3}$	$2.0X10^{-2}$	$5.4X10^{-1}$	$1.7X10^{2}$	$4.5X10^{3}$
Pr-142	Praseodymium. (59)	$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$4.3X10^{4}$	$1.2X10^{6}$
Pr-143	.	3.0	$8.1X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$2.5X10^{3}$	$6.7X10^{4}$
Pt-188. (a)	Platinum. (78)	1.0	$2.7X10^{1}$	$8.0X10^{-1}$	$2.2X10^{1}$	$2.5X10^{3}$	$6.8X10^{4}$
Pt-191	.	4.0	$1.1X10^{2}$	3.0	$8.1X10^{1}$	$8.7X10^{3}$	$2.4X10^{5}$
Pt-193	.	$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	1.4	$3.7X10^{1}$
Pt-193m	.	$4.0X10^{1}$	$1.1X10^{3}$	$5.0X10^{-1}$	$1.4X10^{1}$	$5.8X10^{3}$	$1.6X10^{5}$
Pt-195m	.	$1.0X10^{1}$	$2.7X10^{2}$	$5.0X10^{-1}$	$1.4X10^{1}$	$6.2X10^{3}$	$1.7X10^{5}$
Pt-197	.	$2.0X10^{1}$	$5.4X10^{2}$	$6.0X10^{-1}$	$1.6X10^{1}$	$3.2X10^{4}$	$8.7X10^{5}$
Pt-197m	.	$1.0X10^{1}$	$2.7X10^{2}$	$6.0X10^{-1}$	$1.6X10^{1}$	$3.7X10^{5}$	$1.0X10^{7}$
Pu-236	Plutonium. (94)	$3.0X10^{1}$	$8.1X10^{2}$	$3.0X10^{-3}$	$8.1X10^{-2}$	$2.0X10^{1}$	$5.3X10^{2}$
Pu-237	.	$2.0X10^{1}$	$5.4X10^{2}$	$2.0X10^{1}$	$5.4X10^{2}$	$4.5X10^{2}$	$1.2X10^{4}$
Pu-238	.	$1.0X10^{1}$	$2.7X10^{2}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$6.3X10^{-1}$	$1.7X10^{1}$
Pu-239	.	$1.0X10^{1}$	$2.7X10^{2}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$2.3X10^{-3}$	$6.2X10^{-2}$
Pu-240	.	$1.0X10^{1}$	$2.7X10^{2}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$8.4X10^{-3}$	$2.3X10^{-1}$
Pu-241. (a)	.	$4.0X10^{1}$	$1.1X10^{3}$	$6.0X10^{-2}$	1.6	3.8	$1.0X10^{2}$
Pu-242	.	$1.0X10^{1}$	$2.7X10^{2}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$1.5X10^{-4}$	$3.9X10^{-3}$
Pu-244. (a)	.	$4.0X10^{-1}$	$1.1X10^{1}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$6.7X10^{-7}$	$1.8X10^{-5}$
Ra-223. (a)	Radium. (88)	$4.0X10^{-1}$	$1.1X10^{1}$	$7.0X10^{-3}$	$1.9X10^{-1}$	$1.9X10^{3}$	$5.1X10^{4}$
Ra-224. (a)	.	$4.0X10^{-1}$	$1.1X10^{1}$	$2.0X10^{-2}$	$5.4X10^{-1}$	$5.9X10^{3}$	$1.6X10^{5}$
Ra-225 (a)	.	$2.0X10^{-1}$	5.4	$4.0X10^{-3}$	$1.1X10^{-1}$	$1.5X10^{3}$	$3.9X10^{4}$
Ra-226. (a)	.	$2.0X10^{-1}$	5.4	$3.0X10^{-3}$	$8.1X10^{-2}$	$3.7X10^{-2}$	1.0
Ra-228. (a)	.	$6.0X10^{-1}$	$1.6X10^{1}$	$2.0X10^{-2}$	$5.4X10^{-1}$	$1.0X10^{1}$	$2.7X10^{2}$
Rb-81	Rubidium (37)	2.0	$5.4X10^{1}$	$8.0X10^{-1}$	$2.2X10^{1}$	$3.1X10^{5}$	$8.4X10^{6}$
Rb-83. (a)	.	2.0	$5.4X10^{1}$	2.0	$5.4X10^{1}$	$6.8X10^{2}$	$1.8X10^{4}$
Rb-84	.	1.0	$2.7X10^{1}$	1.0	$2.7X10^{1}$	$1.8X10^{3}$	$4.7X10^{4}$
Rb-86	.	$5.0X10^{-1}$	$1.4X10^{1}$	$5.0X10^{-1}$	$1.4X10^{1}$	$3.0X10^{3}$	$8.1X10^{4}$
Rb-87	.	Unlimited	Unlimited	Unlimited	Unlimited	$3.2X10^{-9}$	$8.6X10^{-8}$
Rb(nat)	.	Unlimited	Unlimited	Unlimited	Unlimited	$6.7X10^{6}$	$1.8X10^{8}$

