

**2014  
RATIONALE FOR REVISIONS**

**PART T  
TRANSPORTATION OF RADIOACTIVE MATERIAL**

Introduction

Persons who transport radioactive material or deliver radioactive material to a carrier for transport are subject to the requirements for packaging, preparation for shipment and care during shipments. These requirements are found in this Part T of the *Suggested State Regulations for Control of Radiation* (SSRCR) of the Conference of Radiation Control Program Directors (CRCPD). Since 1988 the requirements for transportation have been located separate from Part C (Licensing of Radioactive Material) in this Part T.

This 2011 revision of Part T incorporates changes adopted by the U.S. Department of Transportation (DOT) and U.S. Nuclear Regulatory Commission (NRC) in response to recommendations by the International Atomic Energy Agency (IAEA) in their Transportation Safety Standards TS-R-1 and NRC-initiated changes. These revisions made United States regulations compatible with the domestic regulations of most of the international community by bringing United States regulations into accord with relevant portions of the IAEA design and performance requirements to the extent considered feasible. The DOT revisions to Title 49 of the Code of Federal Regulations (CFR) Part 171 begin at 60 Federal Register (FR) 50292. The NRC changes to 10 CFR Part 71 begin at 67 FR 21390.

The NRC considers the adoption of a regulation equivalent to 10 CFR Part 71 a matter of compatibility for an Agreement State. The various provisions of the 10 CFR Part 71 regulation are assigned different compatibility and health and safety categories. Definitions of each category and the specific category assigned to each provision of 10 CFR Part 71 are set out in NRC, Office of Federal and State Materials and Environmental Management Programs (FSME) Procedure SA-200, Compatibility Categories and Health and Safety Identification for NRC Regulations and Other Program Elements.

Changes in the federal regulations to achieve compatibility with IAEA regulations include adoption of radionuclide exemption values in TS-R-1 to assure continued consistency between domestic and international regulations for the basic definition of radioactive material. New  $A_1$  and  $A_2$  values are also adopted, except for molybdenum-99 and californium-252, and 16 radionuclides that do not appear in TS-R-1, in order to retain consistency between domestic and international regulations for radioactive material.

Traditionally, the DOT has used a specific activity threshold for defining a material as radioactive for transportation purposes. During the development of TS-R-1, it was recognized that there is no technical justification for the use of a single activity-based exemption value for all radionuclides. A more rigorous technical approach would be to base radionuclide exemptions on a uniform dose basis, rather than a uniform specific activity. Thus, in accordance with the NRC and DOT adopting

this new approach, Table A-2 establishes the exempt material activity concentrations and exempt consignment activity limits for radionuclides.

The DOT has historically used a specific activity threshold of 70 Bq/g (0.002uCi/g) for defining a material as radioactive for transportation purposes. Materials are exempt from DOT's transportation regulations if the specific activity is equal to or below this value. During the development of TS-R-1, it was recognized that there was no technical justification for the use of a single activity-based exemption value for all radionuclides. A more rigorous, technical approach was pursued, basing radionuclide exemptions on a uniform dose basis instead. This is addressed in Section T.4 of Part T and reflected in Appendix A to this Part. This adoption provides consistency between domestic and international regulations for the basic definition of radioactive material.

The maximum activity of radioactive material that is permitted to be transported in a Type A package is known as the  $A_1$  and  $A_2$  values in Table A-1. The  $A_1$  values apply to special form radioactive material, and the  $A_2$  values apply to normal form radioactive material. These values apply as a package content limit. In addition, fractions of these values can be used for a limited quantity of solid radioactive material or multiples of these values to establish a highway route controlled quantity threshold value.

The IAEA adopted new  $A_1$  and  $A_2$  values for radionuclides listed in TS-R-1. These new values were based on calculations which were performed using the latest dosimetric models recommended by the International Commission on Radiation Protection (ICRP) in Publication 60, "1990 Recommendations of the ICRP." Incorporation of data from updated metabolic uptake studies were also included. In addition, several refinements were introduced in the calculation of contributions to the effective dose from each of the pathways considered, i.e., external photon dose, external beta dose, inhalation dose, skin and ingestion dose from contamination, and dose from submersion in gaseous radionuclides. Though a thorough, up-to-date assessment was performed for each radionuclide, the reference doses, which are used to define an acceptable dose in the event of an accident, were unchanged. As an example, if either the  $A_1$  or  $A_2$  value is increased, then the use of the revised dosimetric models just shows that a higher activity of that radionuclide is actually required to produce the same reference dose.