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)
Re-184	Rhenium (75)	1.0	2.7X10 1	1.0	2.7X10 1	6.9X10 2	1.9X10 4
Re-184m	.	3.0	8.1X10 1	1.0	2.7X10 1	1.6X10 2	4.3X10 3
Re-186	.	2.0	5.4X10 1	6.0X10 -1	1.6X10 1	6.9X10 3	1.9X10 5
Re-187	.	Unlimited	Unlimited	Unlimited	Unlimited	1.4X10 -9	3.8X10 -8
Re-188	.	4.0X10 -1	1.1X10 1	4.0X10 -1	1.1X10 1	3.6X10 4	9.8X10 5
Re-189. (a)	.	3.0	8.1X10 1	6.0X10 -1	1.6X10 1	2.5X10 4	6.8X10 5
Re(nat)	.	Unlimited	Unlimited	Unlimited	Unlimited	0.0	2.4X10 -8
Rh-99	Rhodium (45)	2.0	5.4X10 1	2.0	5.4X10 1	3.0X10 3	8.2X10 4
Rh-101	.	4.0	1.1X10 2	3.0	8.1X10 1	4.1X10 1	1.1X10 3
Rh-102	.	5.0X10 -1	1.4X10 1	5.0X10 -1	1.4X10 1	4.5X10 1	1.2X10 3
Rh-102m	.	2.0	5.4X10 1	2.0	5.4X10 1	2.3X10 2	6.2X10 3
Rh-103m	.	4.0X10 1	1.1X10 3	4.0X10 1	1.1X10 3	1.2X10 6	3.3X10 7
Rh-105	.	1.0X10 1	2.7X10 2	8.0X10 -1	2.2X10 1	3.1X10 4	8.4X10 5
Rn-222. (a)	Radon (86)	3.0X10 -1	8.1	4.0X10 -3	1.1X10 -1	5.7X10 3	1.5X10 5
Ru-97	Ruthenium (44)	5.0	1.4X10 2	5.0	1.4X10 2	1.7X10 4	4.6X10 5
Ru-103. (a)	.	2.0	5.4X10 1	2.0	5.4X10 1	1.2X10 3	3.2X10 4
Ru-105	.	1.0	2.7X10 1	6.0X10 -1	1.6X10 1	2.5X10 5	6.7X10 6
Ru-106. (a)	.	2.0X10 -1	5.4	2.0X10 -1	5.4	1.2X10 2	3.3X10 3
S-35	Sulphur (16)	4.0X10 1	1.1X10 3	3.0	8.1X10 1	1.6X10 3	4.3X10 4
Sb-122	Antimony (51)	4.0X10 -1	1.1X10 1	4.0X10 -1	1.1X10 1	1.5X10 4	4.0X10 5
Sb-124	.	6.0X10 -1	1.6X10 1	6.0X10 -1	1.6X10 1	6.5X10 2	1.7X10 4
Sb-125	.	2.0	5.4X10 1	1.0	2.7X10 1	3.9X10 1	1.0X10 3
Sb-126	.	4.0X10 -1	1.1X10 1	4.0X10 -1	1.1X10 1	3.1X10 3	8.4X10 4
Sc-44	Scandium (21)	5.0X10 -1	1.4X10 1	5.0X10 -1	1.4X10 1	6.7X10 5	1.8X10 7
Sc-46	.	5.0X10 -1	1.4X10 1	5.0X10 -1	1.4X10 1	1.3X10 3	3.4X10 4
Sc-47	.	1.0X10 1	2.7X10 2	7.0X10 -1	1.9X10 1	3.1X10 4	8.3X10 5
Sc-48	.	3.0X10 -1	8.1	3.0X10 -1	8.1	5.5X10 4	1.5X10 6
Se-75	Selenium (34)	3.0	8.1X10 1	3.0	8.1X10 1	5.4X10 2	1.5X10 4
Se-79	.	4.0X10 1	1.1X10 3	2.0	5.4X10 1	2.6X10 -3	7.0X10 -2
Si-31	Silicon (14)	6.0X10 -1	1.6X10 1	6.0X10 -1	1.6X10 1	1.4X10 6	3.9X10 7
Si-32	.	4.0X10 1	1.1X10 3	5.0X10 -1	1.4X10 1	3.9	1.1X10 2
Sm-145	Samarium (62)	1.0X10 1	2.7X10 2	1.0X10 1	2.7X10 2	9.8X10 1	2.6X10 3
Sm-147	.	Unlimited	Unlimited	Unlimited	Unlimited	8.5X10 -1	2.3X10 -8
Sm-151	.	4.0X10 1	1.1X10 3	1.0X10 1	2.7X10 2	9.7X10 -1	2.6X10 1
Sm-153	.	9.0	2.4X10 2	6.0X10 -1	1.6X10 1	1.6X10 4	4.4X10 5
Sn-113. (a)	Tin (50)	4.0	1.1X10 2	2.0	5.4X10 1	3.7X10 2	1.0X10 4
Sn-117m	.	7.0	1.9X10 2	4.0X10 -1	1.1X10 1	3.0X10 3	8.2X10 4
Sn-119m	.	4.0X10 1	1.1X10 3	3.0X10 1	8.1X10 2	1.4X10 2	3.7X10 3
Sn-121m. (a)	.	4.0X10 1	1.1X10 3	9.0X10 -1	2.4X10 1	2.0	5.4X10 1
Sn-123	.	8.0X10 -1	2.2X10 1	6.0X10 -1	1.6X10 1	3.0X10 2	8.2X10 3
Sn-125	.	4.0X10 -1	1.1X10 1	4.0X10 -1	1.1X10 1	4.0X10 3	1.1X10 5
Sn-126. (a)	.	6.0X10 -1	1.6X10 1	4.0X10 -1	1.1X10 1	1.0X10 -3	2.8X10 -2