Because the IAEA will be changing its recommended  $A_1$  value for californium-252 back to the previous value in 10 CFR 71 and 49 CFR, neither the NRC or DOT will change this value for californium-252.

Currently, the domestic  $A_2$  value for molybdenum-99 is 0.74TBq (20 Ci). The IAEA proposed value is 0.6 TBq (16.2 Ci). Because this lower value will cause a significant increase in the number of shipments and a corresponding increase in the occupational doses to individuals, both NRC and DOT are retaining the current value for this radionuclide.

Also, the NRC and DOT will not be including the  $A_1$  and  $A_2$  values for 16 radionuclides not included in TS-R-1. This will allow for continued consistency between the international and domestic transportation regulations for radioactive material.

Historically, the transport index (TI) has been used to determine the appropriate safety requirements during transport. It has been used to control the accumulation of packages for both radiological safety and criticality safety purposes and to specify minimum separation distances from persons.

The TI has been a single number, which is the larger of two values: the “TI for criticality control purposes” and the “TI for radiation control purposes.” Using the larger of the two has ensured conservatism in limiting the accumulation of packages. The TS-R-1 has introduced a new term, i.e., criticality safety index, which is determined in the same way as the “TI for criticality control purposes.”

### Specific Provisions

Sec. T.1 - Purpose and Scope. The Purpose and Scope was changed in part to incorporate additional language listed in 10 CFR 71. However, all wording within 10 CFR 71’s Purpose and Scope were not incorporated because they are captured by other sections in this Part. The Purpose and Scope also incorporated changes to comply with the format prescribed by the SSRCR Style Manual and to correct references.

Sec. T.2 - Definitions. Minor changes were made throughout to comply with the format prescribed by the SSRCR Style Manual and to correct references. Other definitions were added and/or revised to be compatible with the definitions listed in 10 CFR 71.

The following definitions were added to Part T:

- a. "A<sub>1</sub>"
- b. "A<sub>2</sub>"
- c. "Certificate of Compliance"
- d. "Consignment"
- e. "Containment system"
- f. "Conveyance"
- g. "Criticality Safety Index"
- h. "Deuterium"
- i. "Graphite"
- j. "Highway Route Controlled Quantity (HRCQ)"
- k. Indian tribe
- l. "Package"
- m. Tribal official
- n. "Unirradiated uranium"

The definitions of  $A_1$  and  $A_2$  values were changed to conform to a split definition of the two values. This approach is consistent with the standard in TS-R-1.

A definition for "Certificate of Compliance" was added. This is similar to the definition found in 10 CFR 72.3.

The definition of "Criticality Safety Index" was added in line with the adoption of this new term by the NRC in 10 CFR 71.

A definition of "Deuterium" was added to indicate that the definition of deuterium found in 10 CFR 110.2 applies.

A definition of "Package" was added to incorporate changes in package designation, i.e., Type AF, BF, B(U)F, and B(M)F, especially as it relates to a Type A and B package.

It was necessary to add the definition of graphite to indicate that the definition of nuclear grade graphite found in 10 CFR 110.2 applies.

The following definitions were significantly revised:

- a. "Fissile material"
- b. "Fissile material package"
- c. "Low specific activity (LSA) material "

The definition of fissile material was revised by removing plutonium-238 from the list of fissile nuclides in order to clarify that "fissile material" means the fissile nuclides themselves, not materials containing fissile nuclides. The definition of "fissile material package" does not include the new package designations Types AF, BF, B(U)F, or B(M)F. Thus, this is added to the definition.

The definition of "packaging" doesn't appear to merit any change, except adding the reference to 10 CFR 71 in lieu of 49 CFR.

In the definition of "low specific activity", the definition of "LSA-I" was revised to that of the revised 10 CFR 71 and that of "LSA-III" was revised to capture the reference to 10 CFR 71.77.

Changes in the definitions of Type B packages have been adopted.

All other definitions in Section T.2 remain unchanged or the changes were minor (e.g., introduction of SI units or change in federal references).

Sec. T.3 – Requirement for License. There were no changes recommended for this section. There were changes in 10 CFR 71.7 "Completeness and Accuracy of Information;" however, these were not included in Part T. The need was not seen to include this.

Sec. T.4 - Exemptions. There was no change to paragraph "a. " Revisions in 10 CFR 71.10(a), which becomes 10 CFR 71.14(a), are incorporated into paragraph "b. " This change removed the

existing single specific activity value and replaced it with "Activity Concentration for Exempt Material" found in Table A-2. The balance of the paragraph was formatted in conformance to 10 CFR 71.14(a).

New paragraphs "c" and "d" were created to incorporate 10 CFR 71 changes which cover exemptions from classifications as fissile material.

Sec. T.5 - Transportation of Licensed Material. This section remains unchanged, except for adding §§ 172.441 which specifies requirements for labeling fissile packages and updating the SSR reference from D.906.e to D.1906e.

It should be noted that in 49 CFR 173.403 the definition of "exclusive use" was changed to require appropriate radiological training and resources by the consignor and carrier to ensure safe handling of the consignment.

Sec. T.6 - General Licenses for Carriers. There was no change to this section.

Sec. T.7 - General License: Nuclear Regulatory Commission-Approved Packages. This section is modified to require a quality assurance program for general license eligibility and to indicate additional information to be submitted to the NRC.

Sec. T.8 - General License: US Department of Transportation Specification Container was deleted in its entirety.

**Section numbers below reflect the renumbering of the SSR-T document to account for the T.8 deletion.**

Sec. T.8 - General License: Use of Foreign Approved Package. Quality Assurance requirements were added to this section, which is comparable to 10 CFR 71.21, previously designated as 10 CFR 71.16. This section was T.9 but was renumbered with the deletion of the prior section T.8. Also, minor revisions were incorporated to be compatible with NRC regulations.

Sec. T.9 - General License: Fissile Material. This section, which is comparable to the new 10 CFR 71.22, consolidates all general license provisions of T.10 for fissile material into this section. The title of this section was changed accordingly. Clarification of quantity allowed was added. This section was T.10 but was renumbered with the deletion of the prior section T.8.

Instead of concentration-based limits, this section now uses mass-based limits and a criticality safety index (CSI). The general license for plutonium-beryllium sealed sources is now found in section T.12. The values in new Tables I and II are based on new minimum critical mass calculations described in NUREG/CR-5342. The variables in these new tables are used as the variables X, Y, and Z in the equation in paragraph e.

The requirement that fissile material, shipped under this general license, must be contained in a DOT Type A package was added to paragraph a.

Also, the specific gram limits for uranium and plutonium were removed from paragraph c. The paragraph retains the existing Type A quantity limit. Revised gram limits were relocated to new Table I, which are associated with new paragraphs d. and e. A requirement was also added to limit the amount of special moderating materials beryllium, graphite, and hydrogenous material enriched in deuterium present in a package to less than 500 grams.

Previous paragraph d. was removed. Revised gram limits for fissile material mixed with material having a hydrogen density greater than water would be placed in new Table I. A note was added to new Table I to indicate that reduced mass limits apply when more than 15 percent of a mixture of moderating materials contains moderating material with a hydrogen density greater than water.

New paragraph d. was added to require that shipments of packages containing fissile material be labeled with a CSI, that the CSI per package be less than or equal to 10.0, and that the sum of the CSIs in a shipment of multiple fissile material packages is limited to less than or equal to 50.0 for a nonexclusive use conveyance, and to less than or equal to 100.0 for an exclusive use conveyance.

New paragraph e. was added to require that the CSI be calculated via a new equation for any of the fissile nuclides. Guidance on applying the equation and the mass limit input values of Tables I and II is also contained in this paragraph.

#### Sec. T.10 - General License: Plutonium-Beryllium Special Form Material.

The old section (T.12), “General License: Fissile Material, Limited Moderator Per Package” was deleted in its entirety. A new section (T.11) that is comparable with the new 10 CFR 71.23 was created in its place. The title of the section was also changed accordingly. This new section was renumbered to T.10 with the deletion of the prior section T.8.