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)
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	$1.1X10^{2}$	$1.9X10^{5}$	$5.3X10^{6}$
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)	.	$5.0X10^{-1}$	$1.4X10^{1}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$3.0X10^{1}$	$8.2X10^{2}$

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)
Th-229	.	5.0	$1.4X10^{2}$	$5.0X10^{-4}$	$1.4X10^{-2}$	$7.9X10^{-3}$	$2.1X10^{-1}$
Th-230	.	$1.0X10^{1}$	$2.7X10^{2}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$7.6X10^{-4}$	$2.1X10^{-2}$
Th-231	.	$4.0X10^{1}$	$1.1X10^{3}$	$2.0X10^{-2}$	$5.4X10^{-1}$	$2.0X10^{4}$	$5.3X10^{5}$
Th-232	.	Unlimited	Unlimited	Unlimited	Unlimited	$4.0X10^{-9}$	$1.1X10^{-7}$
Th-234. (a)	.	$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$8.6X10^{2}$	$2.3X10^{4}$
Th(nat)	.	Unlimited	Unlimited	Unlimited	Unlimited	$8.1X10^{-9}$	$2.2X10^{-7}$
Ti-44. (a)	Titanium. (22)	$5.0X10^{-1}$	$1.4X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	6.4	$1.7X10^{2}$
Tl-200	Thallium. (81)	$9.0X10^{-1}$	$2.4X10^{1}$	$9.0X10^{-1}$	$2.4X10^{1}$	$2.2X10^{4}$	$6.0X10^{5}$
Tl-201	.	$1.0X10^{1}$	$2.7X10^{2}$	4.0	$1.1X10^{2}$	$7.9X10^{3}$	$2.1X10^{5}$
Tl-202	.	2.0	$5.4X10^{1}$	2.0	$5.4X10^{1}$	$2.0X10^{3}$	$5.3X10^{4}$
Tl-204	.	$1.0X10^{1}$	$2.7X10^{2}$	$7.0X10^{-1}$	$1.9X10^{1}$	$1.7X10^{1}$	$4.6X10^{2}$
Tm-167	Thulium. (69)	7.0	$1.9X10^{2}$	$8.0X10^{-1}$	$2.2X10^{1}$	$3.1X10^{3}$	$8.5X10^{4}$
Tm-170	.	3.0	$8.1X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$2.2X10^{2}$	$6.0X10^{3}$
Tm-171	.	$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$
U-230. (fast. lung. absorption). (a)(d)	Uranium. (92)	$4.0X10^{1}$	$1.1X10^{3}$	$1.0X10^{-1}$	2.7	$1.0X10^{3}$	$2.7X10^{4}$
U-230. (medium. lung . absorption). (a)(e)	.	$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{-3}$	$1.1X10^{-1}$	$1.0X10^{3}$	$2.7X10^{4}$
U-230 (slow lung absorption) (a)(f)	.	$3.0X10^{1}$	$8.1X10^{2}$	$3.0X10^{-3}$	$8.1X10^{-2}$	$1.0X10^{3}$	$2.7X10^{4}$
U-232. (fast. lung. absorption). (d)	.	$4.0X10^{1}$	$1.1X10^{3}$	$1.0X10^{-2}$	$2.7X10^{-1}$	$8.3X10^{-1}$	$2.2X10^{1}$
U-232. (medium. lung . absorption). (e)	.	$4.0X10^{1}$	$1.1X10^{3}$	$7.0X10^{-3}$	$1.9X10^{-1}$	$8.3X10^{-1}$	$2.2X10^{1}$
U-232. (slow. lung. absorption). (f)	.	$1.0X10^{1}$	$2.7X10^{2}$	$1.0X10^{-3}$	$2.7X10^{-2}$	$8.3X10^{-1}$	$2.2X10^{1}$
U-233. (fast. lung. absorption). (d)	.	$4.0X10^{1}$	$1.1X10^{3}$	$9.0X10^{-2}$	2.4	$3.6X10^{-4}$	$9.7X10^{-3}$
U-233. (medium. lung. absorption). (e)	.	$4.0X10^{1}$	$1.1X10^{3}$	$2.0X10^{-2}$	$5.4X10^{-1}$	$3.6X10^{-4}$	$9.7X10^{-3}$

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-233. (slow. lung. absorption). (f)	.	$4.0X10^{1}$	$1.1X10^{3}$	$6.0X10^{-3}$	$1.6X10^{-1}$	$3.6X10^{-4}$	$9.7X10^{-3}$
U-234. (fast. lung. absorption)(d)	.	$4.0X10^{1}$	$1.1X10^{3}$	$9.0X10^{-2}$	2.4	$2.3X10^{-4}$	$6.2X10^{-3}$
U-234 (medium lung absorption) (e)	.	$4.0X10^{1}$	$1.1X10^{3}$	$2.0X10^{-2}$	$5.4X10^{-1}$	$2.3X10^{-4}$	$6.2X10^{-3}$
U-234 (slow lung absorption) (f)	.	$4.0X10^{1}$	$1.1X10^{3}$	$6.0X10^{-3}$	$1.6X10^{-1}$	$2.3X10^{-4}$	$6.2X10^{-3}$
U-235. (all. lung. absorption. types). (a),(d),(e),(f)	.	Unlimited	Unlimited	Unlimited	Unlimited	$8.0X10^{-8}$	$2.2X10^{-6}$
U-236. (fast. lung. absorption). (d)	.	Unlimited	Unlimited	Unlimited	Unlimited	$2.4X10^{-6}$	$6.5X10^{-5}$
U-236. (medium. lung . absorption). (e)	.	$4.0X10^{1}$	$1.1X10^{3}$	$2.0X10^{-2}$	$5.4X10^{-1}$	$2.4X10^{-6}$	$6.5X10^{-5}$
U-236 (slow lung absorption) (f)	.	$4.0X10^{1}$	$1.1X10^{3}$	$6.0X10^{-3}$	$1.6X10^{-1}$	$2.4X10^{-6}$	$6.5X10^{-5}$
U-238 . (all lung absorption types) (d),(e),(f)	.	Unlimited	Unlimited	Unlimited	Unlimited	$1.2X10^{-8}$	$3.4X10^{-7}$
U. (nat)	.	Unlimited	Unlimited	Unlimited	Unlimited	$2.6X10^{-8}$	$7.1X10^{-7}$
U. (enriched. to. 20%. or. less). (g)	.	Unlimited	Unlimited	Unlimited	Unlimited	See. Table. 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	.	$4.0X10^{1}$	$1.1X10^{3}$	$8.0X10^{-1}$	$2.2X10^{1}$	$3.5X10^{2}$	$9.4X10^{3}$