This new section consolidates regulations on the shipment of Pu-Be sealed sources, the maximum quantity of fissile plutonium Pu-Be sealed sources that can be shipped on a single conveyance through changes in the mass limits and calculation of the CSI. Previously, a Pu-Be sealed source package could contain up to 400 grams of fissile plutonium with a CSI equal to 10.0. Consequently, the conveyance limits were 4000 grams per shipment for an exclusive-use vehicle and 2000 grams per shipment for a nonexclusive use vehicle. The CSI per package was increased from 10 to 100; however, the maximum quantity of plutonium per conveyance (shipment) was reduced to 1000 grams. The 1000 gram per shipment limit and a 240 gram of fissile plutonium limit are equivalent to those in section T.11. The change in fissile plutonium limit per package was due to the increased confidence that the fissile plutonium within a sealed source capsule would not escape from the capsule during an accident and reconfigure itself into an unfavorable geometry.

Paragraph a. describes the applicability of this section and the requirement to ship Pu-Be sealed sources in DOT Type A packages.

Paragraph b. requires that shipments of Pu-Be sealed sources be made under an NRC-approved QA program.

Paragraph c. requires a 1000 gram per package limit. In addition, plutonium-239 and plutonium-241 may constitute only 240 grams of the 1000 gram limit.

Paragraph d. requires that a CSI be calculated per paragraph e., and the CSI must be less than or equal to 100.0. For shipments of multiple packages, the sum of the CSIs is limited to less than or equal to 50.0 for a nonexclusive use conveyance, and to less than or equal to 100.0 for an exclusive use conveyance.

Paragraph e. provides an equation to calculate the CSI for Pu-Be sources. This equation is based upon the 240 gram mass limit for fissile nuclide plutonium-239 and plutonium-241 in paragraph c.

Sec. T.11 – Exemption from classification as fissile material was deleted to eliminate duplication. Section was reserved to maintain references elsewhere in the Sections.

Sec. T.12 - Assumptions as to Unknown Properties of Fissile Material. There was no change to this section.

Sec. T.13 - Preliminary Determinations. There was no change to this section.

Sec. T.14 - Routine Determinations. There were no significant changes to this section. “Millisievert” was changed to “mSv” to meet the SSRCR Style Manual.

Added specific 49 CFR regulations to complete the determinations in the USDOT regulations.

Sec. T.15 - Air Transport of Plutonium Paragraph b. was revised to remove the 70 becquerel per gram (0.002 uCi/g) specific activity value and substitute activity concentration values for plutonium found in Table A-2.

Sec. T.16 - Opening Instructions. This section was added to be compatible with 10 CFR 71.89. Corrected a reference.

Sec. T.17 Shipment Records. This section was renumbered T.18 due to the addition of new section T.17. This section remains unchanged, since the items in this section were not altered by the NRC, though couched in paragraph (a) of 10 CFR 71.91. Additional paragraphs exist that address additional requirements on the certificate holder in making records available to the NRC. These requirements were not adopted previously into Part T. The only change was the addition of paragraph (b), which differs little from the existing requirements in this section.

Sec. T.18 - Reports. Paragraph a. remains unchanged. Since this was the only part of this section in 10 CFR 71 that was considered adoptable, no further change was offered.

Sec. T.19 - Advance Notification of Shipment of Nuclear Waste. This section was renumbered from T.19 due to the addition of new section T.17. There is no significant change to this section. Minor changes due to the release of 10CFR37 was made. “Terabecquerel” was changed to “TBq” to meet with the SSRCR Style Manual and several SR-T references were corrected.

Added information about Tribe and Tribal official notification material.

Sec. T.20 - Quality Assurance Requirements. This section was has not changed, but was renumbered due to the earlier addition of new section T.17. This section was revised in its entirety to be compatible with 10 CFR 71.101.

Appendix A to 10 CFR 71 was revised in its entirety. Table A-1 was revised to reflect the values for these radionuclides in TS-R-1 (and corrected Te-132's specific activity). Footnotes in Table a-1 were corrected.

A new Table A-2 was added for listing exempt material activity concentrations and exempt consignment activity limits for radionuclides. Footnotes were added, corrected and made consistent.

The rationale for the major revision to the Appendix was presented in the introduction to the Rationale for Part T. The entire revision in 10 CFR 71 was adopted in its entirety.