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)
W-187	.	2.0	$5.4X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$2.6X10^{4}$	$7.0X10^{5}$
W-188. (a)	.	$4.0X10^{-1}$	$1.1X10^{1}$	$3.0X10^{-1}$	8.1	$3.7X10^{2}$	$1.0X10^{4}$
Xe-122. (a)	Xenon. (54)	$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$4.8X10^{4}$	$1.3X10^{6}$
Xe-123	.	2.0	$5.4X10^{1}$	$7.0X10^{-1}$	$1.9X10^{1}$	$4.4X10^{5}$	$1.2X10^{7}$
Xe-127	.	4.0	$1.1X10^{2}$	2.0	$5.4X10^{1}$	$1.0X10^{3}$	$2.8X10^{4}$
Xe-131m	.	$4.0X10^{1}$	$1.1X10^{3}$	$4.0X10^{1}$	$1.1X10^{3}$	$3.1X10^{3}$	$8.4X10^{4}$
Xe-133	.	$2.0X10^{1}$	$5.4X10^{2}$	$1.0X10^{1}$	$2.7X10^{2}$	$6.9X10^{3}$	$1.9X10^{5}$
Xe-135	.	3.0	$8.1X10^{1}$	2.0	$5.4X10^{1}$	$9.5X10^{4}$	$2.6X10^{6}$
Y-87. (a)	Yttrium. (39)	1.0	$2.7X10^{1}$	1.0	$2.7X10^{1}$	$1.7X10^{4}$	$4.5X10^{5}$
Y-88	.	$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$5.2X10^{2}$	$1.4X10^{4}$
Y-90	.	$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$2.0X10^{4}$	$5.4X10^{5}$
Y-91	.	$6.0X10^{-1}$	$1.6X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$9.1X10^{2}$	$2.5X10^{4}$
Y-91m	.	2.0	$5.4X10^{1}$	2.0	$5.4X10^{1}$	$1.5X10^{6}$	$4.2X10^{7}$
Y-92	.	$2.0X10^{-1}$	5.4	$2.0X10^{-1}$	5.4	$3.6X10^{5}$	$9.6X10^{6}$
Y-93	.	$3.0X10^{-1}$	8.1	$3.0X10^{-1}$	8.1	$1.2X10^{5}$	$3.3X10^{6}$
Yb-169	Ytterbium. (70)	4.0	$1.1X10^{2}$	1.0	$2.7X10^{1}$	$8.9X10^{2}$	$2.4X10^{4}$
Yb-175	.	$3.0X10^{1}$	$8.1X10^{2}$	$9.0X10^{-1}$	$2.4X10^{1}$	$6.6X10^{3}$	$1.8X10^{5}$
Zn-65	Zinc. (30)	2.0	$5.4X10^{1}$	2.0	$5.4X10^{1}$	$3.0X10^{2}$	$8.2X10^{3}$
Zn-69	.	3.0	$8.1X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$1.8X10^{6}$	$4.9X10^{7}$
Zn-69m. (a)	.	3.0	$8.1X10^{1}$	$6.0X10^{-1}$	$1.6X10^{1}$	$1.2X10^{5}$	$3.3X10^{6}$
Zr-88	Zirconium. (40)	3.0	$8.1X10^{1}$	3.0	$8.1X10^{1}$	$6.6X10^{2}$	$1.8X10^{4}$
Zr-93	.	Unlimited	Unlimited	Unlimited	Unlimited	$9.3X10^{-5}$	$2.5X10^{-3}$
Zr-95. (a)	.	2.0	$5.4X10^{1}$	$8.0X10^{-1}$	$2.2X10^{1}$	$7.9X10^{2}$	$2.1X10^{4}$
Zr-97. (a)	.	$4.0X10^{-1}$	$1.1X10^{1}$	$4.0X10^{-1}$	$1.1X10^{1}$	$7.1X10^{4}$	$1.9X10^{6}$

Notes:

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

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

Commented [jsj62]: Footnote updated, consistent with 2015 changes to 10 CFR 71, Table A1.

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

b The values of A_1 and A_2 in Curies (Ci) are approximate and for information only; the regulatory standard units are Terabecquerels (TBq) (see Appendix 17A – Determination of A_1 and A_2, Section 17A1)

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

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

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

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

Commented [jsj63]: 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.

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g These values apply to unirradiated uranium only.

h **A_2 = 0.74 TBq (20 Ci) for Mo-99 for domestic use.** ~~These values apply to domestic transport only. For international transport, use the values in the table below.~~

~~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)~~	~~5.0×10^{-2}~~	~~1.4~~	~~3.0×10^{-3}~~	~~8.1×10^{-2}~~	~~2.0×10^{1}~~	~~5.4×10^{2}~~
~~Mo-99 [6]~~	~~Molybdenum (42)~~	~~1.0~~	~~2.7×10^{1}~~	~~6.0×10^{-1}~~	~~1.6×10^{1}~~	~~1.8×10^{4}~~	~~4.8×10^{5}~~

Commented [jsj64]: 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.

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Commented [jsj65]: 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).

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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}
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}

Commented [JJ66]: Page break inserted at first page of table to ensure the table begins on a new page at time of final publication.

Commented [jsj67]: 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)
Bk-249 [5]	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{6}	2.7×10^{-5}
Br-76	Bromine (35)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
Br-77	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Br-82	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
C-11	Carbon (6)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
C-14	.	1.0×10^{4}	2.7×10^{-7}	1.0×10^{7}	2.7×10^{-4}
Ca-41	Calcium (20)	1.0×10^{5}	2.7×10^{-6}	1.0×10^{7}	2.7×10^{-4}
Ca-45	.	1.0×10^{4}	2.7×10^{-7}	1.0×10^{7}	2.7×10^{-4}
Ca-47 ~~(a)~~	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Cd-109	Cadmium (48)	1.0×10^{4}	2.7×10^{-7}	1.0×10^{6}	2.7×10^{-5}
Cd-113m	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{6}	2.7×10^{-5}
Cd-115 ~~(a)~~	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Cd-115m	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{6}	2.7×10^{-5}
Ce-139	Cerium (58)	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Ce-141	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{7}	2.7×10^{-4}
Ce-143	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Ce-144 (a)	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{5}	2.7×10^{-6}
Cf-248	Californium (98)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{4}	2.7×10^{-7}
Cf-249	.	1.0	2.7×10^{-11}	1.0×10^{3}	2.7×10^{-8}
Cf-250	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{4}	2.7×10^{-7}
Cf-251	.	1.0	2.7×10^{-11}	1.0×10^{3}	2.7×10^{-8}
Cf-252	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{4}	2.7×10^{-7}
Cf-253 ~~(a)~~	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{5}	2.7×10^{-6}
Cf-254	.	1.0	2.7×10^{-11}	1.0×10^{3}	2.7×10^{-8}
Cl-36	Chlorine (17)	1.0×10^{4}	2.7×10^{-7}	1.0×10^{6}	2.7×10^{-5}
Cl-38	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
Cm-240	Curium (96)	1.0×10^{2}	2.7×10^{-9}	1.0×10^{5}	2.7×10^{-6}
Cm-241	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Cm-242	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{5}	2.7×10^{-6}
Cm-243	.	1.0	2.7×10^{-11}	1.0×10^{4}	2.7×10^{-7}
Cm-244	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{4}	2.7×10^{-7}
Cm-245	.	1.0	2.7×10^{-11}	1.0×10^{3}	2.7×10^{-8}
Cm-246	.	1.0	2.7×10^{-11}	1.0×10^{3}	2.7×10^{-8}
Cm-247 ~~(a)~~	.	1.0	2.7×10^{-11}	1.0×10^{4}	2.7×10^{-7}
Cm-248	.	1.0	2.7×10^{-11}	1.0×10^{3}	2.7×10^{-8}
Co-55	Cobalt (27)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Co-56	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
Co-57	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Co-58	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Co-58m	.	1.0×10^{4}	2.7×10^{-7}	1.0×10^{7}	2.7×10^{-4}

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-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}
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}

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)
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}
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}

Commented [jsj68]: 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.

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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)
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}
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}

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)
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}
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}

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)
Pu-237	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{7}	2.7×10^{-4}
Pu-238	.	1.0	2.7×10^{-11}	1.0×10^{4}	2.7×10^{-7}
Pu-239	.	1.0	2.7×10^{-11}	1.0×10^{4}	2.7×10^{-7}
Pu-240	.	1.0	2.7×10^{-11}	1.0×10^{3}	2.7×10^{-8}
Pu-241 ~~(a)~~	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{5}	2.7×10^{-6}
Pu-242	.	1.0	2.7×10^{-11}	1.0×10^{4}	2.7×10^{-7}
Pu-244 ~~(a)~~	.	1.0	2.7×10^{-11}	1.0×10^{4}	2.7×10^{-7}
Ra-223 (a)	Radium (88)	1.0×10^{2}	2.7×10^{-9}	1.0×10^{5}	2.7×10^{-6}
Ra-224 (a)	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
Ra-225 ~~(a)~~	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{5}	2.7×10^{-6}
Ra-226 (a)	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{4}	2.7×10^{-7}
Ra-228 (a)	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{5}	2.7×10^{-6}
Rb-81	Rubidium (37)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Rb-83 ~~(a)~~	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Rb-84	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Rb-86	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{5}	2.7×10^{-6}
Rb-87	.	1.0×10^{4}	2.7×10^{-7}	1.0×10^{7}	2.7×10^{-4}
Rb (natural)	.	1.0×10^{4}	2.7×10^{-7}	1.0×10^{7}	2.7×10^{-4}
Re-184	Rhenium (75)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Re-184m	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Re-186	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{6}	2.7×10^{-5}
Re-187	.	1.0×10^{6}	2.7×10^{-5}	1.0×10^{9}	2.7×10^{-2}
Re-188	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{5}	2.7×10^{-6}
Re-189 ~~(a)~~	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Re (natural)	.	1.0×10^{6}	2.7×10^{-5}	1.0×10^{9}	2.7×10^{-2}
Rh-99	Rhodium (45)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Rh-101	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{7}	2.7×10^{-4}
Rh-102	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Rh-102m	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Rh-103m	.	1.0×10^{4}	2.7×10^{-7}	1.0×10^{8}	2.7×10^{-3}
Rh-105	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{7}	2.7×10^{-4}
Rn-222 (a)	Radon (86)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{8}	2.7×10^{-3}
Ru-97	Ruthenium (44)	1.0×10^{2}	2.7×10^{-9}	1.0×10^{7}	2.7×10^{-4}
Ru-103 ~~(a)~~	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Ru-105	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Ru-106 (a)	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{5}	2.7×10^{-6}
S-35	Sulphur (16)	1.0×10^{5}	2.7×10^{-6}	1.0×10^{8}	2.7×10^{-3}
Sb-122	Antimony (51)	1.0×10^{2}	2.7×10^{-9}	1.0×10^{4}	2.7×10^{-7}
Sb-124	.	1.0×10^{1}	2.7×10^{-10}	1.0×10^{6}	2.7×10^{-5}
Sb-125	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}

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)
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}
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}

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)
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}
Tl-202	.	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Tl-204	.	1.0×10^{4}	2.7×10^{-7}	1.0×10^{4}	2.7×10^{-7}
Tm-167	Thulium (69)	1.0×10^{2}	2.7×10^{-9}	1.0×10^{6}	2.7×10^{-5}
Tm-170	.	1.0×10^{3}	2.7×10^{-8}	1.0×10^{6}	2.7×10^{-5}
Tm-171	.	1.0×10^{4}	2.7×10^{-7}	1.0×10^{8}	2.7×10^{-3}
U-230 (fast lung absorption) (a),(b)	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}

Commented [jsj69]: 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.

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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)**
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) (c)	Uranium (92)	1.0×10^{1}	2.7×10^{-10}	1.0×10^{4}	2.7×10^{-7}
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}

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)
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}
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}

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

940 Sr-90	Y-90
941 Zr-93	Nb-93m
942 Zr-97	Nb-97
943 Ru-106	Rh-106
944 **Ag-108m**	**Ag-108**
945 Cs-137	Ba-137m
946 ~~Ce-134~~	~~La-134~~
947 Ce-144	Pr-144
948 Ba-140	La-140
949 Bi-212	Tl-208 **(**0.36**)**, Po-212 **(**0.64**)**
950 Pb-210	Bi-210, Po-210
951 Pb-212	Bi-212, Tl-208 **(**0.36**)**, Po-212 **(**0.64**)**
952 ~~Rn-220~~	~~Po-216~~
953 Rn-222	Po-218, Pb-214, Bi-214, Po-214

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

Ra-223	Rn-219, Po-215, Pb-211, Bi-211, Tl-207
Ra-224	Rn-220, Po-216, Pb-212, Bi-212, Tl-208 **(**0.36**)**, Po-212 **(**0.64**)**
Ra-226	Rn-222, Po-218, Pb-214, Bi-214, Po-214, Pb-210, Bi-210, Po-210
Ra-228	Ac-228
~~Th-226~~	~~Ra-222, Rn-218, Po-214~~
Th-228	Ra-224, Rn-220, Po-216, Pb212, Bi-212, Tl208 **(**0.36**)**, Po-212 **(**0.64**)**
Th-229	Ra-225, Ac-225, Fr-221, At-217, Bi-213, Po-213, Pb-209
Th-nat	Ra-228, Ac-228, Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208 **(**0.36**)**, Po-12 **(**0.64**)**
Th-234	Pa-234m
U-230	Th-226, Ra-222, Rn-218, Po-214
U-232	Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208 **(**0.36**)**, Po-212 **(**0.64**)**
U-235	Th-231
U-238	Th-234, Pa-234m
U-nat	Th-234, Pa-234m, U-234, Th-230, Ra-226, Rn-222, Po-218, Pb-214, Bi-214, Po-214, **Pb-210, Bi-210, Po-210**
~~U-240~~	~~Np-240m~~
Np-237	Pa-233
Am-242m	Am-242
Am-243	Np-239

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

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

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

e These values apply to unirradiated uranium only.

TABLE 17A3: GENERAL VALUES FOR A1 AND A2

Contents	A_1 (TBq)	A_1 (Ci)	A_2 (TBq)	A_2 (Ci)	Activity concen-tration for exempt material(Bq/g)	Activity concen-tration for exempt material(Ci/g)	Activity limits for exempt consign-ments (Bq)	Acti limit exe consign-ments (Ci)
Only beta or gamma emitting radionuclides are known to be present	1×10^{-1}	2.7×10^{0}	2×10^{-2}	5.4×10^{-1}	1×10^{1}	2.7×10^{-10}	1×10^{4}	2.7×10^{-7}
~~Only a~~Alpha emitting radionuclides**, but no neutron emitters,** are known to be present **(a)**	2×10^{-1}	5.4×10^{0}	9×10^{-5}	2.4×10^{-3}	1×10^{-1}	2.7×10^{-12}	1×10^{3}	2.7×10^{-8}
Neutron emitting nuclides are known to be present or ~~No~~**no** relevant data are available	1×10^{-3}	2.7×10^{-2}	9×10^{-5}	2.4×10^{-3}	1×10^{-1}	2.7×10^{-12}	1×10^{3}	2.7×10^{-8}

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

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ALSO - SEE NEXT COMMENT.

Commented [jsj72]: Changes are made to Table 17A3 and footnote, consistent with existing provisions and recent updates to 10 CFR 71, Table A-3.

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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TABLE 17A4: ACTIVITY-MASS RELATIONSHIPS FOR URANIUM

Uranium Enrichment (i) weight % U-235 present	Specific Activity	Specific Activity
.	TBq/g	Ci/g
0.45	1.8×10^{-8}	5.0×10^{-7}
0.72	2.6×10^{-8}	7.1×10^{-7}
1.0	2.8×10^{-8}	7.6×10^{-7}
1.5	3.7×10^{-8}	1.0×10^{-6}
5.0	1.0×10^{-7}	2.7×10^{-6}
10.0	1.8×10^{-7}	4.8×10^{-6}
20.0	3.7×10^{-7}	1.0×10^{-5}
35.0	7.4×10^{-7}	2.0×10^{-5}
50.0	9.3×10^{-7}	2.5×10^{-5}
90.0	2.2×10^{-6}	5.8×10^{-5}
93.0	2.6×10^{-6}	7.0×10^{-5}
95.0	3.4×10^{-6}	9.1×10^{-5}

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

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